

Abstract  
Book

# APEC 2023

## *Navigating the Cutting Edge in Endodontics*

The 22nd Scientific Congress of the Asian Pacific Endodontic Confederation  
The 33rd Annual Scientific Meeting of the Academy of Endodontology, ROC (Taiwan)



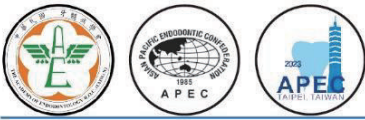
August 25-27, 2023 | Taipei, Taiwan  
NTUH International Convention Center





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# Congress Information

## Congress:

The 22nd Scientific Congress of the Asian Pacific Endodontic Confederation  
The 33rd Annual Scientific Meeting of the Academy of Endodontology, ROC (Taiwan)

## Date:

August 25<sup>th</sup>–27<sup>th</sup>, 2023

## Venue:

NTUH International Convention Center, Taipei, Taiwan

## Organizers:



The Academy of Endodontology, R.O.C. (Taiwan)



School of Dentistry, National Taiwan University

## Co-Organizer:



China Medical University and Hospital

## Funding:



## Sponsors:



# Congress Organizers

## APEC Executive Board & Local Organizing Committee

### APEC Executive Officers

**President :** Hyeon-Cheol Henry Kim

**President Elect :** Samuel Dorn

**Secretary :** Mohsen Ramazani

**Treasurer :** Francis Chan

**Chair of Education Committee :** Sanjay Miglani

**Chair of International Outreach :** Muna Al-Ali

### Local Organizing Committee

**Congress Chairman :** Ming-Gene Tu

#### Scientific Program Sub-committee :

Yuan-Ling Lee (Chair) / Chun-Wei Chang (Co-chair)

Hsueh-Jen Lin, Tsui-Hsien Huang, Yu-Heng Lin,

Chung-Lung Wu, Ya-Yun Lee, Wei-Mei Han,

Cheng-Mei Yang, Wei-Chih Chiu, Wen-Song Su,

Chih-Ming Lu, Chih-Yin Kuo, Chia-Lun Tsai,

Chieh-Ju Chen

**Treasurer :** Yi-Ling Tsai, Hsun-Yu Huang

**Secretariat :** Uei-Ming Li (Secretary General)

Wan-Chuen Liao (Deputy Secretary General)

Eva Hsin-Hui Wang, Wan-Yu Lu, Chun-Pei Lin,

Wei-Sheng Yang, Wei-Quan Wang

#### Advisor :

Wan-Hong Lan, Chun-Pin Lin, Bor-Ren Duh, Gin Chen, Shue-Fen Yang, Mirng-Haur Diau

Jiang-Huei Jeng, Sheng-Fang Pai, Sung-Chih Hsieh, Fu-Hsiung Chuang, Hsin-Cheng Liu

#### Venue & Facility :

Sze-Kwan Lin, Shu-Fang Chang

#### Registration :

Yu-Chih Wang, Kuo-Hao Huang

#### Exhibition :

Chi-Jr Hung, Wen-Hsin Chang

#### Publicity :

Chi-Chia Huang, Yi-Cheng Lin

#### Program Book :

Kuan-Liang Chen, Tien-Hao Chang

#### Local Arrangement :

Wei-Chiang Hung, Chih-Wen Chi

# Welcome Messages

## *APEC President*

### **Prof. Hyeon-Cheol Henry Kim**

As one of the leading societies of global endodontics, Asian Pacific Endodontic Confederation (APEC) is ready to open new era of post pandemic academia of Endodontology by the “The academy of Endodontology, Taiwan, ROC (AEROC)”. It is my pleasure to invite all endodontists and clinicians to join the 22nd APEC Scientific Congress on August 25<sup>th</sup>-27<sup>th</sup>, 2023. I believe all the delegates from APEC member countries, speakers and participants in this scientific event will enjoy this congress.



## *Local Organizing Committee Chair*

### **Prof. Ming-Gen Tu**

It is our pleasure to welcome you all visit Taipei, Taiwan. The major goal of the forum is to bring specialist, certified, APEC members, and colleagues from the dental industry together to exchange the novel knowledge and skills. The scientific program comprises a wonderful array of international and domestic invited speakers. The most up-to-date research, diverse topics of interest, and educational events are explored. We wish all attendees have an enjoyable scientific gathering in the 2023 APEC event. We look forward to welcoming you at 2023 APEC!

# APEC 2023 Scientific Program Agenda

## August 25<sup>th</sup>, 2023 (Friday) –Day1

Time	Lec. ID	Speaker	Title	Moderator
<b>Venue: 401</b>				
08:40-09:00	<b>APEC Event</b>		<b>Opening Ceremony</b>	
09:00-10:30	AK-01	Syngcuk Kim	Endodontic Microsurgery : Old vs. New!	Chun-Pin Lin 林俊彬
11:00-12:30	AK-02	Syngcuk Kim	Endo vs. Implant: Save or Extract ?	Shue-Fen Yang 楊淑芬
13:30-15:00	AI-01	Jarshen Lin	Endodontic Prognosis: Clinical Guide for Optimal Treatment Outcome	Chih-Ming Lu 呂志明
15:30-16:30	AI-02	Samuel Dorn	Extraction-Replantation: An Alternative Surgical Technique	Eva Hsin-Hui Wang 王馨慧
16:30-17:00	AI-03	Mustafa Gündoğar	Peer Proven Technologies to Improve the Clinical Efficacy of Irrigation Activation Systems	
<b>Venue: 402AB</b>				
15:30-16:15	AI-04	Andy Euseong Kim	Outcomes of Endodontic Microsurgery	Ming-Gen Tu 涂明君
16:15-16:45	AI-05	Suman Gautam	Iatrogenic Perforation: Clinical Management and Outcome	
16:45-17:15	AI-06	Mehmet Baybora Kayahan	The Determinants of Outcome in Retreatment	
<b>Venue: 301</b>				
11:00-12:30	AS-01	Yen-Un Chen	<b>Sponsored by Zumax</b> Restorative Considerations of Post Endodontically Treated Teeth	Wei-Sheng Yang 楊為盛
13:30-14:15	AS-02	Allen Ali Nasseh	<b>Sponsored by J. MORITA MFG. CORP.</b> CBCT Use in Endodontics: A Clinical Perspective	Gin Chen 陳錦
14:15-15:00	AS-03	Gianluca Plotino	<b>Sponsored by VDW</b> How to Integrate the Use of Different Instruments to Treat Every Root Canal Anatomy	Yu-Heng Lin 林郁恆
15:30-17:00	DE-01	Gianluca Plotino	The Ideal Instrument for Root Canal Preparation	Uei-Ming Li 李偉明
<b>Venue: 402C</b>				
11:00-12:30	<b>APEC Event</b>		<b>APEC &amp; IFEA Joint Meeting &amp; APEC Council Meeting (Invited Only)</b>	
12:30-14:00	<b>AEROC Event</b>		<b>AEROC Councillor Meeting (AEROC 理事、監事、專審委員聯席會議)</b>	
15:30-16:15	AC-02	Fahad Umer	Deep Learning for Detection of Teeth and Periapical Pathology on Orthopantomograms	Wan-Chuen Liao 廖婉萱
16:15-17:00	AC-03	Ashraf Samir Refai	AI in Endodontics: Is It the End for the Clinician?	Ying-Hui Su 蘇映輝



## APEC 2023 Scientific Program Agenda

### August 25<sup>th</sup>, 2023 (Friday) –Day1

Time	Lec. ID	Speaker	Title	Moderator
<b>Venue: 202</b>				
09:00-12:30	<b>AERO Event (Chinese)</b>		Nurturing Pre-Specialist Competition - Case Report	Shu-Fang Chang 張淑芳
<b>Venue: 403</b>				
09:00-12:30	<b>AERO Event (Chinese)</b>		Nurturing Pre-Specialist Competition – Research	Chun-Wei Chang 張俊偉
13:30-14:30	Oral Presentation		Session #1: O00001 - O00004	Ya-Yun Lee 李亞芸
15:45-16:30	Oral Presentation		Session #2: O00006 - O00007	Kuan-Liang Chen 陳冠良
<b>Venue: 3F Lobby - Poster Presentation (09:00-17:00)</b>				
15:00-15:30	Poster Presentation		Session #1: P00001 - P00020	
<b>Venue: 101</b>				
17:30-19:00	<b>APEC Event</b>		<b>Welcome Reception</b>	



## APEC 2023 Scientific Program Agenda

### August 26<sup>th</sup>, 2023 (Saturday) –Day2

Time	Lec. ID	Speaker	Title	Moderator
<b>Venue: 401</b>				
09:00-10:30	AI-07	Paul V. Abbott	What's in a Name? A Review of Endodontic Diagnosis	Jiang-Huei Jeng 鄭景暉
11:00-11:45	AI-08	Mohsen Ramazani	Vital Pulp Therapy: An Update of Classifications, Indications, Challenges and Follow Ups	Yuan-Ling Lee 李苑玲
11:45-12:30	AI-09	Yuan-Ling Lee	An Update of Endodontic Treatment in Young Permanent Teeth	Uei-Ming Li 李偉明
13:30-15:00	AI-13	George Huang	Twenty Years of Progress on Dental Stem Cells and Regenerative Endodontics	Sung-Chih Hsieh 謝松志
15:30-16:30	AI-14	Jennifer Gibbs	Persistent Pain after Endodontic Treatments- Can We Prevent It?	Yu-Chiao Wu 吳右喬
16:30-17:00	AI-15	Ji Wook Jeong	Palatal Root End Surgery	
<b>Venue: 402AB</b>				
11:00-11:30	AI-10	Jeffrey M. Coil	Clinical Decision Making and the Use of CBCT	Sheng-Fang Pai 白勝方
11:30-12:00	AI-11	Kacharaju Kranthi Raja	Enhancing Endodontic Diagnosis and Treatment Planning with CBCT Technology for Optimal Clinical Outcomes	
12:00-12:30	AI-12	Hui-Na Lee	Application of Digital Technology and Guided Endodontics	
15:30-16:00	AI-16	Motoki Okamoto	Current Location of Vital Pulp Therapy	Yuan-Ling Lee 李苑玲
16:00-16:30	AI-17	Thanaphum Osathanon	Bioactive Molecules Targeting Specific Cell Signaling to Promote Dentin Bridge Formation	
<b>Venue: 301</b>				
09:00-09:45	AS-04	Allen Ali Nasseh	<b>Sponsored by 聯揚牙科器材</b> Simple and Efficient Endodontic Obturation	Sze-Kwan Lin 林思洸
09:45-10:30	AS-05	Sheng Wun Huang Yu Cho Liu	<b>Sponsored by 聯揚牙科器材</b> Mastering Mechanical Shaping, Chemical Cleaning and Warm Vertical Compaction Technique	
11:00-11:45	AS-06	Mustafa Gündoğar	<b>Sponsored by Anders co., Ltd.</b> Feasible Ways to Perform Minimal Invasive Endodontics	Wen-Hsin Chang 張文信
11:45-12:30	AS-07	Harpreet Singh	<b>Sponsored by Coltene Holding AG</b> EDM: Sway Through Thin Lanes, Ahead of the Curves	
13:30-14:15	AS-08	Robert Percy Burgess	<b>Sponsored by MARUCHI</b> Vital Pulp Therapy – Where Do We Go from Here?	Mohammad Hossein Nekoofar
14:15-15:00	AS-09	Kyung-San Min	<b>Sponsored by MARUCHI</b> Easy and Effective Endodontic Irrigation and Disinfection	
15:30-16:15	AS-10	Cheng-Han Yan	<b>Sponsored by META BIOMED</b> Sealing the Canals with Ceraseal	Tsui-Hsien Huang 黃翠賢
16:15-17:00	AS-11	Nai-Chih Chi	<b>Sponsored by 聯揚牙科器材</b> The Key to Successful Pulpectomy for Primary Teeth	



# APEC 2023 Scientific Program Agenda

## August 26<sup>th</sup>, 2023 (Saturday) –Day2

Time	Lec. ID	Speaker	Title	Moderator
<b>Venue: 402C</b>				
09:00-09:45	AC-04	Riham Saffouri	Proper Diagnosis in Endodontics “The Dilemma between Real Pathology and Referred Pain”	Shu-Fang Chang 張淑芳
09:45-10:30	AC-05	Nobuyuki Kawashima	Effects of Hypoxic Condition on Mineralization and Inflammation in the Pulp Tissue	Yi-Ching Ho 何怡青
11:00-11:45	AC-06	Stefan Zweig	Decision Making in Modern Clinical Endodontics: The Viability of the Saving the Natural Dentition—An Evidence Based Approach	Hsueh-Jen Lin 林學仁
11:45-12:30	AC-07	Santosh Man Rajbhandari	Various Endodontic Approaches in Solving Endodontic Challenges	Chi-Jr Hung 洪啟智
13:30-14:15	AC-08	Sanjay Miglani	Intracanal Medicaments & Current Strategies	Chao-An Chen 陳昭安
14:15-15:00	AC-09	Ali Asgor Moral	LSTR Therapy Approaches for Disinfection, Regeneration and Revascularization in Endodontic Treatment: 5 Case Reports	Yi-Cheng Lin 林怡成
15:30-16:15	AC-10	Rachel Fangying Seet	The Ins and Outs of Cracked Teeth	Hsun-Yu Huang 黃薰玉
16:15-17:00	AC-11	Katrina Garcia De Luna	Cracking the Code in Cracked Teeth	Hui-Na Lee 李惠娜
<b>Venue: 402D</b>				
15:30-17:00	<b>APEC Event</b>	<b>APEC Biennial General Meetings (member only)</b>		
<b>Venue: 403</b>				
09:00-09:45	Oral Presentation	Session #3: O10001 - O10003		Bor-Ren Duh 杜博仁
11:00-11:45	Oral Presentation	Session #4: O10004 - O10006		Chi-Chia Huang 黃智嘉
13:30-14:30	Oral Presentation	Session #5: O10007 - O10010		Chun-Wei Chang 張俊偉
15:30-16:15	Oral Presentation	Session #6: O10011 - O00014		Ming-Pang Chung 鍾明邦
<b>Venue: 3F Lobby Poster Viewing (09:00-17:00)</b>				
10:30-11:00	Poster Presentation	Session #2: P00021 - P00033 / PC1001-PC1013		
15:00-15:30	Poster Presentation	Session #3: P00034 - P00047 / PC2001-PC2005		
<b>Venue: Kun Lun Room @ 12F, The Grand Hotel</b>				
17:30-19:00	<b>APEC Event</b>	<b>Gala Dinner</b>		



# APEC 2023 Scientific Program Agenda

## August 27<sup>th</sup>, 2023 (Sunday) –Day3

Time	Lec. ID	Speaker	Title	Moderator
<b>Venue: 401</b>				
09:00-09:45	AI-18	Uei-Ming Li	An Update of the Thermomechanical Treatment of Nickel-Titanium Rotary Instruments	Kyung-San Min
09:45-10:30	AI-19	Sung-Chih Hsieh	Root Canal Obturation: The Essential Concepts and Novel Evolution	
11:00-12:00	AI-20	Yu-Heng Lin	Advances in Root Canal Cleaning and Disinfection	Wei-Chih Chiu 邱威智
12:00-12:30	AI-21	Ying-Hui Su	Static/Dynamic Navigation in Clinical Endodontics	
12:30-13:30	<b>APEC Event</b>		<b>Closing Ceremony</b>	
14:00-15:00	DE-03	Alex Chan	Management of Separated Instruments in Endodontic Practice	Cheng-Mei Yang 楊正燦
15:00-15:30	<b>AEROC Event</b>		Registration for General Meeting (AEROC 會員大會報到)	
15:30-17:00	<b>AEROC Event</b>		AEROC Annual General Meetings (AEROC 會員大會)	
<b>Venue: 402AB</b>				
09:00-10:30	AS-12	Omar Ikram	<b>Sponsored by ZEISS &amp; Dentsply Sirona</b> Calcified Canals - What Do We Have in Our Endodontic Arsenal?	Ming-Gen Tu 涂明君
11:00-12:30	DE-02	Omar Ikram	Endo vs Implants - Relax Don't Extract	Chun-Pei Lin 林均霽
13:30-14:10	<b>AEROC Event (Chinese)</b>		AEROC 育成競賽優勝者演講	
14:10-15:00	<b>AEROC Event (Chinese)</b>		AEROC 牙髓病專科醫師甄審說明會	
<b>Venue: 301 (AEROC Academic Event in Chinese)</b>				
09:00-10:30	DC-01	李正喆	面對藥物相關顎骨壞死—牙髓病科醫師如何趨吉避凶與正確診斷	蔡宜玲
11:00-11:50	DC-02	林志峰	Odontogenic Sinusitis: ENT Perspective	紀智文
11:50-12:40	DC-03	張添皓	Maxillary Sinusitis of Endodontic or Dental Origin	紀智文
13:30-15:00	DC-04	郭育華	I Fill Good —根管充填新浪潮·感覺真的很好?	張添皓
<b>Venue: 402C</b>				
09:00-09:45	AC-12	Jung-Hong Ha	Experimental Methods for Mechanical Performance of Nickel-Titanium Rotary Instrument	Chih-Yin Kuo 郭祉吟
09:45-10:30	AC-13	Marcus Yan	"Doc, Can My Tooth Be Saved?" Endodontic Re-Surgery	Cheng-Han Yan 顏成翰
11:00-11:45	AC-14	Mohammad Hossein Nekoofar	From Root Canal Therapy to Regenerative Endodontics: A Paradigm Shift in Endodontic Treatment	Po-Tang Lai 賴博堂
<b>Venue: 3F Lobby Poster Viewing (09:00-17:00)</b>				
10:30-11:00	Poster Presentation		Session #4: P00048 - P00070	



## APEC 2023 Workshop Program

Time	Venue	Lec. ID	Speaker	Title	Sponsor
<b>Date: August 25<sup>th</sup>, 2023</b>					
11:00-12:30	203	AW-01	Ying-Hui Su	The Visionary Invention: Root-End Operation Endoscope System	Zumax 翊達
13:30-17:00	203	AW-02	Kai-Yun Tso	Exploring the Potential of Dental Endoscopy: Overcoming the Limitations of Microscopic Assistance in Endodontic Surgery <b>(Speech in Chinese)</b>	Zumax 翊達
13:30-17:00	202	AW-03	Ashraf Samir Refai	Pulp Tissue: The Ideal Obturation Material	Produits Dentaires
<b>Date: August 26<sup>th</sup>, 2023</b>					
9:00-10:30	202	AW-04	Ling-Chang Shen	Less Is More- Be Gentle on The Dentin (Clinical Performance of Trunatomy™)	Dentsply Sirona
	203	AW-05	Chun-Pei Lin	Clinical Approaches of Minimally Invasive Endodontics	META BIOMED 誼嘉
	205	AW-06	Chris Chen	Bio-Ceramics: The New Paradigm of Endo-Obturation <b>(Speech in Chinese)</b>	MARUCHI
	402D	AW-07	Uei-Ming Li	Organizing a Series of Your Own Ni-Ti Rotary Instruments	Bondent 聯揚
11:00-12:30	202	AW-08	Allen Ali Nasseh	Endodontic Obturation Hands on Protocol	Eighteenth 聯揚
	203	AW-09	Yo-Hua Kuo	Hydraulic Condensation 4 Points of Ceraseal	META BIOMED 誼嘉
	205	AW-10	Minju Song	Enhanced Vital Pulp Therapy, What's the Difference?	MEDICLUS
	402D	AW-11	Gianluca Plotino	How to Integrate the Use of Different Instruments to Treat Every Root Canal Anatomy	VDW
13:30-15:00	202	AW-12	Alex Chan	Filling the Root Canals - A Hands-On Course	Eighteenth 聯揚
	203	AW-13	Harpreet Singh	EDM: Revolutionizing Modern Endodontics, A Customized Hands-On Workshop	Coltene Holding AG
	205	AW-14	Cheng-Han Yan Hao-Ting Wang	The View of Vital Pulp Therapy under The Microscope/ Pre-Endodontic Restoration of Proximal-Decayed Teeth- How Should We Do under Microscope?	ZEISS
15:30-17:00	202	AW-15	Bai-Hung Huang	Double Rotary Technique with 3S Technique (Single Stroke & Swipe)	Eighteenth 聯揚
	203	AW-16	Shekhar Bhatia	Unlearn to Learn	Coltene Holding AG
	205	AW-17	Chun-Pei Lin Shih-Shiun Shyu	A Case Series of Microscopic Apical Surgery with Dynamic Navigation System/ Ending, with Finesse/Microscopical Suturing Technique (Hands On)	ZEISS



## APEC 2023 Workshop Program

Time	Venue	Lec. ID	Speaker	Title	Sponsor
<b>Date: August 27<sup>th</sup>, 2023</b>					
9:00-10:30	202	AW-18	Tien-Hao Chang	Implementing 3D Imaging in Clinical Decision in Endodontics <b>(Speech in Chinese)</b>	DEXIS Taiwan 台灣諾保科
	203	AW-19	Howard Kuo-Hao Huang George Wen Hsin Chang	The Duet of Classic Technique and Modern Technology	J. MORITA MFG. CORP.
9:00-10:30	402D	AW-20	Alex Chan	The Essence of Rotary Instrumentation Bassi Logic in General Practice	Bassi Endo 誼嘉
11:00-12:30	202	AW-21	Yi-Ting Lin	Endodontic Innovation: Dynamic Navigation, A Solution or Illusion?	Hi-Clearance 杏昌
	203	AW-22	Motoki Okamoto	New Generation Endodontic Motor, Tri Auto ZX2+®	J. MORITA MFG. CORP.
	402D	AW-23	Chi-Jr Hung	Application of CBCT For Endodontic Diagnosis and Case Study <b>(Speech in Chinese)</b>	Vatech TW 博泰

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## Country Representatives

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## Endodontic Microsurgery: Old vs New !

Syngcuk Kim

Louis I. Grossman Professor, Associate Dean for Global Affairs & Advanced Education,  
School of Dental Medicine, University of Pennsylvania, USA

It has been already 30 years that there has been fundamental changes and advances in surgical endodontics that began with the introduction of the microscope in endodontics. The discovery of the true complexity of the root canal anatomy through the microscope started a whole new way of treatments that, in turn, required a whole new generation of instruments: a series of micro-instruments, ultrasonic tips specifically for root-end preparation, CBCT, Piezotme and a totally different, highly biocompatible root-end filling material, called MTA and Bioceramic. With these significant and fundamental changes endodontic microsurgery has no resemblance to the traditional techniques, called Apicoectomy which uses a straight bur, no magnification and amalgam retrofilling and consequently, results in the high failure rate above 50%. Microsurgery may still be considered an aggressive approach, but it has been our experience and judgment, that the microsurgical approach in failed endodontic therapy cases is the more conservative and predictable approach with minimum complications and post-operative pain in many situations.



The main purpose of this presentation is to inform the dental community especially endodontists that patients would benefit from this “evolution” in endodontics by keeping their own teeth. Failed non-surgical endodontics is no longer a death sentence for a tooth.

**Keywords:** apicoectomy, endodontic microsurgery, saving teeth

## Implant vs. Endodontics: Extract Or Save? (Modern Clinical Dilemma)

Syngcuk Kim

Louis I. Grossman Professor, Associate Dean for Global Affairs & Advanced Education,  
School of Dental Medicine, University of Pennsylvania, USA

One of the most challenging dilemmas faced by today's clinician is the management of the endodontically-compromised tooth. In recent years there has been a tendency to take the simplified approach of 'extraction and implant' but this does not always prove to be as simple as we would like to think. Without a doubt the dental implant option has its place, and rightly so, but in many cases the endodontic/restorative option does not always receive its due merits. This is a serious issue, which will haunt us professionally if not corrected.



Are endodontically treated teeth really less predictable than a dental implant-supported restoration? Are they really more likely to fail? With the significant advancement of endodontic procedures in the last decades, the answers are not what implantologists and others have believed. Do implants really have fewer complications? When is the prognosis of the tooth unfavorable, and at what point is extraction and an implant the best option? We should question our treatment choices more critically, suggest useful answers to many of the questions, provide ourselves with objective criteria on which to base our judgments and, finally, offer solutions so that we can make better choices for the treatment of our patients.

In this presentation, outcomes of both endodontic treatment and implants will be evaluated to provide some answers to the above critical questions.

**Keywords:** implant, endodontic therapy, outcome, failure



AI-01

## Endodontic Prognosis: Clinical Guide For Optimal Treatment Outcome

Jarshen Lin

Instructor in Restorative Dentistry and Biomaterials Sciences, School of Dental Medicine,  
Harvard University, USA

Invited Speaker

Outcome refers to the actual result of a patient's condition due to their disease or following a specific intervention, with outcome measures including survival rates and success rates. Meanwhile, prognosis is a medical term that considers information from previous outcomes to anticipate the future developments of a patient's condition and the likelihood of success following an intervention. Having a comprehensive understanding of the factors that influence treatment outcomes is important in endodontics, enabling providers to consider patient and tooth conditions and select procedures that are predicted to maximize tooth survival and minimize postoperative complications. The upcoming course will cover the factors that influence the outcomes of different endodontic treatments, such as primary root canal treatments for both vital and necrotic teeth, non-surgical and surgical re-treatments, and treatments for cracked teeth. This course will emphasize the importance of considering patient-, tooth-, and procedure-related factors as prognostic indicators before developing a treatment plan, with the ultimate goal of enhancing tooth durability and ensuring patient satisfaction.



Learning objectives:

- 1) Explore various success measures, such as tooth survival, postoperative pain, and evidence of apical radiolucency. These measures will be used to delve into multiple prognostic factors that significantly impact the outcomes of the following endodontic treatments:
  - Primary root canal treatments for both vital and necrotic teeth
  - Non-surgical re-treatments
  - Surgical re-treatment
  - Cracked tooth treatments
- 2) Evaluate the potency of patient-, tooth- and treatment-related factors in determining the overall success and survival rates of teeth treated through endodontics.
- 3) Consider these prognostic factors to design a roadmap for endodontic treatment planning that maximizes the success and survival rates of teeth.

AI-02

Invited Speaker

## Extraction-Replantation: An Alternative Surgical Technique

**Samuel O. Dorn**

Professor and Chair of the Department of Endodontics at the West Virginia University School of Dentistry, USA  
Former Chair and Endowed Professor of the Department of Endodontics at the University of Texas at Houston, USA

There are instances when a patient desires to save a previously treated tooth, but conventional surgery is impractical. The technique of extracting such a tooth, correcting the problem, and replacing it in the socket will be investigated and described in detail. In addition, the speaker will discuss the various materials available to repair the tooth either apically or laterally, and the evidence-based literature that is involved in the decisions being made.



AI-03

## Peer Proven Technologies to Improve the Clinical Efficacy of Irrigation Activation Systems

Mustafa Gündoğar

Associated Professor, Department of Endodontics, Faculty of Dentistry at Medipol University, İstanbul, Turkey

Invited Speaker

The success of root canal treatment depends on the complete removal of infected microbial content from the root canal system. Today, with the development of nickel-titanium rotary file systems, root canal shaping has become quite simple and fast. Despite mechanical reduction of the bacterial population, it is not possible to eliminate the whole bacteria and root canal debris without the use of antibacterial solutions and activation systems from the root canals. New technology makes it possible to clean the root canal space without damaging tooth structure. In this presentation, characteristics of known and developing root canal irrigation agents and irrigation activation methods will be evaluated under the light of current literature information.



Objectives:

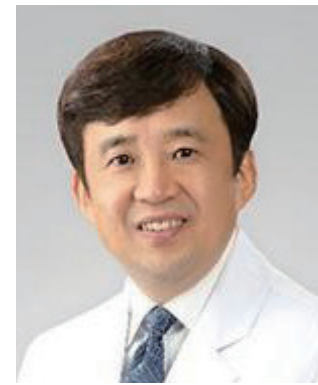
- 1.How to efficiently use NaOCl with new scientific based studies.
- 2.How to efficiently use activation systems and adapt them to minimal invasive endodontics.
- 3.Learn SWEEPS, R-SWEEPS and the GentleWave technology for root canal irrigation.

## Outcomes of Endodontic Microsurgery

**Euseong Kim**

Professor, Department of Conservative Dentistry, Yonsei University, Seoul, Korea  
Adjunct Assistance Professor, University of Pennsylvania, USA

The prognostic data about Endodontic Microsurgery attests to the fact that microsurgical success rates are far superior to traditional surgery. At the same time, within the surgical technique, each step of the procedure is important to ensure successful outcome. Incorporating microsurgical principles, the success rate of endodontic microsurgery has been reported to be approximately 90%. This presentation is based on a 20-year clinical study of microsurgery at the Microscope Center, Department of Conservative Dentistry of Yonsei University, Korea, since 2001. It will critically review the short-term and long-term outcomes of endodontic microsurgery as well as the outcome of micro re-surgery. In our study 192 teeth were followed up every 6 months for 2 years and every year up to 10 years. Over the 5-year period, 172 teeth (91.5%) were successes. The teeth classified as successes were evaluated up to 10 years, with a final follow-up rate of 60.5% (104 of 172 cases). Out of 104 followed-up cases, 97 cases were classified as success in the long term: 91 with complete healing and 6 with incomplete healing. The overall maintained success rate was 93.3%. Regarding micro re-surgery, 54 teeth requiring surgical retreatment were studied. 39 teeth (92.9%) had successful outcomes. This lecture will also deal with the prognostic factors for clinical outcomes in microsurgery based on our clinical studies, especially periodontal involvement, bony defect and lesion size. The healing success rates of endodontic microsurgery will be compared for cases with lesions of endodontic origin and with cases of combined endodontic-periodontal origin. Effects of bone tissue deficiency and lesion size on the outcome will be discussed based on clinical studies of intraoperative measurements of bone defects and 3-dimensional analyses using cone-beam computed tomography.



AI-05

## Iatrogenic Perforation: Clinical Management and Outcome

**Suman Gautam**

Associate Professor/BDS Program Coordinator, Nepal Medical College, Gokarneshwore, Nepal

Iatrogenic root perforation is a complication that can occur during endodontic treatment. It is a significant problem for the tooth integrity as it can lead to inflammation, infection and ultimately tooth loss. Despite the potential complications, the prognosis for iatrogenic root perforation is generally favorable with appropriate management. The clinical management of iatrogenic perforation depends on the location and size of the perforation as well as the severity of the damage caused along with it proper communication with the patient is of utmost importance. Treatment options include sealing of the perforation site with biomaterial non-surgically or surgically depending upon the access to the site, degree of contamination and the condition of the surrounding tissues. The outcome depends on several factors, including the extent of injury, the patient's overall health and the timely and appropriate management of the perforation. This presentation will explore various clinical conditions of iatrogenic root perforation, its management with various biomaterials and its outcome assessed clinically and radiographically.



AI-06

Invited Speaker

## The Determinants of Outcome in Retreatment

**Mehmet Baybora Kayahan**

Professor and Director, Department of Endodontics, Istanbul Health and Technology University, Istanbul, Turkey

The aim of endodontic treatment is to prevent or cure apical periodontitis. Root canal treatment is a predictable procedure with a high survival rate. However, procedural problems such as broken instruments, ledge formation, transportation of the canal, root perforation, and extrusion of the irrigants can affect the prognosis. On the other hand, patients demand the retention of their teeth more than ever before, and this results in an increasing necessity for the procedure. Retreatment is easier with the help of Ni-Tis, irrigation systems, biomaterials, and ultrasonic instruments. Even hopeless teeth can be saved. There is no doubt that both root canal treatment and retreatment of teeth are feasible and economical ways to preserve function. In this lecture, factors that affect the outcome of retreatment will be discussed based on literature and presented cases.



AI-07

Invited Speaker

## What's in A Name? A Review Of Endodontic Diagnosis

**Paul Abbott**

Winthrop Professor, Dental School, Oral Restorative and Rehabilitative Sciences,  
The University of Western Australia, Australia

Diagnosis drives dentistry! Hence, in order to provide the appropriate treatment, clinicians must be able to diagnose the patient's presenting condition. This in turn implies that clinicians must have a thorough understanding of the various conditions that occur and how they progress through their different stages. Unfortunately, pulp, root canal and peri-radicular conditions are not well understood. This is largely due to poor and inconsistent terminology that is seen in the literature as well as in day-to-day practice. The poor terminology that has been advocated in the last 10-15 years in itself demonstrates the lack of understanding of these conditions by those who proposed, and use, these inappropriate terms. Once the diseases are understood, the diagnostic process becomes more meaningful and easier. The diagnosis still requires a thorough examination with the application of all relevant diagnostic tests, plus an understanding of what information the various tests are telling us. In particular, pulp sensibility tests, percussion, palpation and transillumination are often not adequately utilized or interpreted correctly and so important information may not be available to establish the diagnosis. This presentation will provide a simple overview of the disease processes with emphasis on the various symptoms and clinical signs that lead to correct and meaningful diagnoses using appropriate terminology. Guidelines for effective and reliable diagnostic testing under different circumstances will also be outlined since the best test depends on what you are trying to diagnose. Research by the lecturer's group has clearly demonstrated that the use of appropriate terminology is more likely to lead to appropriate treatment, and such terminology should not be based on the presence or absence of symptoms. More comprehensive terminology should be used. The lecture will demonstrate that words do matter!



AI-08

Invited Speaker

## Vital Pulp Therapy: An Update of Classifications, Indications, Challenges and Follow Ups

Mohsen Ramazani

Iranian Center for Endodontic Research, Shahid Beheshti University of Medical Sciences, Tehran, Iran  
Medical Education Develop Center, Mazandaran University of Medical Sciences, Sari, Iran  
Director of International Affairs, Mazandaran University of Medical Sciences

Currently, Endodontics is facing outstanding innovative advancements in diagnosis, and clinical interventions to achieve more sustainable outcomes both for practitioners and the patients. Vital pulp therapy and regenerative endodontic procedures are the most important ones. VPT as a dedicated therapeutic method is targeting pulpal tissue conservation, protection, and maintenance when compromised by different causes. Respecting the inherent capacity of dental pulp to repair actively, VPT seems to be more practical and successful contemporarily based on higher chances of case selection, new biomaterials availability, easier ways of follow ups and also modalities attainable to overcome shortcomings and failed cases if any. As it is needed to extent knowledge and experience of pulp biology, physiology, microbiology, caries progression, dental materials, the aim of this presentation is to provide the last information released on classification, indications, challenges encountered, and modalities to qualify and improve the techniques. Hopefully evidence-based endodontics would help us to reach the best outcomes in case of vital pulp therapy.





AI-09

Invited Speaker

## An Update of Endodontic Treatment in Young Permanent Teeth

Yuan-Ling Lee

Head, Division of Endodontics, Department of Dentistry, National Taiwan University Hospital, Taiwan  
Associate Professor, Graduate Institute of Clinical Dentistry, School of Dentistry, National Taiwan University, Taiwan

Young permanent teeth are susceptible to pulp diseases due to rapid caries progression, facilitated by their high pulp horn and immature mineralization. However, conventional root canal treatment becomes challenging due to the short roots, thin dentin walls, and open root apices commonly found in these teeth. Therefore, vital pulp therapy and regenerative endodontic procedures using tissue engineering principles offer the best treatment options for young permanent teeth. These approaches aim to maintain root development, promote the formation of thick dentin walls, and achieve normal root length. Several factors need to be considered when determining the appropriate endodontic treatment for young permanent teeth. In cases of pulp diseases caused by caries, accurate pulp diagnosis, effective infection control, and thorough cleaning of the remaining pulp tissue or canal space are crucial for successful treatment outcomes. The application of calcium silicate biomaterials, such as mineral trioxide aggregate (MTA) or Biodentine, is recommended. However, in situations involving trauma-induced pulp diseases, factors such as crown or root structure damage and potential pulp tissue damage resulting from tooth displacement should be taken into account. In some instances, young permanent teeth may present root crack with persistent infections that cannot be controlled non-surgically. In such cases, intentional replantation or apical surgery with Biodentine retrograde filling may be considered as alternative treatment options. Overall, understanding the unique challenges associated with treating young permanent teeth and considering the specific clinical circumstances are essential for selecting the most suitable endodontic interventions. By following these principles, clinicians can navigate the complexities and achieve favorable treatment outcomes for their young patients.



AI-10

## Clinical Decision Making and the Use of CBCT

**Jeffrey M Coil**

Director, Graduate Endodontics Program, Department Oral Biological & Medical Sciences,  
Faculty of Dentistry, University of British Columbia, Vancouver, B.C. Canada

Invited Speaker

This presentation will highlight the use of Cone Beam Computed Tomography (CBCT) information in decision making for diagnosis, treatment options and recommendations, and assessments of post-treatment outcomes. Cases will be used to demonstrate how CBCT has strongly influenced endodontic practice. Additionally, CBCT can aid in the differentiation and management of endodontic failure and failure of endodontically treated teeth. This presentation will describe the difference between these two types of treatment failure. Participants will learn how to provide an appropriate endodontic clinical examination, assess radiographic images of endodontically treated teeth, including CBCT images. Discussion will include how this information will inform your diagnosis and treatment planning decisions, in order to provide patients with treatment options.



AI-11

## Enhancing Endodontic Diagnosis and Treatment Planning with CBCT Technology for Optimal Clinical Outcomes

**Kacharaju Kranthi Raja**

Associate Professor in Department of Conservative Dentistry, Faculty of Dentistry,  
MAHSA University, Malaysia

Cone beam computed tomography (CBCT) has become an indispensable radiographic modality for dentists, providing high-quality, accurate three-dimensional (3D) representations of maxillofacial structures. The development of CBCT has highlighted the inadequacies of conventional radiography which are compression of three-dimensional anatomy, geometric distortion, and anatomical noise. Needless to state, clinicians should have a thorough knowledge of CBCT before prescribing/using it for patients. This lecture will discuss the applications, advantages, and disadvantages of CBCT in endodontics. A variety of clinical cases will be presented to the audience to provide a holistic understanding of CBCT in Endodontics.



AI-12

## Application of Digital Technology and Guided Endodontics

Hui-Na Lee

Attending Physician of the Department of Endodontics and Operative Dentistry in Kaohsiung Medical University Chung-Ho Memorial Hospital, Taiwan

The success of root canal treatment depends on accurate diagnosis, effective treatment planning, and overcoming the challenges of root canal anatomy. Digital endodontics, which combines modern tools, is increasingly being used for complex cases. Artificial intelligence interpretation of Laser Doppler provides precise diagnosis, while advances in CBCT equipment and software render true internal anatomy visible. With 3D planning, guided endodontics has become a viable option. These tools are applied at different stages of endodontic treatment, with specific indications and clinical efficacy. Digitally guided endodontics is a precise, effective, safe, and clinically applicable strategy that integrates technical resources and digital planning into clinical endodontic practice. Overall, these techniques represent a significant advancement in the field of endodontics, with potential for revolutionizing the way we approach complex cases.



AI-13

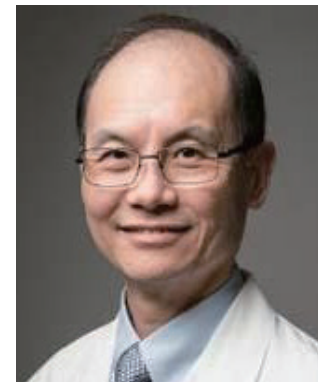
## Twenty Years of Progress on Dental Stem Cells and Regenerative Endodontics

George Huang

Professor and Director for Stem Cells and Regenerative Therapies,  
Department of Bioscience Research at UTHSC, USA

Invited Speaker

The discovery of dental stem cells (DSCs) in the 2000s has promoted the research interest in not only the characterization of these stem cells but also their applications in regenerative medicine. Along with the advancement of tissue engineering research, these DSCs have been tested for regeneration of various dental and oral tissues such as pulp, dentin, cementum, periodontal ligament (PDL) and bone. DSCs are highly angiogenic and neurogenic and can be reprogrammed into induced pluripotent stem cells (iPSCs) that possess a tremendous wide range of biomedical applications. There are at least six types of DSCs from human teeth that have been isolated and characterized, including dental pulp stem cells from pulp of permanent or deciduous teeth, PDL stem cells, stem cells from apical papilla, dental follicle stem cells and gingival mesenchymal stem cells. The emergence of regenerative endodontics has been in part influenced by the discovery of these DSCs. There are two categories of clinical approaches to regain the vitality of pulp. One is stem-cell based therapy that involves implanting exogenously processed stem cells into the root canal space, termed cell-based regenerative endodontic therapy (CB-RET). This approach has shown the regeneration of pulp- and dentin-like tissues in the canal space from animal and human clinical trial studies, suggesting potential practice of true “regenerative endodontics” in the future. On the other hand, revitalization or also termed revascularization, that does not involve the delivery of exogenously processed stem cells into the canals therefore is termed cell-free regenerative endodontic therapy (CF-RET). The various animal and human clinical studies have shown that the tissues developed in CF-RETs are fibrous connective tissue, some resembling periodontal ligament, not pulp-like, and the mineral tissue as cementum-like or bone, not dentin-like. Despite this drawback, CF-RET increases root thickness and eliminates endodontic pathosis with high clinical success rates.



AI-14

Invited Speaker

## Persistent Pain after Endodontic Treatments- Can We Prevent It?

**Jennifer Gibbs**

Assistant Professor & Director of the Division of Endodontics in Restorative Dentistry and Biomaterials Sciences, Harvard University, USA

The diagnosis and treatment of dental pain is fundamental to the practice of Endodontics. However, the experience of pain is complex with biological, psychosocial, and affective components, which means there can be a disconnect between the experience of pain in a patient, and the presence of clinical disease. Teeth are uniquely innervated and cause severe pain and sensitization of the nervous system, even in the absence of pathological infection. Persistent pain can occur even after successful endodontic treatment, due to changes in the nervous system that has been triggered by the original injury to the pulp. Endodontic materials, including sealers can cause injury and inflammation to nervous tissues, further complicating the clinical picture. Understanding the mechanisms by which these materials interact with the nervous system is crucial for successful treatment outcomes. In this presentation, we will discuss recent data describing the effects of different classes of Endodontic sealers on sensory neurons, diagnostic dilemmas related to pain, clinical strategies for when pain doesn't go away after Endodontic treatment.



AI-15

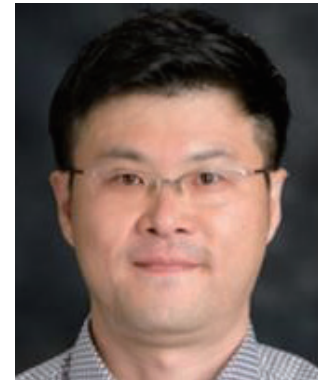
Invited Speaker

## Palatal Root End Surgery

**Ji Wook Jeong**

Assistant professor of The University of Texas Health Science Center at Houston, USA

“Palatal Root-end Endodontic Surgery (PRES)” involves the root-end resection and root-end filling of the palatal root of a maxillary molar and can be one of the most challenging procedures in endodontics. While the transantral approach for PRES and 3D navigated PRES have been advocated, there are cases that are not amenable to transantral PRES or 3D navigated PRES due to anatomic variations therefore it is necessary for clinicians to be knowledgeable in the traditional PRES approach. In this presentation, I will cover the anatomical, technical, and decision-making aspects of PRES.



Learning objectives:

At the conclusion, participants should be able to:

1. Identify key anatomical landmarks including the greater palatine foramen, spine, and grooves in order to locate the greater palatine artery and nerve in relation to PRES.
2. Design the appropriate flap to provide strategic access to the palatal root apex in order to facilitate the root-end resection and root-end preparation and filling.
3. Describe a novel modified continuous sling-mattress suture technique.

## Current Location of Vital Pulp Therapy

### Motoki Okamoto

Assistant Professor of Department of Restorative Dentistry and Endodontology, Osaka University Graduate School of Dentistry, 1-8, Yamadaoka, Suita, Osaka, Japan

Vital pulp treatment (VPT) is a therapeutic strategy aimed at conservatively managing deep carious lesions and the exposed pulp. VPT has recently expanded through the use of hydraulic-calcium-silicate cement, cone-beam CT, and dental operating microscopy (DOM), as well as an improved understanding of pulpal biology and repair mechanisms. It is widely accepted that the treatment strategy for irreversible pulpitis is pulpectomy. Recently, some reports demonstrated that partial or cervical pulpotomy may be a feasible option for the treatment of irreversible pulpitis.



Regarding to how to treat the deep caries or the exposed pulp, consensus documents from American Association of Endodontics and The European Society of Endodontology are available for our clinical treatment. However, despite the positive opinion of VPT as a strategy for irreversible pulpitis, the idea is not widespread generally, even in Europe and the United States. The factors for this include the difficulty of dental pulp diagnosis and the lack of a consistent teaching education for handling exposed pulp. In this symposium, I will show several cases related to VPT with dental operating microscopic video. These case series included successfully in preserving the activity of the pulp by partial pulpotomy caries induce pulpal micro abscess. Here we also discuss dressing agent and material induce pulpal repair the exposed pulp. There may be restrictions depending on the circumstances of each country and available dental materials, but it may lead to new discoveries. Additionally, we will find and discuss the current issues to be solved of VPT and introduce our department's research to solve them.



AI-17

## Bioactive Molecules Targeting Specific Cell Signaling to Promote Dentin Bridge Formation

**Thanaphum Osathanon**

Professor in Oral Biology and Associate Dean in Research Affairs, Faculty of Dentistry,  
Chulalongkorn University, Thailand

Invited Speaker

Vital pulp therapy aims to maintain the vitality of dental pulp tissue by stimulating tertiary dentin formation. Current materials used in clinical treatment still have several drawbacks due to their physical and biological properties. Innovative materials containing bioactive molecules have been introduced to facilitate dentin/pulp complex regeneration. Among current materials for vital pulp therapy, calcium silicate-based materials exhibited better biocompatibility, differentiation induction, and reparative dentin formation in vitro and in vivo. Dental pulp tissues exposed to calcium silicate-based materials markedly enhanced Wnt signaling activation. The Wnt agonist and ligands enhanced reparative dentin formation in vivo. Mechanistically, Wnt signaling modulated inflammation and immune responses and promoted odontogenic differentiation. In addition, Wnt interacted with Notch signaling to control odontogenic differentiation and mineralization. In another aspect, decellularized extracellular matrix derived from human dental pulp stem cells induced mineralization by activated Wnt signaling. This evidence suggests that Wnt signaling modulation represents a promising strategy for vital pulp therapy and the regenerative approach of the dentin/pulp complex.



AI-18

## An Update of the Thermomechanical Treatment of Nickel-Titanium Rotary Instruments

Uei-Ming Li

Adjunctive Attending Doctor, Department of Endodontics, National Taiwan University Hospital, Taiwan  
Adjunctive Assistant Professor, School of Dentistry, College of Oral Medicine, Taipei Medical University, Taiwan

In the past 30 years, the revolutionary development of incorporating nickel-titanium (NiTi) into endodontic files has greatly transformed the methods of root canal instrumentation. The unique material properties make them particularly suited for endodontic treatment. However, there are still a lot of problems demanding solutions till now. Instruments separation and surface blunt after repeated uses are the most concerned problems among them. The two main reasons of unexpected separation of NiTi endodontic instruments are the cyclic fatigue and the torsional overloads. As results, manufacturers made a great effort to find out any parameters that directly or indirectly influence mechanical properties of NiTi rotary instruments. The mechanical performance of NiTi alloys is according to their microstructure and associated thermomechanical treatment history. Heat treatment is one of the most fundamental approaches toward adjusting the transition temperature in NiTi alloy, which affects the fatigue resistance of NiTi rotary instruments. The newly developed NiTi instruments made from the next generation of NiTi alloys represent improved flexibility and better fatigue resistance. The special thermomechanical processing is a metallurgical process that integrates hardening and heat treatment into a single process. Although the details of the thermomechanical treatment history of the new NiTi wires remain unknown, it seems that thermal processing is a very hopeful method of gaining important benefits with regards to the efficiency and safety of NiTi rotary instruments.



## Root Canal Obturation: The Essential Concepts and Novel Evolution

Sung-Chih Hsieh

Professor, School of Dentistry, College of Oral Medicine, Taipei Medical University  
Vice Chairman, School of Dentistry, Taipei Medical University  
Chairman, Department of Endodontics, School of Dentistry, College of Oral Medicine, Taipei Medical University

Root canal obturation is a critical step in endodontic treatment, as it involves the complete filling of the root canal system with an inert material to prevent bacterial reinfection and promote healing. Appropriate root canal obturation can ensure the aseptic and long-term success of endodontic treatment. The essential concepts of obturation include the use of a biocompatible, dimensionally stable material that can be easily manipulated and adapted to the canal space. Historically, gutta-percha has been the material of choice for obturation, with the use of sealers to enhance its sealing ability. At that time, gutta percha was preferred over poor quality root canal sealers, which would shrink and wash out over time, leaving a gap. Thus, compaction techniques aimed to replace the soluble sealer with the insoluble gutta percha. However, the recent development of a new generation of sealers with superior properties, such as bioceramic sealer, has called into question the axiom of minimizing the sealer interface. The bioceramic sealer is dimensionally stable, non-soluble, biocompatible, antibacterial, hydrophilic, and can bond to dentin, indicating a new era of endodontic obturation. Minimal invasive endodontics is a concept that emphasizes the preservation of healthy tooth structure during root canal treatment, while still achieving optimal cleaning, shaping, and obturation of the root canal system. Hydraulic condensation with bioceramic sealer may be a novel evolution of root canal obturation. This presentation provides an overview of the essential concepts of root canal obturation, the vertical compaction of warm gutta percha technique including the thermal profiles of different gutta percha, the indication of different obturation technique and materials and highlights the recent advancements in materials and techniques that have improved the quality and success of endodontic treatment.





AI-20

## Advances in Root Canal Cleaning and Disinfection

Yu-Heng Lin

Attending Doctor, Department of Endodontics, Chang-gung Memorial Hospital, Taoyuan, Taiwan

Invited Speaker

The concept of minimally invasive treatment has widely gained popularity among the profession. As preservation of cervical dentin merge into the main purpose root canal treatment, thorough cleaning and disinfection of the root canal system still dominate the outcome of successful root canal treatment. Revolution of technology has changed cleaning and disinfecting the root canal system. The lecture will introduce on new advances of root canal disinfection for minimal invasive preparation including multi-sonic irrigation, nanoparticles and photodynamic therapy.



AI-21

## Static/Dynamic Navigation in Clinical Endodontics

Ying-Hui Su

Visiting Staff, Department of Endodontics and Operative Dentistry, Kaohsiung Medical University Memorial Hospital, Taiwan

Invited Speaker

In recent years, digital dentistry has experienced significant growth and development, which is no exception in the field of endodontics. CBCT and oral scans are widely used in dental implantation and prosthetics. In the field of endodontics, CBCT, and oral scans can be used to perform guided endodontics, also known as static navigation. Additionally, stereotactic technology is utilized in dynamic endodontic navigation. Both static and dynamic navigation utilize digital technology to more accurately locate the position of root canals or root apex, to achieve precise endodontic treatment results. This presentation will review this topic and present examples of clinical applications.



AC-02

Country Representative

## Deep Learning for Detection of Teeth and Periapical Pathology on Orthopantomograms

Fahad Umer

Assistant Professor and Associate Program Director Operative Dentistry,  
The Aga Khan University Hospital Stadium Road, Karachi, Pakistan

**Introduction:** The field of medicine and dentistry are beginning to integrate artificial intelligence (AI), especially deep learning (DL) in diagnostics, thereby eliminating subjectivity and improving accuracy of diagnoses and treatment planning. Current evidence on pathology detection on orthopantomograms (OPGs) either indicate the presence or absence of disease in the entire image; literature on the relation of pathology to causative tooth is lacking.



**Objective:** To develop a DL AI model for the segmentation of periapical pathology and its relation to teeth on OPGs.

**Methodology:** 250 OPGs were manually annotated by subject experts to establish ground-truth for training an AI model on segmentation of periapical pathology. The labelling of periapical pathology was carried out denoting two classes; class 1: uncertain periapical lesion; and class 2: certain periapical lesion. An untrained U-net algorithm was trained and validated on the labelled dataset. Our existing trained model on teeth segmentation and numbering tasks was also further trained on 250 labelled OPGs to improve performance and accuracy. Both models were then integrated which allowed for relation of periapical pathology to the causative tooth on OPG.

**Results:** The performance of the existing teeth segmentation and numbering model was further improved as indicated by the following performance metrics including accuracy=98.1%, precision=91.8%, re-call=93.3%, F-1 score=92.5%, dice index=90.1% and Intersection over Union (IoU)=82.1%. The performance metrics of lesion segmentation carried out by the current model are as follows: accuracy=98.1%, precision=84.5%, re-call=80.3%, F-1 score=82.2%, dice index=75.2% and IoU=67.6%.

**Conclusion:** Our integrated AI model performs the task of lesion detection and its relation to the causative tooth on OPG with comparable results to that laid down in the ground truth as indicated by performance metrics.

AC-03

## AI in Endodontics: Is It the End for the Clinician?

**Ashraf Samir Refai**

Professor & Former Head of Department, Department of Endodontics, Al-Azhar University, Egypt

Country Representative

To the lay person, when the words AI or artificial intelligence are used, it conjures up images of violent state of the art robots taking over the world and eliminating the human race. Using AI to speed up and improve upon the limitations of humans is not new, since the early 1950's research on AI has been proceeding steadily. AI has infiltrated all aspects of our life such as search engines, facial and speech recognition software. AI in dentistry is a growing field of research and its application in endodontics is growing. This lecture outlines the current status of AI in endodontics, its current application and its future directions.



AC-04

Country Representative

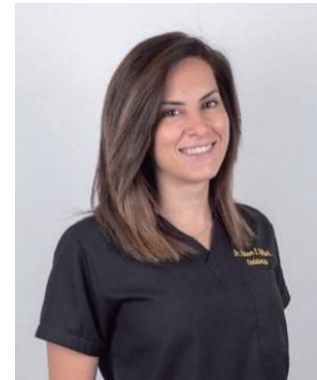
## Proper Diagnosis in Endodontics "The Dilemma between Real Pathology and Referred Pain"

**Riham Saffouri**

Endodontist, Jordanian Endodontic Society, Jordan

The purpose of this lecture to fully understand the art and science of diagnosis, which is the most crucial and important step in our treatment, explaining step by step how to use our tools and expertise to know the root cause of the patient's complaint so we can properly treat it and enhance people's quality of life,

It is as important to understand the concept of referred pain, and how to exclude it by taking full medical and dental history, doing proper test, and to know how to explain this to your patient.





AC-05

## Effects of Hypoxic Condition on Mineralization and Inflammation in the Pulp Tissue

**Nobuyuki Kawashima**

Associate Professor of Tokyo Medical and Dental University, Japan

Dental pulp tissue is encapsulated with dentin, a specialized hard tissue, and blood supply to the pulp mainly comes from the apex. Therefore, the pulp tissue of avulsed/luxated teeth, which frequently develops abundant mineralization, easily suffers from hypoxia by disruption of the blood supply. Following the progress of pulp inflammation, circulatory impairment and resulting ischemia can readily occur following inflammatory exudation, which increases the tissue pressure leading to vascular compression. However, the involvement of hypoxia in mineralization and inflammation in the pulp tissue is still unclear. Recently, we have revealed that hypoxia and hypoxia inducible factor 1 $\alpha$  (HIF1 $\alpha$ ), a typical transcriptional factor of hypoxia, promote osteo/odontoblastic differentiation of human dental pulp stem cells via B-cell CLL/lymphoma 9 (BCL9), which is a Wnt/ $\beta$ -catenin transcriptional cofactor. Furthermore, HIF1 $\alpha$  negatively regulates interleukin-6 synthesis in lipopolysaccharide-stimulated human dental pulp cells via upregulation of suppressor of cytokine signaling 3 and subsequent downregulation of CCAAT element binding protein beta. This lecture will focus on the mineralization-inducing and anti-inflammatory effects of hypoxia/HIF1 $\alpha$  as a new insight into the biology of the pulp tissue.



**AC-06**

## **Decision Making in Modern Clinical Endodontics: The Viability of the Saving the Natural Dentition—An Evidence-Based Approach**

**Stefan Zweig**

US Country Representative; Immediate Past President, AAE; Associate Professor of Clinical Dentistry, Herman Ostrow School of Dentistry of USC, USA

The decision as to whether to incorporate an endodontically treated tooth in a periodontal/restorative treatment plan is often difficult. The availability of other successful treatment alternatives (dental implants) further complicates the issue. Yet, the retention of the natural dentition has many benefits for the patient. Endodontic success rates are high given new technologies and treatment modalities but is undeniably tied to restorative and periodontal factors. This lecture will focus on the evidence that endodontic therapy (initial therapy, retreatment, and surgical procedures) is still a viable and successful alternative in saving teeth which can be strategically used in restorative treatment plan. The prognosis for endodontically treated teeth will be considered along with an approach to determine the appropriate endodontic modalities when considering retaining natural teeth.



**AC-07**

## **Various Endodontic Approaches in Solving Endodontic Challenges**

**Antosh Man Rajbhandari**

Associate Professor, Department of Endodontics, Asian Specialized Dental Hospital and College, Nepal

Saving infectious natural teeth with an endodontic treatment hasn't always been an easy task. Sometimes there are lot of endodontic challenges to preserve what is remaining. Whatever be the challenge if done with correct endodontic approach and a zeal in mind to conserve the nature, it can be rewarding to both patient and dentist. Basically, endodontic challenges can be overcome by two different approaches either orthograde or retrograde with appropriate choice of biocompatible materials.





AC-08

## Intracanal Medicaments & Current Strategies

**Sanjay Miglani**

Professor & Head, Department of Conservative Dentistry & Endodontics, Faculty of Dentistry, Jamia Millia Islamia (Central University), New Delhi, India

It is an established fact now that apical periodontitis is a disease induced by biofilms. Cleaning and shaping of the root canals using instrumentation, irrigation, and intracanal medicaments play an essential role in eliminating bacteria and bacterial biofilms. The role of intracanal medicaments is strategically important in eliminating these bacteria after the chemo-mechanical preparation.

This presentation will review the currently used intracanal medicaments and if there is a need to modify the current strategies according to various host and medical factors and future directions.



## LSTR Therapy Approaches for Disinfection, Regeneration and Revascularization in Endodontic Treatment: 5 Case Reports

**Ali Asgor Moral**

Professor, Chairman, Department of Conservative Dentistry & Endodontics & Dean, Faculty of Dentistry, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh

Lesion sterilization and tissue repair (LSTR) therapy includes applies of a triple antibiotic mixture in a suitable vehicle, which is considered to disinfect, regenerate and revascularize the dental infection. In endodontics, LSTR has been vastly applied and varied from vital pulp therapy to the recently introduced regeneration and revascularization protocol. Five patients with different clinical manifestations were treated with the aim to preserve the tooth pulp vitality, disinfect the root canal system and promote regeneration capacity of pulp tissue by undifferentiated mesenchymal/stem cells. These reports highlighted five cases with exposed pulp, pulp polyp, tooth with sinus/fistula etc. where LSTR therapy was applied with triple antibiotic paste. Cariology Research Group of Niigata University Graduate School of Medical & Dental Science, Niigata, Japan and Conservative Dentistry & Endodontics Department of Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh jointly conducted this study.



**Case-I:** Exposed pulp was treated with vital pulp therapies such as direct pulp capping using LSTR therapy. **Case-II:** Carious destruction with pulp polyp was treated with pulpectomy procedure with a triple antibiotic mixture or LSTR therapy. **Case-III:** Hopelessly carious tooth was also treated by pulpectomy procedure with a triple antibiotic mixture. **Case-IV:** Destroyed deciduous tooth with buccal swelling as well as sinus was treated with a triple antibiotic mixture. **Case-V:** A failed root canal treatment with fracture reamer in apical region was also treated by LSTR therapy. All tooth samples mentioned above were rehabilitated by permanent restoration and inlay. Clinical and radiographic examinations were performed at 3, 6, 12 and 24 months. At the end of 24 months, the patients were completely asymptomatic and free of any clinical and radiographic signs of inflammation and periapical lesion. Follow-up examinations revealed reduction of periradicular pathosis in all the five cases.

This case reports open a perspective on the use of LSTR therapy in endodontics as an alternative option to foregoing the more invasive root canal therapy and extraction in treating pulpally involve tooth with gross periradicular pathosis. LSTR therapy is very much effective, less time-consuming treatment. We can use this therapy confidently but proper technique must be maintained with proper knowledge.

**Keywords:** LSTR, regeneration, revascularization

## The Ins and Outs of Cracked Teeth

**Rachel Fangying Seet**

Registrar, Restorative Dentistry, National Dental Centre Singapore

Cracked teeth are defined by having a thin surface disruption of enamel and dentin, and possibly cementum, of unknown depth or extension. Cracked teeth are becoming increasingly prevalent in developed countries. Patients are now more dentally aware after decades of public dental education. This, coupled with heavy masticatory function, results in teeth being kept for longer periods and being succumbed to repeated loading. As a result, there is a predisposition for the development of cracked teeth in these patients. The etiology and predisposing factors of



these teeth will be discussed. Evidence on the prevention, diagnosis and management of cracked teeth is heterogeneous. Although evidence suggests that cuspal protection and early detection is paramount in the management of cracked teeth, there is currently no one specific method that is favored over the other. Vital cracked teeth have been suggested to be treated using crowns or other indirect restorations definitively. However, it has also been suggested that these teeth require an interim period of stabilization prior to definitive restorations to avoid further trauma to an inflamed pulp during crown preparations. The existing literature will be discussed. Non-vital cracked teeth require root canal treatment prior to crowns. However, understanding the factors leading to treatment failure will also help us to better advise patients on the prognosis and appropriate treatment for these teeth. Management strategies for vital and non-vital cracked teeth differ.

In this lecture, we discuss the evidence behind the different management strategies for cracked teeth. Several new technological advancements in the detection of cracked teeth will also be discussed.

AC-11

Country Representative

## Cracking the Code in Cracked Teeth

**Katrina Garcia De Luna**

Associate Professor, University of the East, Graduate School of Dentistry (MScD Endodontics), 2012-2022, Manila, Philippines

“Cracked Teeth (CT)” is among the top three leading causes of tooth loss. CT has been well defined and acknowledged since the 1960s but to this day, its management has not received much attention it deserves. In order to understand CT before it further causes coronal and root fractures, it is important for a clinician to recognize and detect cracks while it is in its initiation stage and how it could progress to reversible or irreversible pulpitis.

This lecture aims to:

1. Be able to understand how tooth structure cracks complicate and affect dental treatment.
2. Learn the different classifications, etiology and initiation mechanism of cracks.
3. Know how endodontic treatment can be of help or also be a factor in causing cracks.
4. Know the role of the restorative design in preventing cracks following tooth restoration.



AC-12

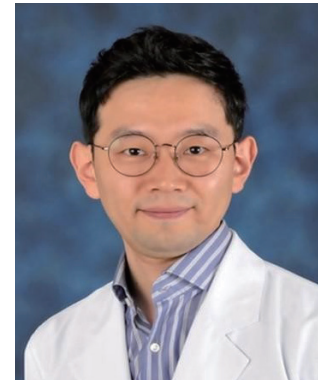
## Experimental Methods for Mechanical Performance of Nickel-Titanium Rotary Instrument

Jung-Hong Ha

Professor, Department of Conservative Dentistry, Kyungpook National University, Republic of Korea

Country Representative

The goal of root canal preparation is to remove vital and necrotic pulp remnants, microorganisms, and microbial toxins, through mechanical preparation of the root canal space and chemical disinfection. To achieve this objective the curved root canals is difficult with the use of stainless-steel files. They are stiff and tend to make so many aberrations. Over two decades, nickel-titanium (NiTi) instrument plays an important role in root canal preparation; improved preparation quality and greatly reduced aberrations. In clinical use, nickel-titanium rotary instrument shows different performance depending on the design and mechanical properties. A variety of models and methods have been used to investigate the mechanical properties and behavior of NiTi instruments. The aim of the lecture is to review the testing methods of nickel-titanium rotary instruments and to present the related study results.





## Doc, Can My Tooth Be Saved? Endodontic Re-Surgery

**Marcus T Yan**

Principle Endodontist, Sydney Micro-Endodontics-Private Specialist Endodontic Practice, Australia

When the surgical endodontic treatment fails, the failure may be attributed to incorrect diagnosis and the surgical technique used or materials employed. Endodontic microsurgery has evolved tremendously in the last decade and is fundamentally different from traditional apical surgery. There are now many clinical studies supporting the predictable and positive outcome of modern endodontic microsurgery and re-surgery in the management of post-treatment endodontic disease. Endodontic re-surgery can now be considered a good alternative for failed surgically treated teeth with post-treatment endodontic disease.



Learning objectives:

- To understand the etiology of postsurgical treatment endodontic disease.
- To appreciate the difference between traditional apical surgery and modern endodontic microsurgery.
- To understand the outcome endodontic re-surgery.

AC-14

## From Root Canal Therapy to Regenerative Endodontics: A Paradigm Shift in Endodontic Treatment

**Mohammad Hossein Nekoofar**

Immediate Past President of Iranian Association of Endodontists  
Director of International Relations, Tehran University of Medical Sciences  
Honorary Senior Clinical Lecturer, Cardiff University

Country Representative

Regenerative endodontics is a novel approach to restore the vitality and function of the pulp-dentin complex in teeth with pulp necrosis and immature root development. Conventional root canal therapy, which involves cleaning and filling the root canal space with inert materials, may compromise the long-term prognosis of these teeth due to the thin dentinal walls and open apices. Regenerative endodontics, on the other hand, uses the principles of tissue engineering to promote the regeneration of pulp-like tissue within the root canal system, allowing for continued root maturation and increased dentinal thickness. This lecture will provide an overview of the biological basis, clinical protocols, and outcomes of regenerative endodontic procedures, as well as discuss the challenges and future directions of this emerging field. The lecture will also compare and contrast regenerative endodontics with conventional root canal therapy and other alternative treatments for immature teeth with pulp necrosis. The aim of this lecture is to introduce the audience to the paradigm shift that regenerative endodontics represents in endodontic treatment and to highlight its potential benefits for oral health and quality of life.



**AS-01**

**Sponsored by Zumax Medical Co., Ltd.**

Sponsored Speaker

## Restorative Considerations of Post Endodontically Treated Teeth

**Yen-Un Chen**

Co-founder of TK85 MicroDental Education Center

As a general practitioner, I do the root canal treatment and prosthodontic restoration by myself. Conventionally, after finalizing root canal treatment on a tooth, we either fill the cavity or access opening with a filling material or we cement a post and fabricate a full crown. Nowadays, with the improvement of the materials used in dentistry, especially lithium disilicate and zirconia, and the knowledge we newly acquired on adhesive bonding and fracture resistance, is it really necessary to prepare the endodontically treated tooth for a full coverage crown? Can adhesive dentistry replace full coverage crowns?



**AS-02**

**Sponsored by J. MORITA MFG. CORP.**

**Sponsored Speaker**

## **CBCT Use in Endodontics: A Clinical Perspective**

**Allen Ali Nasseh**

Clinical Instructor, Lecturer, Harvard School of Dental Medicine Graduate Endodontics Program, USA

In this presentation, Dr. Nasseh shares some of his clinical experiences and perspective on the use of CBCT technology in clinical endodontics.

Dr. Nasseh has been using the CBCT Technology in his clinical practice since 2008 and after reading thousands of scans for non-surgical and surgical endodontic treatment planning, he will share some simple tips and tricks during this presentation to help improve the quality and usefulness of your scans and will focus on indications for their use and interpretation.



**AS-03**

**Sponsored by VDW GmbH**

## **How to Integrate the Use of Different Instruments to Treat Every Root Canal Anatomy**

**Gianluca Plotino**

Professor of Endodontics in the School of Dentistry at the Catholic University of Rome, Italy

Sponsored Speaker

The present lecture will analyze the different possible clinical scenarios: first we will consider the 80-85% of the root canals in primary treatments, that may be defined as standard cases and may be easily shaped with a single-file basic preparation technique using only one reciprocating heat-treated instrument; then it will be described how to clinically deal in a predictable, safe and efficient way the remaining 15-20% of the canals, that may be defined as complex, using different instruments, each one for every specific clinical situation. In fact, the use of a small reciprocating glide path file and the possibility to hybridize the techniques with a sequence of rotary files will also be described to solve those clinical cases with the most complex and particular root canal anatomies and achieve a minimally invasive root canal preparation.



**AS-04**

**Sponsored by 聯揚牙科器材有限公司**

Sponsored Speaker

## Simple and Efficient Endodontic Obturation

**Allen Ali Nasseh**

Clinical Instructor, Lecturer, Harvard School of Dental Medicine Graduate Endodontics Program, USA

Endodontic obturation has evolved greatly over the past century. Advances in hydraulic cement technology has made the prospect of modern obturation a less complicated task. In this presentation, Dr. Nasseh will review the history of endodontic obturation and work to demonstrate a Real World approach to several new obturation techniques in different types of cases that can help address root canal obturation in a simple, predictable manner. In this presentation, various forms of root canal obturation using hydraulic cements will be discussed and demonstrated.



AS-05

Sponsored by 聯揚牙科器材有限公司

## Mastering Mechanical Shaping, Chemical Cleaning and Warm Vertical Compaction Technique

Sheng-Wun Huang , Yu-Cho Liu

Diplomate, Academy of Endodontology (Taiwan)

Sponsored Speaker

The core aims of endodontic treatment were to prevent and treat microbial contamination of pulps and root canal systems. We commonly used the terms “cleaning and shaping” to describe root canal treatment procedure. However, if we didn’t have good shaping, we could not remove microorganism efficiently and the irrigant could not enter the root canal system to achieve good cleaning. Therefore, the purpose of this topic is to discuss how to do good mechanical shaping and match good chemical cleaning to achieve effective debridement and long-term prognosis in root treatment.

Vertical compaction technique of warm gutta-percha, described by Dr. Herbert Schilder in 1967, produces consistently dense, 3-dimensional root canal fillings, and has been developed to fill canal irregularities more effectively. While most clinicians should have a general understanding of the procedure, there are still some concepts that we may easily overlook or not fully clarify, which could potentially impact the outcome of the treatment. I hope this presentation can provide you with more inspiration and insights related to this technique.



## Feasible Ways to Perform Minimal Invasive Endodontics

**Mustafa Gündoğar**

Associated Professor, Department of Endodontics, Faculty of Dentistry at Medipol University, İstanbul, Turkey

The term minimally invasive endodontics has become very popular with the use of magnification methods and the modern endodontic devices that keep up with technological developments. An endodontic treatment with the maximum preservation of pericervical dentin is the most important goal of today's endodontics. The most important key to success in today's endodontics is to have knowledge and practice about the new methods determined in the access cavity preparation, the new generation NiTi rotary file systems used in the current root canal shaping procedures, the latest methods used in the activation of irrigation solutions, and the three-dimensional filling of root canals with new generation devices and materials. In this presentation, general information about the applications of minimally invasive endodontics will be given and the latest techniques will be explained in detail so that you will be able to perform in your dental clinic.





**AS-07**

**Sponsored by Coltene Holding AG**

## **EDM: Revolutionizing Modern Endodontics-Sway through Thin Lanes, Ahead of The Curves**

**Harpreet Singh**

Dean and Principal, Professor & Head Endodontics, of BJS Dental College,  
Hospital and Research Institute, Ludhiana, India

The sophistication for performing predictably successful root canal therapy has occurred through an interactive dynamics of advanced materials available, newer effective techniques and change in related biologic understanding and perspectives. With increase in number of cases reporting for endodontic therapy, dental professionals must deal with more complicated cases such as those with very fine and curved canals. Electrical discharge machine files (EDM) have revolutionized Endodontics by their extraordinary properties of flexibility and fracture resistance, which have begun a new era in Endodontics. This has reduced the number of files required for cleaning and shaping without having to compromise preservation of the root canal anatomy. This customized hands-on workshop shall focus on effective shaping and cleaning of highly curved canals with subsequent obturation and shall teach predictably successful endodontic techniques for management of highly curved canals that can be immediately implemented into clinical practice.



## Vital Pulp Therapy – Where Do We Go from Here?

**Robert Percy Burgess**

Endodontic Registrar, Department of Dental Surgery, Woodlands Health Singapore

Pulpotomies have traditionally been reserved for young patients, preferably with immature root apices, due to their increased pulpal blood flow, higher propensity for pulpal healing and desire for continued root development. However, advances in endodontic materials and our understandings of pulp biology over the past 20 years have allowed these conservative therapies to be applied as definitive treatments in mature teeth. Long-term prospective clinical studies and systematic reviews have shown these treatments possess good clinical and radiographic outcomes, with a recent systematic review showing an average clinical and radiographic success rate of 93.97% and 88.39% respectively at 3 years in patients presenting with irreversible pulpitis.



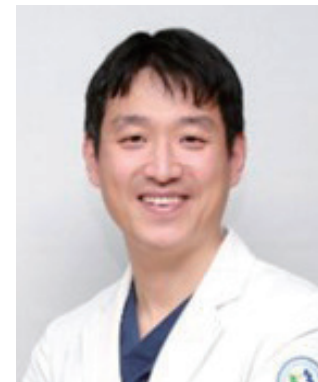
Bioceramics have proven critical to the success of pulpotomies as they demonstrate good sealing properties, excellent biocompatibility and favourable tissue response when placed in direct contact with pulp tissue, stimulating the release of growth factors that promote pulpal repair. Unfortunately, bioceramics currently available for pulp capping have setting times which might be considered long for day-to-day dental practice. Preparing these materials usually involve mixing powder to liquid manually or via trituration of capsules, which potentially results in increased preparation time, potential contamination during transfer and also wastage of material if too much is prepared. As such, for pulpotomies to be regarded as fast and predictable alternatives to RCTs, materials with similar if not better properties, including faster setting times and handling characteristics, are desirable. This lecture aims to summarise current and contemporary evidence for vital pulp therapy, focusing on material advancements for pulp capping. Findings from a clinical trial conducted at the National University Oral Health Centre Singapore using a novel fast-setting and premixed flowable calcium trisilicate cement for pulp-capping following pulpotomy in patients with reversible and irreversible pulpitis will also be shared.

## Easy and Effective Endodontic Irrigation and Disinfection

**Kyung-San Min**

Department of Conservative Dentistry, Jeonbuk National University School of Dentistry, Jeonju, Korea

The rationale for endodontic treatment is unarguably to eradicate the occurring infection and/or prevent microorganisms from infecting the root canal system. The microorganisms usually form biofilms so that have the ability to survive tough growth and environmental conditions. Therefore, endodontic disease is a biofilm-mediated infection, and the primary aim in the management of the pathological situation is the elimination of microbial biofilms formed on the root canal wall. There have been many attempts to remove biofilms effectively from the root canal system. Among these, over the past few decades, ultrasonically activated irrigation (UAI) is probably the most widely used supplementary method in root canal disinfection. A large body of evidence has shown that by inducing acoustic microstreaming and creating shear stress, UAI can improve the irrigant distribution as well as the physical disruption of bacterial aggregations.



Recently, a titanium oxide-coated heat-treated nickel-titanium irrigation file was introduced in the endodontic field. This instrument is known to have the potential to be used as a favorable UAI system regarding the removal of intracanal biofilms and medicaments according to previous studies. Here, this presentation describes several clinical strategies for the management of endodontic biofilms using the irrigation device. This lecture also highlights the novel 3D-printed root canal model that can be widely applied for various endodontic studies and shows evidence regarding the effectiveness of the instrument with the model.

## Sealing the Canals with CeraSeal

**Han-Yan Cheng**

Endodontist of Academy of Endodontology, Taiwan

Three-dimensional root canal obturation is one of the key elements for a successful root canal treatment. Root canal obturation acts as a revealing mirror, reflecting the perfection of the process from the initial pulp chamber opening to the final root canal enlargement, cleaning and shaping. During the treatment, clinicians may overlook some details, which could accumulate like compound interest, ultimately leading to an imperfect root canal obturation. In recent years, the use of bioceramic sealers with the hydraulic condensation technique has gained popularity.



CeraSeal is a new bioceramic sealer that offers excellent sealing ability, fluidity, and ease of operation. However, is this filling technique reliable? What are its advantages and disadvantages? What are the details of the operation? In this lecture, we will unveil the most popular root canal obturation method in recent years: the HYDRAULIC CONDENSATION technique. We will also incorporate numerous clinical cases using CeraSeal with gutta percha point as the filling material, helping you to gain a deeper understanding of how CeraSeal can improve your clinical work efficiency.



AS-11

Sponsored by 聯揚牙科器材有限公司

## The Key to Successful Pulpectomy for Primary Teeth

Nai-Chih Chi

Director, Pediatric Dentistry, ABC Dental Group, Kaohsiung, Taiwan

1. Function of the primary teeth
2. Behavior management
3. Efficient instruments
4. Conclusion



## Calcified Canals - What Do We Have in Our Endodontic Arsenal

**Omar Ikram**

Specialist Endo Crows Nest – Private Specialist Endodontic practice Sydney, Australia

Untreated anatomy is the number one cause of failure of root canal treatment. We have modern files for preparing canals once they are located, but location of calcified canals still remains a huge challenge in endodontics. There are a number of techniques we can use to find calcified canals ranging from cone beam computed tomography (CBCT), use of modern microscopy, ergonomics and modern optics, as well as treated metal files, that can aid negotiation of these canals. This talk will cover techniques we can use to locate and negotiate calcified canals. A novel patency filing technique will also be described, where 2% tapered hand files can be minimized using greater tapered hand files. It will also discuss tools in our arsenal which make location and negotiation of root canals less stressful.



**AW-01**

**Sponsored by Zumax Medical Co., Ltd.**

## **The Visionary Invention: Root-End Operation Endoscope System**

**Ying-Hui Su**

Visiting staff, Department of Endodontics and Operative Dentistry, Kaohsiung Medical University Memorial Hospital, Taiwan

As an endodontist, the utilization of surgical microscopes in performing apicoectomy has become commonplace. Microscopic apical surgery offers numerous advantages, such as enhanced visualization, smaller incisions and bone windows, and precise retrograde preparation. However, the application of endoscopy in apical surgery has been limited to a few published studies. In this presentation, I will introduce an endoscopic system comprising an endoscope and a capsule. The capsule serves multiple purposes, including securing the endoscope, controlling bleeding, maintaining a clear surgical field of vision, and minimizing contact between infectious materials and the bone cavity during the procedure. Moreover, this capsule can be used in conjunction with a surgical microscope.



**AW-02**

**Sponsored by Zumax Medical Co., Ltd.**

## **Exploring the Potential of Dental Endoscopy: Overcoming the Limitations of Microscopic Assistance in Endodontic Surgery**

**Kai-Yun Tso**

Visiting staff, Department of Endodontics, National Cheng Kung University Hospital, College of Medicine,  
National Cheng Kung University, Tainan, Taiwan

In the past, endodontic surgery was primarily assisted by dental microscopes. A review of recent literature reveals that there is limited research in this area, largely due to the difficulties associated with the use of rigid or flexible medical endoscopes in dentistry. However, with the advent of new dental endoscopes that feature small, flexible heads and the ability to operate under water, many of the challenges encountered with traditional microscopic assistance in endodontic surgery can be effectively addressed. This novel technology presents a promising avenue for future research in the field.







AW-03

Sponsored by Produits Dentaires

## Pulp Tissue: The Ideal Obturation Material

**Ashraf Samir Refai**

Professor & Former Head of Department, Department of Endodontics, Al-Azhar University, Egypt

This lecture is designed to inform the attendees on the current state of affairs regarding adult pulpotomies as a definitive treatment in Endodontics. During the lecture the attendees will:

1. Become familiar with the idea of adult pulpotomies
2. Understand its indications and contraindications
3. Understand the importance of using hydraulic calcium silicate materials and why it is superior to other capping materials.
4. Evaluate multiple clinical cases of successful and failed adult pulpotomies
5. Be familiar with its limitations
6. Become familiar with the most valid research available on the subject
7. Have an idea about future directions





AW-04

Sponsored by Dentsply Sirona

## Less Is More- Be Gentle on The Dentin (Clinical Performance of Trunatomy™)

Ling-Chang Shen

Adjunctive Attending Doctor, Department of Endodontics, National Cheng Kung University Hospital, Taiwan

The improved flexibility and slim taper of TruNatomy™ allows us to shape nature's wide variety of curved roots with confidence and still offering a proper disinfection. This session will present many cases showing that TruNatomy™ system not only preserves dentin, ensuring minimally invasive canal preparation, but is also a versatile system with many clinical benefits and advantages when used in these challenging cases.



**AW-05**

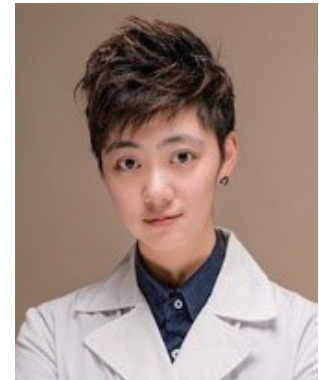
**Sponsored by META BIOMED**

## **Clinical Approaches of Minimally Invasive Endodontics**

**Chun-Pei Lin**

Endodontist, National Taiwan University Hospital, Taiwan

Minimally invasive endodontics (MIE) is a newly formed concept and technique for root canal treatment in recent years. Previous studies revealed that the remaining dental structure and restorations have a significant impact on the long-term viability of an endodontically treated tooth. To preserve more tooth structure during the root canal treatment procedures, minimally invasive endodontics (MIE) has been proposed. In other words, the aim of minimally invasive endodontics is to maintain as much of the healthy coronal, cervical, and radicular tooth structure as possible.



This workshop will focus on the concepts and clinical approaches of minimally invasive endodontics (MIE). Access opening, root canal cleaning and shaping, and surgical endodontics are all possible applications for minimally invasive endodontics (MIE) in endodontic treatment. The participants can not only acquire knowledge of minimally invasive endodontics (MIE) but also practice MIE by hands-on training.

AW-06

Sponsored by MARUCHI

## Bio-Ceramics: The New Paradigm of Endo-Obturation

Chris Chen

Clinician, Key Opinion leader (KOL) for Ultadent, Coltene Micro-Mega and Maruchi

Obturation of root canal seems to be the final crucial phase for successful endodontic treatment. Various materials and techniques exist for accomplishing this step. But the golden standard of today seems to be the “Vertical heat condensation technique”. Unfortunately, majority of dentists who perform Endodontics every day, opt for the traditional, much easier and quicker technique - “cold lateral condensation” or the even simpler - “single cone obturation technique”. The reason being that, the “Vertical heat condensation technique” need -



- 1) Investment in time and money to learn from “Masters”.
- 2) Technique sensitive, hence longer learning curve.
- 3) Additional investment in equipment.
- 4) Longer time needed for the technique
- 5) Risk of developing cracks or micro cracks of the root during the technique.
- 6) Possible discomfort to patient due to high heat and condensation.
- 7) Possible post-operative discomforts.

The lecturer will share how the most used “traditional technique” of obturation can become the “Perfect” obturation, making the “Golden standard” of today’s obturation as OBSOLETE!



AW-07

Sponsored by 聯揚牙科器材有限公司

## Organizing a Series of Your Own Ni-Ti Rotary Instruments

Uei-Ming Li

Adjunctive Attending Doctor, Department of Endodontics, National Taiwan University Hospital, Taiwan  
Adjunctive Assistant Professor, School of Dentistry, College of Oral Medicine, Taipei Medical University, Taiwan

For over 30 years, Ni-Ti rotary instruments have played a significant role in root canal treatments. Clinicians have the flexibility to select their preferred files and operating sequence based on personal habits and the complexity of root canal anatomy. The aim of this workshop is to offer appropriate guidelines that will enhance the standards of endodontics.



**AW-08**

**Sponsored by 聯揚牙科器材有限公司**

## **Endodontic Obturation Hands-on Protocol**

**Allen Ali Nasseh**

Clinical Instructor, Lecturer, Harvard School of Dental Medicine Graduate Endodontics Program, USA

Endodontic Obturation has evolved greatly over the past century. Advances in hydraulic cement technology has made the prospect of modern obturation a less complicated task. In this presentation, Dr. Nasseh will review the history of endodontic obturation and work to demonstrate a Real World approach to several new obturation techniques in different types of cases that can help address root canal obturation in a simple, predictable manner. In this presentation, various forms of root canal obturation using hydraulic cements will be discussed and demonstrated.



**AW-09**

**Sponsored by META BIOMED**

## Hydraulic Condensation 4 Points of Ceraseal

**Yo-Hua Kuo**

Clinical instructor, Lecturer, NCKUH department of stomatology, Taiwan

### 1 Cone Filling?

Many participants may confuse hydraulic condensation with one cone filling. Actually, with the use of high-quality sealer it makes hydraulic condensation (sealer-based obturation) practicable and thus one cone filling more predictable.

### 2 Steps

Put and cut.

Simple, easy and high efficiency.

### 3D obturation

Successful endodontic treatment cannot be achieved without proper root canal obturation. Due to the high complexity of the nature root canal system, three dimensional obturation is almost a mission impossible.

### 4 Good

Good antimicrobial effect / Good biocompatibility

Good volumetric stability / Good clinical characteristic

This presentation will introduce hydraulic condensation with Ceraseal sealer and discuss the difference between calcium silicate-based sealer and traditional sealer; also, will demonstrate some tips and equipment to make three dimensional obturation more clinical achievable.



## Enhanced Vital Pulp Therapy, What's the Difference?

### Minju Song

Assistant Professor, School of Dentistry, Dankook University, Cheonan, Korea  
Chair of Department of Conservative Dentistry, Dankook University Dental Hospital, Korea

Direct pulp capping is a representative 'vital pulp therapy' with a long history, with the first reported case using gold foil in 1756. Since the 1930s, direct pulp capping using calcium hydroxide-based materials has been widely performed for preserving the pulp. However, long-term clinical studies reported several restrictions such as tunnel defect of the dentin bridge, which led to limiting the procedure only to immature teeth. Recently, vital pulp therapy seems to be highlighted again. With bioceramics as a capping material, direct pulp capping has reported favorable clinical outcomes even in mature teeth with carious exposure. It seemed to expand the indication and reduce negatively affecting factors compared to previously performed traditional pulp capping. In addition, in 2019, the European Society of Endodontology (ESE) suggested that the enhanced protocol (using magnification, disinfection irrigant, and calcium silicate cement) leads to a high level of success even after complete caries removal and pulp exposure. This presentation will point out three keys of the enhanced protocol of vital pulp therapy - the use of magnification, disinfection irrigant, and calcium silicate cement, and describe the characteristics of recently introduced premixed putty-type bioceramics with clinical cases.





**AW-11**

**Sponsored by VDW GmbH**

## **How to Integrate the Use of Different Instruments to Treat Every Root Canal Anatomy**

**Gianluca Plotino**

Professor of Endodontics in the School of Dentistry at the Catholic University of Rome, Italy

The lecturer will do a theoretical part on root canal preparation with VDW R-pilot, Reciproc blue and Rotate and irrigation with high-power sonic activation and then will perform a practical demonstration on a resin tooth using these instruments to show how to use the files. The participants will follow this demonstration that will be projected on screen and then they will practice on resin blocks, resin teeth or extracted teeth, as previously shown by the lecturer. The lecturer will also give a practical demonstration how to retreat the filled canals with Reciproc blue and Reciproc Mwire and then the participants will perform a retreatment of the previously filled canals. Participants are strongly encouraged to bring disinfected natural teeth with opened access cavity and canals negotiated with a size 10 stainless-steel hand file and their own loupes (if they have) to obtain a more realistic overview on the use of the different instruments.



**AW-12**

**Sponsored by 聯揚牙科器材有限公司**

## **Filling the Root Canals - A Hands-On Course**

**Alex Chan**

Honorary Clinical Associate Professor, Faculty of Dentistry, the University of Hong Kong

In modern endodontic therapy, emphasis is placed far more on shaping and cleaning the root canal system than on filling it. This does not mean that root canal obturation is not important. The purpose of obturating a root canal is two-fold:(1) to prevent micro-organisms from re-entering the root canal system from both apical and coronal directions, and (2) to isolate any micro-organisms that may remain within the root canal system. This hands-on course will give an overview on the methods and principles of different obturation techniques including the newest 'bioceramic sealer-hydraulic condensation technique'. This information will help you to select the right system for your requirements, which provide you with an ideal aid for your intricate endodontic work. At the end of the course, participants should be familiar with the optimal obturation of root canal systems with different filling techniques.



**AW-13**

**Sponsored by Coltene Holding AG**

## **EDM: Revolutionizing Modern Endodontics, A Customized Hands-On Workshop**

**Harpreet Singh**

Dean and Principal, Professor & Head Endodontics, of BJS Dental College,  
Hospital and Research Institute, Ludhiana, India

The sophistication for performing predictably successful root canal therapy has occurred through an interactive dynamics of advanced materials available, newer effective techniques and change in related biologic understanding and perspectives. With increase in number of cases reporting for endodontic therapy, dental professionals must deal with more complicated cases such as those with very fine and curved canals. Electrical discharge machine files (EDM) have revolutionized Endodontics by their extraordinary properties of flexibility and fracture resistance, which have begun a new era in Endodontics. This has reduced the number of files required for cleaning and shaping without having to compromise preservation of the root canal anatomy. This customized hands-on workshop shall focus on effective shaping and cleaning of highly curved canals with subsequent obturation and shall teach predictably successful endodontic techniques for management of highly curved canals that can be immediately implemented into clinical practice.



**AW-14**

**Sponsored by Carl Zeiss Co., Ltd.**

## **The View of Vital Pulp Therapy under The Microscope/ Pre-Endodontic Restoration of Proximal-Decayed Teeth-How Should We Do under Microscope?**

**Cheng-Han Yan, Hao-Ting Wang**

Endodontist of Academy of Endodontology, Taiwan

The sophistication for performing predictably successful root canal therapy has occurred through an interactive dynamics of advanced materials available, newer effective techniques and change in related biologic understanding and perspectives. With increase in number of cases reporting for endodontic therapy, dental professionals must deal with more complicated cases such as those with very fine and curved canals. Electrical discharge machine files (EDM) have revolutionized Endodontics by their extraordinary properties of flexibility and fracture resistance, which have begun a new era in Endodontics. This has reduced the number of files required for cleaning and shaping without having to compromise preservation of the root canal anatomy. This customized hands-on workshop shall focus on effective shaping and cleaning of highly curved canals with subsequent obturation and shall teach predictably successful endodontic techniques for management of highly curved canals that can be immediately implemented into clinical practice.

This course is designed to provide dental professionals with the knowledge and skills necessary to effectively restore teeth prior to endodontic treatment.

The course will focus on the assessment of structurally compromised teeth under microscope, including the identification of potential problems and the development of treatment plans to address them.

Participants will learn about various restorative materials, techniques that can be used to improve the prognosis of endodontic treatment and how to improve the treatment outcome through the microscope.





**AW-15**

Sponsored by 聯揚牙科器材有限公司

## Double Rotary Technique with 3S Technique (Single Stroke & Swipe)

**Bai-Hung Huang**

Director, Diplomate, Taiwan Implant Academy of Minimally Invasive -Dentistry (TIAMID), Taiwan

1. The introduction of 3S technique
2. The introduction of double rotary technique
3. The demonstration of double rotary technique with 3S technique





AW-16

Sponsored by Coltene Holding AG

## Unlearn to Learn

Shekhar Bhatia

The primary goals of endodontic therapy continue to be the mechanical enlargement and shaping of the complex endodontic root canal systems and to aid in its disinfection. This lecture and workshops will focus on about understanding about new generation Nickel Titanium files, their properties, configuration, geometry and different motions advantages and its clinical applications. Participants will have hands on experience learning chemo-mechanical preparation using new file system, learning scientific based disinfection protocol and the three-dimensional obturation of the root canal system.



AW-17

Sponsored by Carl Zeiss Co., Ltd.

## A Case Series of Microscopic Apical Surgery with Dynamic Navigation System/ Ending, with Finesse/Microscopical Suturing Technique (Hands On)

Chun-Pei Lin, Shih-Shiun Shyu

Endodontist of Academy of Endodontology, Taiwan

Surgical intervention of root canal treatment is the last option to preserve a root canal treated tooth with persisted apical periodontitis. Microscopic apical surgery is a modern technique, which performing apical surgery under microscope and using the special-designed ultrasonic instruments.

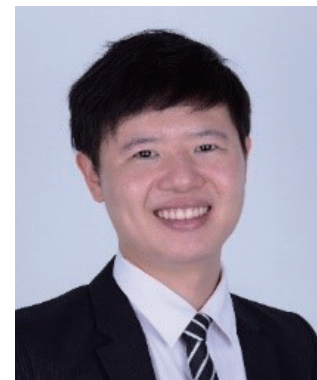
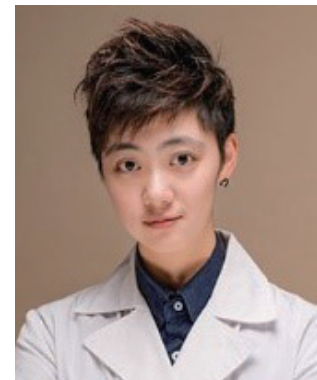
Guided endodontics, including static guide and dynamic navigation, is one of the latest topics in endodontics. Dynamic navigation system was initially developed for implantology and introduced to endodontics in recent years. Dynamic navigation system can integrate surgical instrumentation and CBCT images and give the clinicians a real-time guide. These features could help in reducing the risk of unintentional iatrogenic damage to nearby anatomic structures and perform minimally invasive surgery.

This case series will focus on how to use the dynamic navigation system for microscopic apical surgery and share the clinical experience of using dynamic navigation system. In summary, the case series aims to provide the practitioners another way for performing microscopic apical surgery.

Suturing is a crucial step in surgeries. Without proper suturing over the surgical sites, treatment outcomes can be compromised, even in microsurgeries.

This hands-on workshop is designed to provide participants with practical skills in achieving fine, precise wound closure. Participants will learn about the principles of micro-suturing, including the different types of needles and sutures used, as well as the proper instruments and techniques for handling and manipulating under operating microscopes.

By the end of the workshop, participants will have acquired the basic skills of micro-suturing and gained confidence in ending future surgeries with finesse.



**AW-18**

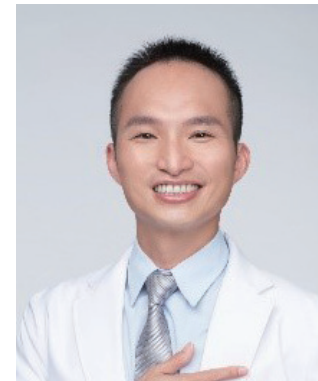
**Sponsored by DEXIS TW**

## **Implementing 3D Imaging in Clinical Decision in Endodontics**

**Tien-Hao Chang**

Head of Endodontics and Head of Micro Endodontics Center, Department of Dentistry, China Medical University Hsinchu Hospital, Taiwan

Proper diagnosis is the key to successful endodontic treatment. Dental radiography is an important diagnostic tool for dentists to find hidden information. It has become a trend in using 3D imaging to interpret dental anatomy and its surrounding areas. CBCT allows for visualization of anatomy in three dimensions whereas periapical or panoramic images cannot. This workshop includes lecture and hands-on session and will show you what kind of endodontic cases should take CBCT scans and how to interrogate the scans.



### **Learning Objectives:**

- Understand the importance of 3D imaging in endodontics
- Explain when and how to use 3D imaging to evaluate complex anatomy in endodontics
- Step by step to analyze CBCT scans by using 3D imaging software



## The Duet of Classic Technique and Modern Technology

**Howard Kuo-Hao Huang<sup>1</sup>, George Wen Hsin Chang<sup>2</sup>**

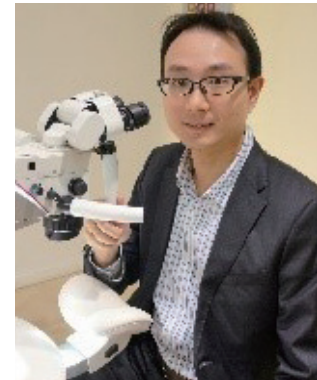
University of origin Chung Shan Medical Collage and National Taiwan University, Taiwan<sup>1</sup>

University of origin Kaohsiung Medical University and National Taiwan University, Taiwan<sup>2</sup>

The beautiful and refined radiograph of root canal treatment have been widely shared on social media, virtually raising the standards and self-expectations of dentists. However, a good root canal treatment goes beyond the mere placement of filling material at the apex. A good root canal filling stems from proper root canal shaping, which, in turn, requires a systematic and patient approach, anatomical knowledge, strategic processes, and the use of appropriate tools.

In this presentation, we will cover the following topics:

1. Analyzing the operating principles and limitations of Root ZX, known as the gold standard electronic apex locator. As well as the stability requirements when used in conjunction with a rotary motor, such as the latest model, Tri Auto ZX2+.
2. Exploring the evolution of traditional manual techniques, rotary systems, and motor operation forms. We will examine how Tri Auto ZX2+ achieves superior root canal treatment and restoration while aligning with the contemporary philosophy of minimally invasive endodontics.



**AW-20**

**Sponsored by Bassi Endo**

## **The Essence of Rotary Instrumentation Bassi Logic in General Practice**

**Alex Chan**

Honorary Clinical Associate Professor, Faculty of Dentistry, the University of Hong Kong

Endodontics as a discipline has offered patients the opportunity to maintain their natural teeth. As the population expands and ages, the demand for endodontic therapy can be expected to increase as more patients seek dental treatment options to keep their teeth for a lifetime. 'ENDO' can be one of the most rewarding, predictable and profitable treatment a general dentist (GP) can do if done right. New materials, techniques and instruments are entering the marketplace to assist dentists in providing patients with more predictable and reliable endodontic treatment. In addition, these new systems make the delivery of endodontic treatment more efficient. This hands-on course will introduce the new advances in heat-treated nickel titanium (Controlled Memory) instruments (Bassi Logic™) and will guide you how to complete a root canal preparation with fewer instruments and less complication and complete the obturation with the 'hydraulic condensation technique (bioceramic sealer)'. A short presentation is prepared to give attendees a knowledge base for NiTi rotary use. The attendees will subsequently be trained to use Bassi Logic™ System. This nickel-titanium rotary system and its associated techniques are simple, efficient, predictable and readily transferrable to a clinical setting. This hands-on course is intended for dentists who would like to take their endodontic skills to the next level on non-surgical root canal treatment. This course is suitable for both current NiTi and first-time users.





**AW-21** Sponsored by Hi-Clearance

## Endodontic Innovation: Dynamic Navigation, A Solution or Illusion?

**Yi-Ting Lin**

Attending Physician, Changhua Christian Hospital, Taiwan

Dental navigation technology is becoming increasingly mature, and its application in implant surgery is becoming more widespread. In addition to implant applications, this lecture discusses the highly market-dominant navigation system, X GUIDE, and how it can be applied in clinical endodontic treatment. Through a review of the literature and sharing of clinical cases, we trace the historical evolution, and compare the similarities and differences between free hand and surgical stent. We hope that participating dentists will have a preliminary understanding of the practical situations they encounter in clinical use, as well as the various possibilities and limitations.



**AW-22** Sponsored by J. MORITA MFG. CORP.

## New Generation Endodontic Motor, Tri Auto ZX2+®

### Motoki Okamoto

Assistant Professor of Department of Restorative Dentistry and Endodontology, Osaka University Graduate School of Dentistry, 1-8, Yamadaoka, Suita, Osaka, Japan

Today, the use of NiTi rotary files is widely accepted. It saves time on root canal preparation. NiTi files have an ability to maintain the original root canal morphology and reduce the incidence of complications. However, the initial step of canal preparation, negotiation, still often performed manually with stainless-steel files because it was thought that conventional rotary endodontic motors could not achieve it. Recently, a new endodontic motor with novel drive system was developed by J. MORITA MFG. CORP., Japan, ahead of the world. The concept of this novel drive system – named “OGP2” (Optimum Glide-Path 2) - cause less torsional fractures while enabling the completion of all procedures of preparation starting with negotiation mechanically. Additionally, OGP2 is usable with almost all NiTi files. In our lecture, we will introduce the unique characteristics of the Tri Auto ZX2+ which has introduced this system, while sharing the development and the results of researches along with case reports. You can experience this system first-hand and the next generation of root canal preparation.



**AW-23** Sponsored by Vatech TW

## Application of CBCT For Endodontic Diagnosis and Case Study

**Chi-Jr Hung**

Attending Physician of Eternal Dental Clinic, Taiwan

In this era, patients will demand better quality of treatment. With CBCT, it provides the anatomy of root canal that can help dentists improve the quality and success of endodontic treatment when we approach endodontics complex cases. We can use the newest CBCT technology with root canal special software to improve our work efficiency such as getting a high-resolution imaging (Voxel Size 50 $\mu$ m) and measure root canal length and degree of curvature. This presentation will share CBCT literature with a variety of clinical cases and some tips on endodontic treatment. Let participants to experience CBCT with special software in Endodontics.



DE-01

## The Ideal Instrument for Root Canal Preparation

**Gianluca Plotino**

Professor of Endodontics in the School of Dentistry at the Catholic University of Rome, Italy

Endodontic specialists usually treat complex cases, which need advanced equipment, materials and techniques. The use of three-dimensional diagnostic tools (CBCT), microscope, ultrasonics and all the technical advancements available today increases the outcome of the most difficult cases. This lecture aims to present an explicative case series representative of several complex clinical situations solved using the correct approach and to describe techniques and clinical tips to simplify and make the treatment of such cases more predictable. A specific emphasis will be given to the crucial phase of these complex cases: the establishment and maintenance of glide path and apical patency and the root canals shaping phase, especially in complex anatomies. This phase is often the most delicate of the treatment, it is time-consuming and requires skills and clinical experience for its correct management. Different solutions will be illustrated how to predictably, safely and effectively shape the most difficult and curved root canals, using the ideal instrument for each clinical situation and describing in detail the scientific background of the characteristics proper of an ideal instrument for root canal shaping.





DE-02

## Endo Vs Implants - Relax Don't Extract!

**Omar Ikram**

Specialist Endo Crows Nest – Private Specialist Endodontic practice Sydney, Australia

Retaining teeth is what we hope to do as an Endodontist. Implants are the best replacement available for teeth that can't be saved. But when should we decide to retain a tooth and when should we decide to replace it? This is a debate that has gone on for decades. This lecture will touch on the literature regarding this and discuss many cases related scenarios where the tooth was either root treated or recommended for replacement- it will also importantly discuss patient centred factors why these recommendations were made.



DE-03

## Management of Separated Instruments in Endodontic Practice

**Alex Chan**

Honorary Clinical Associate Professor, Faculty of Dentistry, the University of Hong Kong

Successful endodontic treatment depends on a sequence of procedures which include shaping, cleaning and obturation of the root canal system. Procedural errors such as ledging, zip-ping, canal perforation and transportation can occur during root canal instrumentation. However, the separation (or “fracture”) of endodontic instrument is another problematic situation and the reported frequency rate for separated instruments during root canal procedure varies from 0.7% to 6% of cases.

When a file separates during root canal treatment, there are several treatment options available to the clinician. The definitive management should be based on a thorough knowledge of the success rates of each treatment option balanced against the potential risks of removal or file retention.

This presentation will discuss the causes, prevention and management of separated endodontic instruments in root canal treatment.





DC-01

## 面對藥物相關顎骨壞死—牙髓病科醫師 如何趨吉避凶與正確診斷

李正喆

台大醫院口腔顎面外科主治醫師，台灣大學牙醫學系部定專任副教授  
台灣大學臨床牙醫學研究所暨口腔生物科學研究所合聘副教授，中華民國口腔顎面外科部定專科醫師

現代社會已逐漸進入老年化社會，老年人口占比逐年增加，骨質疏鬆症已成為常見的文明疾病。此外癌症的發生率亦節節高升，平均每 3-4 人就有一人可能罹癌，甚至產生骨轉移的情形。由於可以有效抑制破骨細胞的活性，抗骨吸收藥物目前是骨質疏鬆症或癌症產生骨轉移的治療首選，近年來使用量大幅增加。但由於骨頭的新陳代謝受到藥物影響，造骨細胞功能亦會降低，一旦顎骨產生傷口，可能會產生癒合不良，甚至顎骨壞死的現象，這些疾病被稱作藥物相關顎骨壞死，也成為許多牙科醫師與病患的夢魘。

植牙、拔牙手術是產生顎骨傷口的重要途徑，因此是造成藥物相關顎骨壞死的最主要原因。其次原因是牙齒的長期發炎，包括牙周病及牙髓感染引起的根尖牙周炎，甚至不當之牙髓感染疾病治療，亦是造成藥物相關顎骨壞死的常見原因。顎骨壞死的臨床症狀包括顎骨暴露、齒動搖、牙齦發炎紅腫、膿腫瘻管形成；X 光影像則可見到齒槽骨吸收破壞、腐骨形成、甚至齒周圍或根尖放射線透射性病變。這些症狀有時與牙髓感染引起的根尖牙周炎非常類似，因此如何做好正確的區別診斷，進而制定正確的治療計畫，常是牙髓病科醫師每日臨床需要面對的困難挑戰。為了避免顎骨壞死及醫療糾紛的產生，趨吉避凶，了解抗骨吸收藥物可能產生顎骨壞死的影響是非常的重要。本演講將回顧藥物相關顎骨壞死的相關文獻、本土資料庫之分析、介紹藥物相關顎骨壞死的風險、定義、發生率、病生理機轉、風險因子、臨床症狀、如何與牙髓感染疾病區別診斷、轉介時機、預防策略、臨床治療方法及預後，做一完整介紹，並分享講者十七年來治療 1200 多位顎骨壞死患者之本土經驗。



DC-02

## Odontogenic Sinusitis: ENT Perspective

林志峰

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Odontogenic sinusitis (ODS) is a condition characterized by bacterial infection in the maxillary sinus, either limited to the maxillary sinus or extending to other paranasal sinuses. It occurs as a result of nearby dental infections or complications arising from dental procedures. ODS comprises a significant proportion, ranging from 25% to 40%, of all cases of chronic maxillary sinusitis. It predominantly affects one side of the face and accounts for 45% to 75% of cases where the maxillary sinus appears opaque on computed tomography (CT) scans. Despite its prevalence, ODS has not received adequate attention in the literature on sinusitis, and recent guidelines and position statements on acute or chronic rhinosinusitis do not provide formal discussions on diagnosing ODS. Establishing a diagnosis for ODS can be challenging as it often requires evaluation from both otolaryngologists and dental professionals.



When patients initially present to otolaryngologists, their symptoms may resemble those of non-odontogenic rhinosinusitis, and the possibility of an odontogenic source may be overlooked. Conversely, when patients first seek dental care for maxillary dental issues, sinusitis may be disregarded. However, certain clinical and microbiological characteristics can help predict an odontogenic origin for sinusitis, facilitating suspicion of ODS and subsequent referrals to otolaryngologists or dental professionals for confirmation. Additionally, diagnosing ODS is complicated by the fact that optimal dental testing and imaging to confirm specific dental pathologies contributing to ODS may not always be conducted, potentially resulting in false-negative evaluations. Furthermore, there is a lack of established diagnostic methods to confirm sinusitis in ODS, despite its distinction from other forms of rhinosinusitis.

The diagnosis of ODS needs the involvement of both otolaryngologists, who confirm the presence of sinusitis, and dental specialists, who confirm the existence of odontogenic pathology in the maxillary region. It is crucial for both dental specialists and otolaryngologists to consider the possibility of ODS based on specific clinical features and promptly refer patients to the appropriate healthcare professionals for confirmation of the condition.



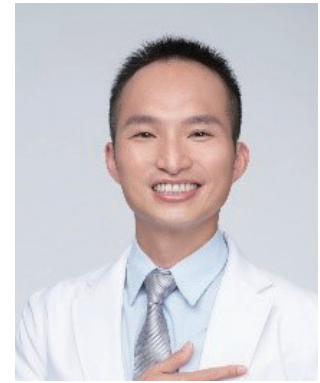
DC-03

## Maxillary Sinusitis of Endodontic or Dental Origin

張添皓

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不知你有沒有這個經驗，耳鼻喉科醫師請有鼻竇炎的病人來找你治療牙齒呢？或者是你的病人一直都有膿鼻涕，當你幫他把那顆牙髓壞死的上顎大白齒根管治療後，他的膿鼻涕就改善了呢？或是拔牙後、根管治療過程中，而有一些鼻竇炎的症狀出現呢？本次演講，我是以一位牙髓病專科醫師的角度簡單分享，什麼是牙髓病原性鼻竇炎、齒源性鼻竇炎 ODS？以目前的文獻佐證，分享常見的病因、診斷、影像表現、目前文獻中與 ENT 的共識與處置。



DC-04

## I Fill Good — 根管充填新浪潮，感覺真的很好？

郭育華

陽明交通大學牙醫學士，成功大學醫學院附設醫院牙髓病科兼任主治醫師  
成功大學醫學院口腔醫學研究所指導醫師，台北欣揚、薇美、陽安牙醫診所牙髓病科主治醫師  
台南瑞比、貝安牙醫診所牙髓病科主治醫師

3.3.1 完美充填，只要拍起來亮亮的就是完美？根管充填重要性在於提供良好的封閉性 ( Seal )，維持根管內近乎無菌的環境，是成功根管治療最後一里路。長久以來大家從技術、工具、材料各方面探討，如何能達到理想的根管充填；隨著科學的進步，新一代的根管充填材料們如雨後春筍般出現，仿單上近乎完美的生物相容性、封閉性、操作性令人深深著迷，感覺好像真的很好？面對林林總總的新產品我們需要思考從何去分析，中立面對它的善與惡，進而放心擁抱未來。



O-00001

## Assessing the Biocompatibility of 3D Printed PLA-based Filament Mixtures for Jaw Reconstruction

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**Objective:** This research aims to explore the biocompatibility of filaments composed of different proportions of  $\beta$ -tricalcium phosphate ( $\beta$ -TCP), hydroxyapatite (HA), and polylactic acid (PLA) for the reconstruction of the jaw bone.

**Materials and Methods:** Biomaterials composed of  $\beta$ -TCP, HA, and PLA with different proportions were tested. The study was divided into five groups: Only cells (human embryonic palatal mesenchymal cells, HEPM), only PLA, HA/PLA,  $\beta$ -TCP/PLA, and HA/ $\beta$ -TCP/PLA. PLA particles mixed with TCP and HA were fabricated as 1.75mm filaments and put in 3D printing (FDM) at 200 °C to produce scaffolds sized 9×2.5 mm (R×H). The scaffolds were tested with Fourier-transform infrared spectroscopy (FTIR), scanning electron microscope (SEM), and cell viability test.

**Results and Discussion:** 1. FTIR detection revealed distinctive bands typical of PLA, HA, and  $\beta$ -TCP in the composite filament; 2. All groups showed an optical density >0.8 in the cytotoxicity test, indicating non-significant toxicity; 3. All groups had higher ALP phosphating reactions than the positive control. The  $\beta$ -TCP/PLA group showed double the observation point of other groups on day 14 and a higher phosphating reaction during early osteogenesis.

**Conclusion:** Although synthetic filaments combined with  $\beta$ -TCP showed remarkable cellular compatibility and potential for mineralization, further in vitro and in vivo studies are necessary.

**Fundings:** National Science and Technology Council (MOST 110-2314-B-418 -003 -MY2)

**Keywords:** biocompatibility, filament, 3D printing, polylactic acid



O-00002

## Synergistic Effect of Platelet Rich Fibrin and Mineral Trioxide Aggregate in Direct Pulp Capping

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**Objective:** The aim of the present study was radiographic estimation of reparative dentin formation after direct pulp capping (DPC) with calcium hydroxide (CH), mineral trioxide aggregate (MTA) and a combination of platelet rich fibrin (PRF) and mineral trioxide aggregate.

**Materials and Methods:** The study design was a parallel-group clinical trial. 30 systemically healthy patients, requiring DPC were recruited, and randomly divided three groups: CH (control, n=10), mineral trioxide aggregate (MTA, n=10), platelet-rich fibrin plus mineral trioxide aggregate (PRF+MTA, n=10). Pre-operative intraoral digital radiographs of the affected teeth were taken to identify the radiographic density of dentin at the site of pulpal exposure at three points: most mesial, middle and most distal points of the exposure area. Mean of readings of these 3 points was calculated and compared with six months follow up radiographs at the same points. Pre and postoperative mean radiographic density values were then compared to assess the formation of reparative dentin after DPC.

**Results and Discussion:** According to ANOVA, difference in mean density values among the various groups was found to be significant [(p=0.001). On bi-group comparison (using post Tukey HSD), increase in grey value difference between CH & PRF+MTA was highly significant (p=0.001), between MTA & PRF+MTA significant (p=0.022) and between CH & MTA not significant (p=0.347). The PRF+MTA group showed the highest increase in mean density values.

**Conclusion:** PRF and MTA when used in combination have better radiographic outcomes than MTA alone when used as pulp capping agents.

**Keywords:** MTA, PRF, direct pulp capping

O-00003

## Biphasic Hyaluronic Acid Gel with Different Cross-Linking Degree in Dentin-Pulp Tissue Regeneration

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**Objective:** Injectable biphasic hyaluronic acid gels (biHAGs) have shown promise as scaffolds for dentin-pulp regeneration. This study aimed to investigate the properties of biHAGs with varying degrees of cross-linking in dentin-pulp regeneration.

**Materials and Methods:** 2% crosslinked hyaluronic acids (cHAs) were synthesized at different BDDE/HA (wt%) ratios: 11% (H), 8.25% (M), and 5.5% (L). These 2% cHA were then mixed with 2% non-crosslinked HA (ncHA) at a ratio of 4:1 to prepare biHAGs. The physical and chemical properties, in vitro and in vivo biocompatibility and degradation behaviors, and pulp tissue regeneration ability using a de novo root implantation animal study, were evaluated to assess the potential of biHAGs in dentin-pulp regeneration.

**Results and Discussion:** The degree of modification (MoD) of cHA was 14.87%(H), 8.42%(M), and 5.29%(L), indicating reducing the BDDE/HA ratio led to a decrease in cross-linking degree of cHA. As the cross-linking degree decreased, the injectability and biodegradability of biHAGs improved. All biHAGs exhibited good biocompatibility regardless of the cross-linking degrees. In the de novo root implantation study, H-biHAG and M-biHAG showed little fibrous tissue and vessels formation with no inflammation in root canal space. Some dentin-like structures were observed in a few samples. L-biHAG demonstrated the formation of pulp-like tissue, characterized by well-structured connective tissue and blood vessels without inflammation. Odontoblast-like cell lining was found between the newly-formed tissue and dentinal walls, although no dentin-like tissue formation was noted. Combining the characteristics of biHAGs with different cross-linking degrees may provide further potential in dentin-pulp regeneration.

**Fundings:** Ministry of Science and Technology, Taiwan (MOST 111-2314-B-002-115)

**Keywords:** cross-linking, de novo study, dentin-pulp regeneration, hyaluronic acid, injectable

O-00004

## Glycation of the Dental Pulp

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**Objective:** Type 2 diabetes (T2D) is a chronic systemic disease and is characterized by hyperglycemia. Hyperglycaemia has been shown to induce systemic low-grade inflammation damage to organs and tissues through different pathways including glycation. The aims of the study were to examine the histological appearance and to investigate the glycation products in the clinically normal dental pulp of mature permanent teeth from non-type 2 diabetes and type 2 diabetes participants using Immunohistochemistry.

**Materials and Methods:** Permanent molar teeth with complete root development, which were clinically diagnosed as normal and uninflamed, were collected from type 2 diabetic participants and non-diabetic participants, cut, prepared, sectioned, fixed, and decalcified for different histological stains and Immunohistochemistry. Slides were evaluated using light microscopy.

**Results and Discussion:** The results showed that there were histological differences in the pulp associated with type 2 diabetics compared with non-diabetics. There was increased fibrous connective tissue in dense strands, fewer blood vessels and the tissue was less cellular within the type 2 diabetic samples. Immunohistochemistry showed increasing glycation processes in type 2 diabetic samples.

**Conclusion:** T2D leads to significant changes in dental pulp morphology and increased glycation products. These changes from normal dental pulp may influence the healing response in T2D and may require modifying the treatment plan for them.

**Fundings:** New Zealand Ministry of Health, Oral Health Research Fund. New Zealand Dental Research Foundation

**Keywords:** dental pulp, glycation, hyperglycemia, collagen



O-00006

## Effect of Artificial Aging on Microhardness of Restorative Materials

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**Objective:** Secondary-carries is the primary causes of failure in restorations and have frequently been associated with the type of restorative material utilized. Science and technology now encourage restorative-material modification. The aim of this study was to evaluate the hardness of Glass ionomer-cement (GIC), Glass hybrid ionomer-cement (GHIC) and bioactive-composite (BC) after aging in the artificial saliva pH 6.8 and 4.5 for 24 hours and 14 days.

**Materials and Methods:** Three groups of 120 restored-dentin specimens were created using GIC, GHIC, and BC. Each group was divided four subgroups and immersed in artificial saliva (pH 6.8 and 4.5) for 24 hours and 14 days. The Vickers microhardness test was used to determine the specimen's hardness. Using a three-way analysis of variance followed by a Tukey post-hoc test, the values were analyzed.

**Results and Discussion:** The group aged BC submerged in pH-6.8 saliva had the hardest surface ( $98,94 \pm 13.78$ ), whereas the group aged GHIC immersed in pH-4.5 saliva had the lowest ( $19.41 \pm 1.04$ ). GIC, GHIC, and BC exhibited significant differences ( $p < 0.05$ ). The microhardness of restorations is influenced by the type of material and the pH, but not by the aging condition. After aging, saliva with a neutral pH increased BC hardness, but saliva with a low pH reduced due to bioactive component release. In patients with a high caries risk and minimal salivary acidity, BC may be considered as a restorative material. Due to its low hardness, the use of GHIC for posterior teeth should be evaluated with caution.

**Fundings:** This research was funded by Faculty of Dentistry, Universitas Gadjah Mada

**Keywords:** microhardness, restorative materials, pH saliva, material aging

O-00007

## Comparison of Chitosan with Different Molecular Weights as Possible Antibiofilm Materials Against *Enterococcus faecalis* Biofilm

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**Objective:** Chitosan is a biopolymer with various molecular weights that has promising exploitable materials in endodontic treatment due to its antibacterial activity against Gram-positive bacteria such as *Enterococcus faecalis*. The antibiofilm effect of chitosan nanoparticles (CNPs) with different molecular weights (low molecular weight; LMW and high molecular weight; HMW) on 2-week-old *Enterococcus faecalis* biofilm was investigated in this study.

**Materials and Methods:** Two types of chitosan, LMW and HMW, were prepared to form CNPs using modified ionic gelation methods. The 2-week-old *Enterococcus faecalis* biofilm formed on the hydroxyapatite plate (HA) surface was exposed to 30% LMW and 30% HMW CNPs for 30 seconds. The colony formation (CFU) assay and adenosine triphosphate (ATP) assay were performed to determine bacterial viability in biofilm. The *Enterococcus faecalis* biofilm morphology on the surface of hydroxyapatite plates was observed using a scanning electron microscope (SEM).

**Results and Discussion:** The viable numbers (CFU/mL) and bacterial viability (relative fluorescence units; RFU) of *Enterococcus faecalis* were reduced in all chitosan-treated groups compared with the untreated group (negative control). The 30% HMW CNPs group showed a significantly lower number of viable bacteria than the 30% LMW CNPs and negative control. The SEM observation also showed less biofilm density on the surface of the HA plates from the 30% HMW CNPs group compared with 30% LMW CNPs. Conclusion: These results suggest that the HMW CNPs have a better capability as possible antibiofilm materials than the LMW CNPs on the reduction of viable bacteria in the *Enterococcus faecalis* biofilm.

**Acknowledgement:** The authors gratefully acknowledge all members of the Department of Periodontology and Endodontology, Tokushima University Graduate School of Biomedical Sciences for their support

**Keywords:** chitosan, low molecular weight, high molecular weight, *Enterococcus faecalis*, biofilm

O-10001

## Management of Dilacerated Maxillary Incisors with an Interdisciplinary Approach – A Challenge with a Twist

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**Introduction:** Dilaceration is a dental anomaly characterized by an abrupt deviation in the long axis of the tooth. It can be in the crown, between the crown and the root, or, most frequently, in the tooth root. A dilacerated tooth can lose its eruptive pathway, becoming ectopic and sometimes even unerupted, adversely affecting the patient's orofacial, nutritional and psychosocial well-being. This case series describes the management of dilacerated maxillary anteriors fraught with unique challenges.

**Case Presentation:** The patients reported to the department with chief complaints of pain, swelling, gingival inflammation and bleeding, and unerupted maxillary incisors. Clinical and radiographic (Orthopantomogram and Cone Beam Computed Tomography scan) examination revealed severe dilaceration in crowns and roots of the maxillary incisors with associated open apices, periradicular radiolucency, and abnormal position of the impacted tooth in the bone. The treatment modalities adopted varied according to the clinical condition. They ranged from single-step apexification procedure and nonsurgical endodontic treatment to forced eruption using a surgical-orthodontic approach accompanied by combined nonsurgical and surgical endodontic therapy. Endodontic considerations involved the split rubber dam technique, modified access openings, use of pathfinder and Ni-Ti files, irrigation and placement of intra-canal medicament, and obturation with thermoplasticized gutta-percha technique.

**Discussion:** The follow-up period was from 1 to 5 years. Clinical and radiographic examination revealed orthodontic and periodontic stability with no apparent root resorption, no gingival recession, same clinical crown height as the adjacent central incisor, healed gingival inflammation and healing periradicular pathology, thus restoring function, esthetics, and confidence of the patient.

**Keywords:** dilaceration, maxillary incisors, open apices, periradicular radiolucency, split rubber dam, thermoplasticized obturation technique

O-10002

## Favorable 3-Year Outcome of Internally Repaired Mandibular Second Molar with Impaction Related Root Resorption

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**Introduction:** This case report describes a successful case of internal repair with Biodentine and CollaTape barrier for a mandibular second molar (37) with severe pressure-induced root resorption related to an impacted third molar.

**Case Presentation:** A 22-year-old asian female presented for pain and swelling on her lower left posterior region. Intraoral periapical radiography (IOAP) and Cone-beam computed tomographic (CBCT) imaging revealed severe pressure-induced root resorption of tooth 37 caused by an impacted third molar 38. She has undergone endodontic emergency therapy on tooth 37 due to spontaneous pain a year ago without completing full root canal treatment. After root canal debridement of tooth 37, the root resorption was internally repaired with Biodentine next to a CollaTape barrier. Tooth 37 remained asymptomatic and functional at 2-year follow-up.

**Discussion:** In this case report, non-surgical root canal therapy combined with internal root resorption repair with Biodentine successfully deferred dental implant placement for teeth with severe external root resorption caused by an impacted third molar.

**Keywords:** pressure-induced external root resorption, internal repair of root resorption, biodentine, CollaTape absorbable collagen, treatment outcome

O-10003

## Intentional Replantation Combined with Platelet-Rich Plasma: Implication of a Novel Technique in Periapical Surgery

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**Introduction:** Platelet-Rich Plasma (PRP) has demonstrated success in promoting tissue healing and regeneration in various dental procedures such as oral and maxillofacial surgery and implantology. However, its potential use in endodontic therapy remains elusive. In the subsequent case reports, PRP associated with intentional replantation (IR) were applied to remove and repair two large periapical lesions with prominent bony defect. Through the evaluation of clinical outcomes, we aim to explore whether IR combined with PRP can become a valuable tool in endodontic surgery.

**Case Presentation:** Two cases of apical periodontitis with prominent bony defects underwent surgical intervention since the prognosis of conventional root canal treatment was unfair. IR was applied due to the awkward lesion location. Further, PRP was also used as an adjunctive therapy to promote tissue and bone regeneration. The post-operative follow-up showed promising outcomes, elucidating the therapeutic potential of IR combined with PRP in the treatment of large periapical lesions with extensive bone destruction.

**Discussion:** The observed pattern of bony destruction in these cases implied that traditional periapical surgery followed by guided tissue regeneration with bone graft and bio-membrane may possess limited prognosis. The data presented here highlight the use of IR associated with PRP as an alternative scenario for teeth that were previously planned for extraction. In the presentation, the rational and detailed operative procedures for applying this novel technique in periapical surgery will be provided. More information concerning this procedure, such as underlying mechanisms for tissue regeneration as well as long-term prognosis deserves further investigation.

**Keywords:** platelet-rich-plasma, intentional replantation, novel technique



O-10004

## Surgical Removal of an Infected Cemento-osseous Dysplasia Using a Dynamic Navigation System: A Case Report

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**Introduction:** Fibro-osseous lesions (FOLs) are characterized by the replacement of normal bone with a fibrous tissue containing varying amounts of mineralized substance which demonstrate bony or cementum-like appearance. Cemento-osseous dysplasia (COD) is defined as a FOL with tooth structure involvement. Dynamic navigation system (DNS), which links a spatial positioning technology and CBCT images using an optical tracking system controlled by a special computerized interface can provide a real-time navigation tool for clinician.

**Case Presentation:** A 60-year-old female patient was referred to our hospital for treatment of a swelling with persistent abscess discharge, locating at the apical area of lower left 1st molar (#36) buccal gingival. Panoramic radiograph demonstrated a mixed radiolucent and radiopaque lesion, measuring 1.0 x 0.8 cm in size at apical and mid-root level of #36. GP tracing suggested this tooth to be the infection source. Under the impression of COD associated with #36 apical abscess, endodontic treatment of this tooth followed by surgical removal of COD was proposed. Further, DNS was also applied in the operation due to the concern of disease character and lesion location. However, the patient received operation twice because the outcome of first surgery was unfair.

**Discussion:** In conclusion, an infected COD was removed successfully via surgical intervention combined with DNS technology. In this presentation, the indications as well as the detailed operative procedures in applying DNS in periapical surgery will be reported. Furthermore, possible factors accounting for the first operation failure will also be discussed.

**Keywords:** cemento-osseous dysplasia, dynamic navigation system, periapical surgery

O-10005

## Computer-aided Rapid Prototyping Model with Digital Technology for Tooth Autotransplantation

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**Introduction:** Tooth autotransplantation is an alternative treatment option for the patient with untreatable tooth that need to be extracted. By utilizing computer-aided rapid prototyping (CARP) models of donor tooth and surgical planning software, clinicians can prepare the recipient site with minimal damage.

**Case Presentation:** This paper presents the case of a 40-year-old female patient underwent tooth autotransplantation to replace her vertically root-fractured tooth 36 with tooth 38. Under local anesthesia, tooth 36 was extracted after reflecting mucoperiosteal flap, and the recipient socket was reshaped using the CARP model with preoperative virtual planning. Subsequently, tooth 38 was extracted and immediately transplanted the recipient socket within a few minutes. The transplant tooth was stabilized with a suture after removing occlusal interferences. Two weeks later, after the removal of suture, grade I mobility of the transplant tooth was noted. Root canal treatment (RCT) was then initiated using Ca(OH)<sub>2</sub> as intra-canal dressing. The transplanted tooth exhibited normal mobility upon completion of RCT. During the 12-month follow-up period, the transplant tooth remained asymptomatic and functional, with normal surrounding bony density observed in radiography.

**Discussion:** The key factors for successful autotransplantation treatment involve reducing the extra-oral time of the donor tooth and performing accurate osteotomy to minimize surgical trauma to the recipient socket. This case report highlights the use of the CARP model and virtual planning to enable less invasive bone preparation in a short surgical time.

**Keywords:** computer-aided rapid prototyping model, tooth autotransplantation, virtual planning

O-10006

## Composite Resin Jacket Crown with Fiber Post on Discolored Maxillary First Incisor

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**Introduction:** A root canal treated tooth with limited amount of extracoronary hard tissue require additional retention in the form of post. Fiber post is the preferred type because it has a modulus of elasticity similar to dentin.

**Case Presentation:** This paper reports a discolored non vital first maxillary incisor that has been root canal treated followed by metal post installation. A 29-year-old female came to the Dental Conservation Clinic RSGM UGM complaining the discoloration of upper right anterior tooth post root canal treatment 7 years ago. Radiographic examination showed there was a metal post in the root canal, and radioluscent area under the composite resin filling. Metal post was removed and prefabricated fiber post was placed. In this case we choose fiber post because it has a similar elasticity modulus with the dentin that will result in better adaptation. An intra coronal bleaching was performed followed by indirect restoration using composite resin jacket crown since bleaching only will not result in satisfaction improvement to overcome the discoloration happened.

**Discussion:** Composite resin jacket crown with prefabricated fiber post followed by intra coronal bleaching was suitable to treat the discoloration of maxillary right first incisor post root canal treatment.

**Keywords:** jacket crown, fiber post, discolored incisor



O-10007

## Evaluation of Ion Diffusion of Calcium Hydroxide–loaded Poly (lactic-co-glycolic acid) in External Root Resorption Models

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**Objective:** To evaluate ion diffusion of calcium hydroxide–loaded poly(lactic-co-glycolic acid) through dentinal tubules in root external resorption models.

**Materials and Methods:** 30 single-rooted permanent mandibular premolars were collected and sectioned below the cemento-enamel junction to obtain 10 mm root specimens. The canals were enlarged to a size of 55/06. External root surface cavities were prepared to obtain 1.0 mm deep and 1.8 mm in diameter. Root specimens were randomly divided into 3 groups regarding to the intracanal materials: poly(lactic-co-glycolic acid), calcium hydroxide–loaded poly(lactic-co-glycolic acid), and conventional calcium hydroxide. The amount of calcium ion diffusion through dentinal tubules in external root resorption tooth model was measured at day 7, 30, and 60 by using an inductively coupled plasma mass spectrometry (ICP-MS). The data was analysed with Pearson chi-square with Mann–Whitney test ( $p < 0.05$ ).

**Results and Discussion:** The diffusion of calcium ions in calcium hydroxide–loaded poly(lactic-co-glycolic acid) was significantly higher than the others in all time points ( $p < 0.05$ ). The ion diffusion in day 30 was highest ( $p < 0.05$ ). Therefore, calcium hydroxide–loaded poly (lactic-co-glycolic acid) could be utilized as an intracanal medicament in the external inflammatory root resorption cases for 30 days.

**Conclusion:** This study suggested that calcium hydroxide–loaded poly(lactic-co-glycolic acid) was most effective in ion diffusion from the root canal to the surrounding media in root external resorption models.

**Keywords:** calcium hydroxide–loaded poly(lactic-co-glycolic acid), calcium hydroxide, root canal medicaments, external root resorption

O-10008

## Mechanical Properties of EdgeTaper Platinum Instruments

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**Objective:** To compare the cyclic fatigue resistance and torsional resistance of EdgeTaper Platinum (ETP; Albuquerque, NM, US) to ProTaper Gold (PTG; Dentsply Sirona, Ballaigues, Switzerland) at simulated body temperature.

**Materials and Methods:** ETP and PTG systems with #25 tip size were used (n=15). Cyclic fatigue test was performed in a stainless steel artificial canal until fracture occurred. The time to fracture was recorded. For the torsional resistance testing, the apical 5 mm of the file was firmly secured with acrylic resin, and the assembly was fixed over torque gage device. A uniform torsional stress was applied with continuous rotation motion at 40 rpm until fracture occurred. The torque at failure was recorded. Both experiments were conducted at  $37\pm 1$  °C. Statistical analysis was performed using independent student's t-test at 5% significance level.

**Results and Discussion:** The ETP and PTG had comparable time to fracture (p=0.19). The torsional resistance of ETP was statistically lower than PTG (p=0.03).

**Conclusion:** The ETP and PTG systems showed comparable cyclic fatigue resistance, whilst the PTG system exhibited superior torsional fatigue resistance.

**Acknowledgement:** The authors deny any conflicts of interest related to this study

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**Keywords:** cyclic fatigue, edgetaper platinum, protaper gold, torsional resistance

O-10009

## The Necessity of Supplement Anesthesia Can Predict by Machine Learning Model

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**Objective:** The goal of this work was to create machine learning (ML) models that could forecast the need for further anesthesia.

**Materials and Methods:** According to inclusion and exclusion criteria, this study included 128 individuals with endodontic discomfort. All patients underwent a clinical evaluation and endodontic diagnostic investigation. Investigation and clinical examination results were entered a prepared data sheet. Github software version ydata-profiling vv4.1.2, configuration config.json, was used to examine all examination and investigation features' explanatory data for ML models.

**Results and Discussion:** The results showed that for ML models, 11 of the 28 independent features—such as pulp stone or calcification of the pulp space, pain duration, age, percussion, palpation, response persistent after EPT, dental history, curved root canal, pain persistent after a cold test, and pain severity during a cold test—were important. In logistic regression, F1 for the train set was 0.793, while for the test sets, it was 0.878. Regression using a logistic model had an accuracy of 0.81. KNN F1 for train was 0.781, while for test it was 0.829. The ML model's KNN F1 accuracy was 72.86.

**Conclusion:** The trained machine learning models can predict if further anesthetic will be required during endodontic treatment based on the specific feature.

**Keywords:** machine learning, supplement anesthesia, feature importance, test model, train model.

O-10010

## Effect of Bleaching Protocols and Antioxidants on Composite Shear Bond Strength to Extra-coronal Bleached Enamel

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**Objective:** Extra-coronal bleaching can adversely affect the bond strength of composite resin restoration; therefore, this study aimed to investigate the effect of different bleaching protocols and the use of antioxidants on the shear bond strength of composite resin restorations to enamel following extra-coronal bleaching.

**Materials and Methods:** This study used 30 premolars, randomly divided four groups of five samples each. Group 1, no bleaching and no antioxidant application. Group 2, after bleaching, the restoration with composite resin was immediately performed. Group 3 was the same as Group 2, but the composite restoration was performed two weeks later. Group 4, after bleaching, teeth were applied with 10% sodium ascorbate and restored with composite. Group 5 was the same as Group 4, but bleached teeth were applied with 0.2% chitosan nanoparticles. Thermocycling was carried out, and the shear bond strength was tested with a universal testing machine. The data were analyzed using one-way ANOVA and Tukey's test.

**Results and Discussion:** The application of chitosan nanoparticles to bleached enamel and then restored it with composite resulted in greater shear bond strength than the group that immediately performed composite restoration following bleaching ( $p < 0.05$ ), whereas other groups produced the same results as chitosan nanoparticles ( $p > 0.05$ ). Chitosan nanoparticles produced the same shear bond strength of composite restorations to enamel after extra-coronal bleaching treatment as the other groups, except for the group in which composite restoration was performed immediately after bleaching. It is because chitosan has antioxidant capability and remineralization action by preventing enamel demineralization.

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**Funding:** Universitas Gadjah Mada, Faculty of Dentistry Grant number 3276/UN1/FKG/Set.KG1/ LT/2022

**Keywords:** antioxidant, chitosan nanoparticle, shear bond strength, extra-coronal bleaching

O-10011

## 35% Sodium Ascorbate with 0.4 % Surfactant Increased Shear Bond Strength of Composite Resin

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**Objective:** The aim of this study was to determine the effect of surfactant concentration in 35% Sodium Ascorbate (SA) on the contact angle and shear bond strength of composite resin after bleaching using 35% Hydrogen Peroxyde (HP).

**Materials and Methods:** The research has received approval from the ethics committee. 35% SA without surfactant, 35% SA with 0.4% surfactant, and 35% SA with 0.5% surfactant were dropped on to a glass slide, photographed after 5 minutes, and the contact angle analyzed using image J software. For the shear bond strength study using 40 premolars were cut 4 mm on coronal. 35% HP was applied to the dentinal surface of coronal for 5 days. After 5 days samples were divided for 4 groups: no SA 35% (I), applied by SA 35% without surfactant (II), SA 35% with 0.4% surfactant (III), and SA 35% with 0.5% surfactant (IV). All groups received composite resin restoration and then immersed in artificial saliva for 7 days. The shear bond strength test was done using Universal Testing Machine.

**Results and Discussion:** The 35% SA with 0.4% surfactant showed the smallest contact angle. The beached teeth were applied by 35% SA with 0.4% surfactant showed the highest shear bond strength of composite resin. The addition of 0.4% surfactants in 35% sodium ascorbate could made deeper penetration of sodium ascorbate into dentin so it can bind free radicals better. When the free radicals are lost, the polymerization of composite resin will be perfect so that composite resin adhesion increases.

**Funding:** Faculty of Dentistry Gadjah Mada University

**Keywords:** bleaching, sodium ascorbate, surfactant, contact angle, shear bond strength, composite resin

O-10012

## Thread Geometry Design and Flexibility of NiTi Rotary Protaper Files

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**Objective:** One important stage of root canal treatment is root canal instrumentation. File design is an important role in root canal instrumentation. Each design determines how the file works on the root canal to be instrumented. The purpose of this study was to determine the effect of geometric design of the number of threads and flexibility between universal protaper files (Dentsply, Switzerland) and protaper gold (Dentsply, Switzerland) on root canal shape and cyclic fatigue.

**Materials and Methods:** The three-dimensional tooth model was constructed from a micro-computed tomography dental scan and a simulated canal. A total of two of the NiTi rotary instruments were employed to investigate the influence of cutting geometry. A workflow was developed using the mechanical design and analysis software I-DEAS 11 and the LS-DYNA finite element package.

**Results and Discussion:** Our simulated root canal procedure enables the efficacy of rotary Ni–Ti instrument. This may aid the dentist in choosing the optimal tool set and provides data for improving tool design to analyze the cyclic performance of two different NiTi endodontic rotary files made from different alloys under bending using Finite Element Analysis (FEA).

**Funding:** This research was supported by Faculty of Dentistry Universitas Gadjah Mada – Research Foundation

**Keywords:** instrumentation, rotary files, file design, cutting geometry, finite element analysis



O-10014

## Effect of Calcium Hydroxide as Intracanal Medicament with Various Solvents on the Growth of Enterococcus

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**Objective:** This investigation aims to ascertain how calcium hydroxide as intracanal medication combined with various solvents affects *C. albicans* and *E. faecalis* resistance.

**Materials and Methods:** Three wells measuring 6 mm in diameter were produced from nine petri dishes containing Mueller–Hn agar media and suspensions of *E. faecalis* and *C. albicans*. Each well was incorporated with 0.1 ml of medication paste of calcium hydroxide mixed with solvents of chitosan nanoparticles, glycerin, and distilled water and subjected to 7 days of 37°C incubation. A caliper was used to determine the diameter of the inhibition zone that formed. Statistical analysis with one-way analysis of variance and Post hoc LSD ( $\alpha = 0.05$ ) were used to analyze data from each evaluation with a significance level of 95%.

**Results and Discussion:** One-way ANOVA revealed that the solvents had a different impact on the growth of *E. faecalis* and *C. albicans*. Post hoc LSD test revealed substantial differences in the three solvents' abilities to inhibit *E. faecalis*. Chitosan and glycerin had insignificant effects when used to treat *C. albicans*.

**Conclusions:** In summary, chitosan had the strongest antibacterial effect against *E. faecalis*. Glycerol solvents and chitosan nanoparticles exhibited the same antifungal effectiveness against *C. albicans*.

**Acknowledgement:** This work was supported by Universitas Gadjah Mada, Indonesia

**Keywords:** Intracanal medicament, *Enterococcus faecalis*, *Candida albicans*, calcium hydroxide, chitosan nanoparticles

P-00001

## New Development of Root Canal Length Measurement by SR Technology

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**Objective:** In dental education, an environment that allows for the acquisition of both accurate knowledge and skills is desired for learning practical skills. We developed an application called "SR View for Endo" that allows for the measurement of root canal length while grasping the root canal morphology in three dimensions. This study examines the operability of root canal length measurement in dental models based on differences in tooth morphology, using a new and accurate method for measuring root canal length quickly.

**Materials and Methods:** Dental models with different root canal morphologies were scanned using dental CT (3DAccuitomo; J Morita Mfg. Corp., Kyoto, Japan). The DICOM data was segmented using software (Materialise Mimics) and converted to STL. The precise 3D computer graphics model of the tooth was displayed on a Spatial Reproduction Display (SRD: Sony, ELF-SR1, Tokyo, Japan), and measurements were taken using the "SR View for Endo" application. The study was conducted with 40 dentists affiliated with Kanagawa Dental University Hospital.

**Results and Discussion:** There was no significant difference in measurement values or measurement time using "SR View for Endo" for dental models with different root canal morphologies. This suggests the usefulness of a new root canal length measurement method using three-dimensional spatial representation, even for models with multiple cusps or root canals that may be anatomically difficult.

**Keywords:** XR, SRD, 3DCG, dicom





P-00002

## Surgical Management of Maxillary Sinusitis of Endodontic Origin after Reestablishment of Sinus Floor

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**Introduction:** When the maxillary sinus floor (MSF) is violated by root canal infections, maxillary sinusitis of endodontic origin (MESO) occurs. When the surgical approach is performed for the teeth, the risk of maxillary sinus perforation increases since the root apex of the teeth is in close proximity to the MSF. This case report shows the surgical management of MSEO after reestablishing MSF by a nonsurgical approach.

**Case Presentation:** A 55-year-old woman was presented complaining of left facial pain and a diagnosis of MSEO with periapical abscess originating from the left upper first molar was made. Nonsurgical root canal treatment was performed, but there was no evidence of bony healing even after 6 months. Interestingly, the cone-beam computed tomographic (CBCT) scans demonstrated the remarkable reestablishment of the cortical MSF. In this respect, surgical intervention was performed under a dental operating microscope (DOM). Mineral trioxide aggregate was used for the root-end filling. After 2-year of the surgery, the patient's symptoms were absent. Furthermore, the CBCT images showed that complete bony healing around the roots occurred and the mucosal edema had resolved with the well-reestablished MSF.

**Discussion:** Preservation of the MSF is another important factor for the success of endodontic surgery. When MSEO occurred, the integrity of the MSF should be examined to determine the treatment options. Furthermore, clinicians should bear in mind that the maxillary posterior teeth involved with MSEO can be diagnosed and treated successfully through the proper use of CBCT and DOM.

**Funding:** This research was supported by a grant of the Korea Medical Device Development Fund grant funded by the Korea government (the Ministry of Science and ICT, the Ministry of Trade, Industry and Energy, the Ministry of Health & Welfare, Republic of Korea, the Ministry of Food and Drug Safety)  
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**Keywords:** maxillary sinusitis, sinus floor, cone-beam computed tomography, dental operating microscope, mineral trioxide aggregate

P-00003

## Navigation of Orifices of Calcified Canals via Dynamic Navigation System: A Case Report

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**Introduction:** The aim of this case presentation is to discuss the application and the pros and cons of digital dentistry in non-surgical endodontic treatments, so as to underline the benefits of guided endodontics.

**Case Presentation:** Images from cone beam computed tomography illustrate the orifices of an upper left first premolar that are difficult to locate prior to endodontic treatment. Pre-operative planning and synchronized drill-guiding devices utilizing the X-guide dynamic navigation system were used to finally locate the root canals. Then the standard endodontic treatment procedures were well performed, and no symptoms and signs occurred in follow-up periods.

**Discussion:** Digital dentistry has become a developing trend in modern dentistry. It is widely applied in the field of the implant surgery, orthodontic treatment, prosthetic fabrication, and even surgical guide for oral maxillofacial surgery. With a view of non-surgical endodontic treatment, digital dentistry can be used for navigation of orifice or patency of calcified canals, endodontic retreatment or fiber post removal. And the success rate of the procedures can be over 90% if operators are well-trained, no matter they're intern doctors or endodontic specialists.

**Conclusions:** Digital dentistry of X-guide dynamic navigation system has great potential in progress in non-surgical endodontic treatment.

**Keywords:** guided endodontics, dynamic navigation system, calcified canals, cone beam computed tomography



P-00004

## Guided Endodontic Surgery in Mandibular First Premolar to Avoid Injuring the Mental Nerve: A Case Report

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**Introduction:** Endodontic surgery will usually be considered if the teeth still have symptoms or lesions after non-surgical endodontic treatment. However, there are always challenging issues in management of posterior teeth. Due to various reasons, such as limitation of the view, the thickness of the cortical plate, and the presence of important anatomical structures, those of them increase the difficulty and unpredictable prognosis of the endodontic surgery in posterior teeth. Therefore, application of surgical guide in traditional apical surgery can significantly increase the accuracy of endodontic surgery, reduce the risk of damaging important anatomical structures, and also pursue the goal of minimally invasive treatment.

**Case Presentation:** This paper reports a 46-year-old woman with acute swelling, pain and numbness over her lower right first premolar. After evaluation and non-surgical endodontic treatment, the patient's symptoms improved significantly. But there were still numbness and discomfort after three months following up. Thus, cone beam computed tomography (CBCT) was taken and guided endodontic surgery was planned to avoid injuring the mental nerve.

**Discussion:** The image of CBCT and intraoral scan model were used to design a surgical guide, offering a more convenient, safer and minimal invasive way of endodontic surgery.

**Keywords:** apicoectomy, guided surgery, surgical endodontic treatment, guided endodontics, surgical template, digital guide

P-00005

## Nonsurgical Root Canal Treatments of Molars with Complicated Morphology Coordinated with Cone Beam Computed Tomography

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**Introduction:** Treatment of aberrant root canal system was always challenging. Due to the advancement in technology, cone beam computed tomography (CBCT) provided a lot more helpful information than 2D images. This case report presented two rare cases: mandibular second molar with 6 canals, maxillary first molar with MB3 canal. Due to the complexity morphology of these cases, CBCT was a powerful tool for the whole treatment sequences.

**Case Presentation:** Case 1: A 41-year-old male visited our hospital for acute toothache over lower left quadrant for 2 days. After emergency treatment, he was referred to our endodontic department. With the aid of CBCT and microscope, nonsurgical root canal treatment (NSRCT) of this tooth 37: 4 canals in mesial root and 6 canals in total were treated smoothly and perfectly. After 3-month follow up, fabrication of an over-cuspal prosthesis was suggested and fabricated. Case 2: A 43-year-old male was referred to our hospital due to large apical size of disto-buccal (DB) root and symptoms of maxillary sinusitis. With the aid of CBCT and microscope, NSRCT of this tooth 26: 3 canals in mesio-buccal (MB) root and 5 canals in total were treated smoothly and perfectly. Root canal obturation was done with warm gutta-percha vertical compaction technique.

**Discussion:** CBCT is a useful and powerful tool for diagnosis and treatment when dealing with root canal morphology with complexity.

**Keywords:** CBCT aided endodontics, complicated molar morphology

P-00006

## Using Absorbable Hemostatic Gelatin Sponges Regeneration Periapical Surgery Bone Defect: Cases Reports

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**Introduction:** Periapical surgical procedures, which involve opening a bone window, removing infected root tips and granulation tissue, or enucleating cysts, often result in destruction of the alveolar bone, specifically the buccal cortical plate and sponge bone. In cases where the alveolar bone defect is extensive, guided bone regeneration procedures are necessary. If the alveolar bone defect area is too large, it is necessary to perform guided bone regeneration procedure.

**Case Presentation:** To prevent collapse of the gingiva in the surgical area and hinder the formation of new bone, bone grafts and regenerative membranes will be utilized. These serial case reports were the six patients suffered from odontogenic infection or radicular cyst. After non-surgical root canal treatment, the gingiva sinus tract or swelling still existed. Periapical surgery was then performed. The infected root tip and cyst are removed during the surgery. We put about more than ten compacted absorbable hemostatic gelatin sponges (AHGS), dense filling bone defect area, then placed a layer of alloplastic bone graft on the surface. Before we sutured the flap, put a flattened gelatin, instead of used collagen membrane covered in the bone window. All these cases cone beam computed tomography (CBCT) images showed a new cortical bone plate and sponge bone growth after 6 or 12 months.

**Discussion:** We could use AGHS to replace some types of bone grafts and collagen membrane in the guided bone regeneration procedure after periapical surgery from these cases studies.

**Funding:** National Science and Technology Council Financial Support: 111-2314-B-567 -001

**Keywords:** periapical surgery, absorbable hemostatic gelatin sponges, guided bone regeneration, CBCT



P-00007

## Endodontic Retreatment of a Fused Maxillary Molars Using Cone-Beam Computed Tomography

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**Introduction:** Fusion occurs due to the union of two or more separately developing tooth buds at dentinal level, the degree of fusion depends on the stage of tooth development. Endodontic treatment of fused teeth may cause difficulties due to the localization and access to the canals.

**Case Presentation:** This 57-year-old male was referred from LDC for upper right molar endodontic retreatment due to the suspicion of missing canals of the tooth. The clinical examination showed a upper right molar with wide clinical crown, without any tenderness to percussion and palpation. Intraoral periapical film showed the molar in which 3 canals with old root canal filling material but additional canals without filling material. It looks like a fusion tooth of upper right second and third molar in crown portion. Treatment plan was discussed with patient, and he decided to undergo root canal retreatment under dental operative microscope examination. Before root canal treatment started, cone-beam computed tomography was performed and showed 6 canals of this tooth in which 3 canals without root canal filling material. After removing old root canal filling materials, 3 canals were located in the same orifice. All canals were cleaned and shaped, copious irrigated with 2.5% sodium hypochlorite, calcium hydroxide dressing was used. In the next appointment, root canals were filled with customized gutta-percha and Ceraseal sealer. Patient showed no clinical symptom and sign in the next appointment, and composite resin as a permanent restoration.

**Discussion:** Fused tooth may showed complex pulp chamber and root canal system anatomy. CBCT can provide additional information before root canal treatment and is used to be an effective tool for endodontics.

**Keywords:** fusion, cone-beam computed tomography

P-00008

## Endodontic Retreatment of a Fused Maxillary Molars Using Cone-Beam Computed Tomography

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**Objective:** Carbon nanotubes (CNTs) have been reported the ability to promote proliferation and mineralization in osteoblasts. However, the role of CNTs for cementogenesis in human cementoblasts remain unclear. The purpose of this study was to analyze the cytotoxicity and functions of multi-walled carbon nanotubes (MWCNTs) in proliferation and differentiation of human cementoblasts.

**Materials and Methods:** Human cementoblast cells (HCEM) were cultured in  $\alpha$ -MEM containing 10% FBS. HCEM cells were stimulated with MWCNT-COOH at concentrations of 0, 0.1, 1, 5, 10, and 100  $\mu\text{g/ml}$ . A proliferation assay was performed for 24-48 hours. In mineralization medium (MM), consisting of ascorbic acid, dexamethasone, and  $\beta$ -glycerophosphate, cell mineralization induced with MWCNT-COOH was analyzed by alizarin red S staining on days 7 and 14. Quantitative RT-PCR was used to examine the effects of MWCNT-COOH (10  $\mu\text{g/ml}$ ) on the mineralization-related genes expression on days 3 and 7.

**Results and Discussion:** MWCNT-COOH showed no effect on HCEM cell proliferation at 10  $\mu\text{g/ml}$ . Alizarin red S staining areas were observed in HCEM cells stimulated with MWCNT-COOH + MM (0.1 and 1  $\mu\text{g/ml}$ ) on days 7 and 14. One  $\mu\text{g/ml}$  of MWCNT-COOH + MM upregulated calcium deposition and promote mineralization. Compared with group of MM, MWCNT-COOH + MM (0.1 and 1  $\mu\text{g/ml}$ ) remarkably enhanced ALP and BSP gene expression on day 7, whereas no effect was observed in Col I gene expression during experimental period. These results indicated that MWCNTs might be used as a new nanomaterial in root canal treatment to regain cementum and bone formation.

**Keywords:** HCEM, nanomaterials, carbon nanotubes, mineralization



P-00009

## Automatic Tissue Segmentation of Dental Cone-Beam Computed Tomography Scans Using Deep Learning Algorithms

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**Objective:** The application of artificial intelligence in dentistry has been increasingly prevalent, applications such as interpreting X-ray images, analyzing intraoral photographs, and segmenting oral scan models. This article demonstrates a deep learning algorithm designed to automatically segment different oral tissues in dental cone-beam computed tomography (CBCT).

**Materials and Methods:** A total of 8 CBCT were used, focusing on adult patients with fewer dental restorations, no implants, and relatively intact dental morphology. These CBCT scans were manually annotated and classified into the following tissue categories: alveolar bone, teeth, root canals, soft tissue, and blank regions. A deep learning algorithm was employed to train the model (80% data for training, 20% data for validation).

**Results and Discussion:** The average Dice scores of 90.9% and 96.2% for alveolar bone, 92.2% for teeth and 84.2% for root canals segmentation. The results indicate that the difficulty of auto-segmenting root canals is higher than in other tissues, which may be attributed to the limited resolution of CBCT scans and the complexity of root canal morphology. If CBCT scans can be automatically converted to segmented tissue images, it would enable the conversion of labeled data to 3D mesh models. This advancement could have significant applications in digital dentistry treatments.

**Funding:** This study is sponsored by the National Science and Technology Council, Taiwan, R.O.C. under Grant no. NSTC 111-2314-B-037-019 and Kaohsiung Medical University Memorial Hospital, Taiwan, R.O.C. under Grant no. KMUH111-1R70

**Keywords:** artificial intelligence, deep learning, auto-segmentation, 3D model



P-00010

## Endodontic Treatment of a C-Shaped Maxillary First Molar with the Aid of 3D Printing Technology

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**Introduction:** The C-shaped configuration is rare in the maxillary permanent first molars. Here, we report the use of a 3-dimensional (3D) printed physical tooth model including internal root canal configuration for the endodontic treatment of a challenging tooth anomaly.

**Case Presentation:** A 32-year-old female patient was referred for root canal treatment of maxillary permanent first molar because her general dentist had difficulties to locate buccal canals. The tooth presented vertically enlarged pulp chamber and narrow root canals radiographically. Cone-beam computed tomographic (CBCT) scans revealed a C-shaped canal in the fused buccal roots. A translucent physical tooth model carrying the information on internal root canal configuration was built through a 3-step process: CBCT data acquisition by scanning, virtual modeling by image processing, and manufacturing by 3D printing. The buccal canals were prepared to a NiTi rotary file 30/.06 because the longitudinal groove on lingual surface of the fused buccal roots and the thin connecting isthmi are prone to perforation according to pre-treatment on the printed model. At the 9-month follow-up, the endodontically treated tooth showed no periapical lesion with no clinical signs and symptoms.

**Discussion:** This case report highlights the usefulness of 3D printed physical tooth model to aid clinical diagnosis and management of challenging anatomical variations.

**Keywords:** C-shape, maxillary first molar, root canal anatomy, root canal treatment, 3D printing

P-00011

## Augmented Reality in Endodontic Decompression Procedures: A Case Report

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**Introduction:** Augmented reality (AR) is a novel technology that can enhance the visualization and guidance of dental procedures. In endodontics, AR can provide a comprehensive view of the pulp chamber, root canals, and in detecting the periapical lesion. Because apical lesions are often enveloped by soft and hard tissues, this poses a significant challenge for endodontic surgery. This case report discusses the utilization of AR in endodontic decompression procedures, highlighting its advantages in addressing common challenges encountered during the operation.

**Case Presentation:** A 64-year-old female who suffered a chronic swelling of the maxillary right anterior vestibule, accompanied by dull pain for over two months. Radiographically revealed a 13 x 17 mm<sup>2</sup> radiolucency surrounding the roots of tooth 11 to 13. Clinical assessment indicated that tooth 11 was previously treated, while pulp vitality tests of teeth 12 and 13 were normal. Treatment plan was made to perform a decompression procedure, incorporating use of AR on the head-mounted display (Microsoft HoloLens 2). The AR system consisted of a markerless tracking device, which provided a guidance by overlaying digital information on real jaw. During decompression procedures, the operator can locate the precise site of the lesion and surgical incision through AR image. The outcome was favorable at 6-month follow-up, with significant reduction of the lesion size and symptom relief.

**Discussion:** By integrating AR technology the process can enhance visualization in accurately determining the incision site and locating the precise position of the lesion.

**Funding:** This work was supported by the Central Taiwan Science Park Bureau, National Science and Technology Council [grant numbers 111A04, 2022]

**Keywords:** augmented reality (AR), decompression

P-00012

## Evaluation of Root Canal Dentine Adhesion Using Newly 1-Step Irrigants

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**Objective:** The purpose of this study was to analyze the effects of irrigation for root canal dentin with the prototype alkaline EDTA solution prepared on resin cement adhesion to be used at the time of building the abutment after root canal filling.

**Materials and Methods:** T Bovine mandible anterior teeth were used for this study. Teeth were cut horizontally at the cervical region, then the root was split halves in the tooth axis direction. The method for measuring the tensile bond strength test at the root canal dentine surface is follows. Test samples were sorted three groups: the prototype EDTA solution (EDTA group); Smear Clean (SC group); and untreated (control group). Adhesive resin cement (PANAVIA V5) was applied on the sample and crimped with fingers. Afterward, a tensile bond strength test was performed by the desktop universal testing machine (EZ Test). The statistical analysis used by the One-way ANOVA and Bonferroni correction.

**Results and Discussion:** The results showed that the most highly adhesive group was the EDTA group (21. 3), followed by the control group (18. 3), then the SC group (14. 3). Compared with the SC group, the EDTA group indicated significantly higher adhesive strength. Therefore, the results of this study suggested that the dentin surface after root canal cleaning with the prototype alkaline EDTA solution increased the adhesive strength of resin cement for making an abutment

**Keywords:** 1-step Irrigants, alkaline EDTA



P-00013

## Delay Replantation of Avulsed Tooth: A Case Report

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**Introduction:** When managing traumatic dental injuries, avulsion is one of the most complicated trauma types, especially when the extra oral time is prolonged to more than one hour. The main target of treatment of avulsed tooth is to regain periodontal ligament fiber attachment and to establish a normal periodontal ligament space. Ideally, the avulsed tooth should be conserved in acceptable transport solution and be re-planted within one hour. However, this criterion is often compromised in clinical practice.

**Case Presentation:** This case report describes a 65 years old male patient with tooth 11 avulsion caused by dental trauma. The patient came with the tooth covered with tissue and was staying extra-oral for 2 hours. The tooth was replanted and stabilized by non-rigid fixation. Following non-surgical endodontic treatment was performed, and the tooth was then restored with resin. After 7 years of follow up, ankylosis of tooth 11 was observed.

**Discussion:** Although replacement resorption and ankylosis seems to be inevitable in delay replantation of avulsed tooth and will eventually lead to tooth loss. This procedure is still a good alternative option. Because these events will happen slowly with no loss of the alveolar ridge height, which is important for future prosthesis planning.

**Keywords:** avulsion, replantation, extra-oral dry time



P-00014

## Sodium Hypochlorite Accidental Extrusion through a Laterally Luxated Maxillary Incisor during Root Canal Treatment

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**Introduction:** Sodium hypochlorite (NaOCl) is widely used in root canal treatment for its antibacterial properties and ability to dissolve organic matter. However, if NaOCl goes beyond the root apex, it can cause chemical burns, tissue irritation, and damage to nerves and blood vessels. Dental trauma can increase the risk of NaOCl accidents due to the compromised root structure and vulnerability of the tooth.

**Case Presentation:** A 62-year-old female with a laterally luxated maxillary incisor underwent root canal treatment. During the treatment procedure, the patient experienced sudden pain and the canal became moist. Following local anesthesia administration, the canal was irrigated with NaOCl and subsequently filled with calcium hydroxide and Caviton for coronal sealing. Shortly after, the patient returned due to whitening mucosal swelling around the root apex area. The endodontist diagnosed the incident as a NaOCl extrusion. Emergency management involved needle aspiration and oral medication (e.g., antibiotics, analgesics, corticosteroids) to control pain, infection, and inflammation. During follow-up, a necrotic zone over the vestibular area of the tooth and palpation pain were observed. The necrotic lesion healed after 1.5 months, and subsequent completion of root canal treatment was performed. Follow-up examinations revealed gradual and satisfactory healing.

**Discussion:** Awareness of the potential complications associated with NaOCl extrusion is essential for clinicians performing root canal treatment. Prompt recognition and effective management of NaOCl extrusion are crucial to mitigate tissue damage, prevent infection, and promote successful healing.

**Keywords:** complication, endodontics, extrusion, irrigant, sodium hypochlorite, dental trauma



P-00015

## Surgical Management of Teeth with Short Clinical Crown

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**Introduction:** Violation of the biological width due to dental trauma frequently appears in clinical practice. There are three treatment options for securing the biological width and ferrule effect; crown length procedure, orthodontic extrusion, and surgical extrusion. In this case report, surgical extrusion was performed in a case of crown-root fracture and periapical lesion requiring crown extension.

**Case Presentation:** Case1 #21 (upper left central incisor) had a crown-root fracture due to trauma, and the fracture margin was 4 mm below the gingival margin at the palatal area. After careful luxation of the tooth, the tooth was extracted with a rotation motion. After 3 mm apical resection was performed, retrograde filling was performed with one-fil PT (MEDICLUS, Cheongju, Korea). The tooth was rotated 180° from the original position, and fixed with a wire splint. The wire splint was removed 4 weeks later, and no symptoms of ankylosis or root resorption appeared on the x-ray 4 months later. Case2 #24 (upper left first premolar) showed a periapical lesion on x-ray and was diagnosed as symptomatic apical periodontitis. Because the tooth had a long post that was difficult to remove by non-surgical endodontic treatment, surgical extrusion was planned. The process is the same as case 1.

**Discussion:** Surgical extrusion is preferable to orthodontic extrusion when root canal treatment is required due to apical disease. In conclusion, surgical extrusion can be a good option when crown extension is needed with severely damaged crown due to trauma and with apical disease.

**Keywords:** surgical extrusion, biologic width, dental trauma



P-00016

## Intentional Replantation of a Mandibular Molar: A Case Report with over 25 Years Follow-Up

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**Introduction:** Intentional replantation is the act of deliberate removal of a tooth from its socket, following by examination, diagnosis, endodontic manipulation and repair then returning the tooth to its original socket.

**Case Presentation:** A 40-year-old woman suffered from tooth 36 apical swelling and pain. RCT was done about three months at local dental clinic but the discomfort and pain is still persisted. Then she was referred to our hospital for further evaluation and treatment. For the conventional RCT of tooth 36 could not be improved, the intentional replantation was performed for the tooth. On July 14, 1992, tooth 36 was extracted following by careful examination, preparation, apical curettage, apicoectomy and retrograde filling with amalgam. Finally, tooth replantation and stabilization along with post operative instruction was given to patient. After the replantation treatment, tooth 36 stayed in a good state with normal function. The tooth condition is maintained well for the subsequent periodic three years follow-up. Until 2016, 24 years follow-up, the crown restoration was dislodged due to crown restoration margin decay in addition to subgingival caries. However, patient rejected the tooth extraction treatment option. In 2020, 28 years follow-up, tooth 36 was noted with retained root in site.

**Discussion:** This case report demonstrates intentional replantation can be considered an alternative treatment option for the tooth with persistent clinical symptoms that cannot be resolved by conventional root canal treatment.

**Keywords:** intentional replantation, persisted apical pain, amalgam retrograde filling

P-00017

## Endodontic Retreatment of a Maxillary First Molar with Multiple Iatrogenic Complications

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**Introduction:** Iatrogenic complications may jeopardize the prognosis of endodontic treatment and require meticulous management to obtain favorable outcome. This report aims to present endodontic retreatment of a case with complex, multiple iatrogenic complications.

**Case Presentation:** A 44-year old male patient was referred for endodontic retreatment of his maxillary left first molar presenting a buccal sinus tract. CBCT revealed defective root canal filling, radiolucency at the three apices and the furcal area, a broken instrument in the distobuccal canal, two furcal perforations near the mesiobuccal and distobuccal orifices, and an artificial canal in the palatal root causing perforation near the apex. Ledge formation in the mesiobuccal canal and untreated secondary mesiobuccal canal (MB2) were suspected. Non-surgical microscopic retreatment was conducted, involving negotiation and reinstrumentation of the three canals, repair of furcal perforations with MTA, broken instrument removal using an ultrasonic technique, and instrumentation of MB2. The palatal canal and the artificial canal, which had been excessively enlarged, were filled with MTA, and the other canals were filled with gutta-percha and sealer. Six months later, CBCT exhibited that radiolucency had been resolved around the palatal root apex, but remained at the furcal and periapical areas of buccal roots. Then, periapical microsurgery with Super-EBA retrograde filling was conducted to the buccal roots. 25 months after surgery, CBCT showed an almost complete reduction of periapical and furcal radiolucency.

**Discussion:** A case with complex, multiple iatrogenic complications was successfully treated following one-by-one management of each complication with best predictable microendodontic techniques aided with CBCT.

**Keywords:** CBCT, endodontic microsurgery, multiple iatrogenic complications, non-surgical endodontic retreatment



P-00018

## Endodontic Retreatment of a Fused Maxillary Molar and Paramolar: A Case Report

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**Introduction:** Paramolar is a supernumerary tooth located buccally or lingually to the molar, and is usually small and rudimentary. When fusion takes place between a normal tooth and a supernumerary tooth, the variation in crown morphology occurs, the root and pulp anatomy may be also altered.

**Case Presentation:** This case report discusses the endodontic retreatment of a left maxillary first molar fused with a supernumerary tooth by using cone-beam computed tomography (CBCT). The CBCT image revealed this unique tooth has two roots which were a fused C-shaped buccal root with C-shaped canal system and an independent palatal root with a single canal. A large periradicular lesion with palatal root resorption was also identified on the CBCT image. Nonsurgical endodontic retreatment was performed with dental operating microscope and the aid of ultrasonic instruments. The periradicular lesion decreased in size at 3-year and 7-year follow-up.

**Discussion:** The CBCT image is beneficial in understanding the complicated tooth morphology and pulp anatomy, which aid in diagnosis and treatment planning. With the use of modern operating microscope and ultrasonic instruments, the successful nonsurgical endodontic retreatment was carried out thereafter. Tooth preservation through endodontic retreatment has priority over tooth extraction even if there is such a complex tooth and pulp anatomy.

**Keywords:** paramolar, paramolar tubercle, cone-beam computed tomography, nonsurgical endodontic retreatment



P-00019

## Treatment of a Mesotaurodontic Maxillary First Molar with Four Canals: A Case Report

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**Introduction:** Taurodontism is a rare dental anomaly caused by failure of Hertwig's epithelial sheath diaphragm to invaginate at the proper horizontal level.

**Case Presentation:** A 68-year-old male patient with spontaneous pain over upper right first molar. The periapical film of the tooth showed that narrow and elongated body and pulp chamber with apical displacement and short roots which were corresponded to the feature of taurodontism. In addition, the CBCT revealed that there are four narrow root canals with sudden curve on apical third of the canal. Considering the complexity of the root canal system, the endodontic treatment was conducted using a microscope, Ni-Ti rotary files, and filled utilizing the hydraulic condensation technique with BioC sealer and gutta-percha.

**Discussion:** In this case, the severity of the tooth was classified as mesotaurodont according to the classification by Shifman & Chanannel (1978). However, the circumstance we met while endodontic treatment was a lot more complicated than estimated. The previous classification of taurodontism, based on periapical and bitewing films that considered the length of the tooth body and root, may have underestimated its severity. Therefore, we conclude that further case reports utilizing CBCT as a reference are needed to develop a more accurate classification system.

**Keywords:** taurodontism, root canal treatment, cone beam computed tomography



P-00020

## Outcome of Selective Root Canal Retreatment : Cases Reports

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**Introduction:** Selective root canal retreatment is the treatment concept limited to root(s) with radiographic evidence of periapical lesion, leaving other root(s) with no visible apical pathosis untouched.

**Case Presentation:** This case report presents selective root canal retreatment cases which achieved satisfying healing. In the first case, radiolucency lesion around MB root apex of #26 (previously treated, a year ago) was identified on radiographic image. Diagnosed as periapical abscess with sinus tract on #26, nonsurgical endodontic re-treatment was planned for root canal debridement. Since other roots except MB root were intact, only affected apical portion of MB canal was selectively retreated. After 3 months follow-up, swelling of gingiva subsided and the symptom has disappeared. In the second case, radiolucent lesion around MB and DB root apex #26 (previously treated, 4 year ago) was identified on radiographic image. Since palatal root canal was intact, only affected MB and DB root canals were selectively retreated. After 3 months follow-up, radiolucent lesion of MB and DB root apex has disappeared.

**Discussion:** Selective root canal treatment has clear advantages; more conservative access cavity, preserving tooth structure, and reduced likelihood for iatrogenic errors. On the other hand, 3.5% of unretreated roots show radiographic signs of new periapical lesions at follow-up. Clinicians should be aware of the risk of new periapical lesion(s) in the unretreated root(s) and follow-up the tooth.

**Keywords:** selective root canal treatment, selective endodontic treatment

P-00021

## Histological Analysis of Pulpitis and Periapical Periodontitis in Rheumatoid Arthritis Model Mice

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**Objective:** The purpose of this study was to analyze the pathology of pulpitis and periapical periodontitis in rheumatoid arthritis model mice, and to clarify the pathology after dental pulp infection in autoimmune diseases.

**Materials and Methods:** Six-week-old female SKG mice (experimental group) and BALB/c mice (control group) were exposed to establish a pulp infection model. All mice were histological analyzed after 3, 5, 7, 14, 28 days. Histological analysis was performed by HE staining, and odontoblast kinetics was analyzed by anti-Nestin antibody and apoptotic cell kinetics by TUNEL staining.

**Results and Discussion:** In the experimental group, inflammatory cell infiltration was strongly observed in the crown of the tooth after 3 and 5 day, and the inflammatory cell infiltration expanded to the root apex after 14 and 28 days. Nestin-positive cells were observed in 1/3 area of the root apex after 7 days in both groups and decreased after 14 days. TUNEL-positive cells were observed in the pulp tissue of the crown to the apical 1/3 of the root canal in both groups, and after 28 days, more TUNEL-positive cells were observed in the pulp tissue of the experimental group than in the control group.

**Conclusions:** The results of this study showed that the experimental group had a wider range of expression of TUNEL-positive cells and strong inflammatory cell infiltration than the control group, indicating that the development of pulp infection was remarkable. The persistence of these immune responses tends to sustain chronic inflammation.

**Keywords:** rheumatoid arthritis, pulpitis, periapical periodontitis, odontoblast, apoptosis

P-00022

## Histopathological Study of Pulpitis and Periapical Periodontitis in IgA Nephropathy Model Mice

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**Objective:** The purpose of this study was analysis the histological feature of pulpitis and periapical periodontitis in IgA nephropathy, an autoimmune disease of the immune complex type.

**Materials and Methods:** A pulp infection model was established using 6-week-old 20 HIGA (IgA nephropathy model) mice (experimental group) and 15 BALB / c mice (control group). All mice were histologically analyzed after 3, 5, 7, 14, 28 days. The dynamics of odontoblasts using anti-Nestin and apoptotic cells by TUNEL staining were analyzed.

**Results and Discussion:** In both groups, polymorphonuclear cells (PMNs) infiltration was localized in the exposed pulp at 7 days, spread to the middle of the pulp tissue at 14 days, and spread to periapical periodontal tissue at 28 days. Nestin-positive cells decreased from 3 days in both groups and disappeared at 28 days. Nestin-positive cells in experimental group decreased significantly compared to the control group at 5 days. TUNEL-positive cells in the pulp and apical periodontal tissue did not show a significant difference between the both groups before 14 days, but increased significantly in the experimental group compared to the control group at 28 days.

**Conclusion:** IgA nephropathy may delay the inflammatory process in the pulp and periapical periodontal tissue.

**Keywords:** IgA nephropathy, pulpitis, periapical periodontitis, odontoblast, apoptosis

P-00023

## Cholesterol Crystals and Apical Periodontitis

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**Introduction:** Apical periodontitis lesions often contain deposits of cholesterol crystals which in histopathological sections appear as narrow, elongated tissue clefts. The presence of cholesterol crystals may be an etiological problems that lead to persistent apical periodontitis after root canal treatment.

**Case Presentation:** This paper reports a maxillary lateral incisor with persistent apical periodontitis after root canal treatment. There is no obvious change of apical radiolucency after six months follow-up . Under physical examination, patient felt palpation pain over the lateral incisor apical area. After discussion with patient, apical surgery was done with canal retrograde preparation and MTA retrograde filling. Pathology report revealed inflamed granulation tissue formation and markedly cholesterol clefts accumulation. After 4 months follow-up, the radiolucency become smaller and lamina dura could be detected on periapical radiographs.

**Discussion:** In this case report, apical surgery successfully treated persistent apical periodontitis. The macrophages and giant cells that accumulate around cholesterol crystals are unable to degrade the crystalline cholesterol. Extraradicular factors such as cholesterol crystals , foreign body or other problems, can only be resolved through apical surgery.

**Keywords:** endodontic failure, cholesterol crystals, persistent apical periodontitis, apical surgery



P-00024

## Actinomycosis and Apical Periodontitis: A Case Report

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**Introduction:** Actinomycosis has increasingly been recognized as a cause of persistent or recurrent periapical disease associated with endodontic therapy. Actinomycosis is an infectious disease caused by gram-positive anaerobic pathogen, and *Actinomyces israelii* is the most common isolated species in human actinomycosis.

**Case Presentation:** This article reports a case of extra-radicular actinomycosis that caused failure of endodontic treatment, and thus made apical surgery necessary. After conventional root canal therapy of the upper right first incisor, the periapical lesion persisted, and a sinus tract was noted. The lesion was surgically removed, and actinomycosis was diagnosed according to biopsy results. After 1 month follow-up, the wound healed well and sinus tract was no longer existed.

**Discussion:** Microorganisms play an important role in the etiology and development of periradicular inflammatory responses. The actinomycotic organisms are able to establish extra-radicular, so they can perpetuate even after proper root canal treatment. Because they are inaccessible to endodontic disinfection procedures, these microorganisms may be a factor in the failure of root canal therapy. In this case report, apical surgery successfully treated persistent apical periodontitis.

**Keywords:** actinomycosis, apicoectomy, apical periodontitis

P-00025

## Respiratory Epithelium in Apical Periodontitis Lesions: One in the Maxilla and One in the Mandible

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**Introduction:** Apical cystic cavities can be partially or totally lined by an epithelium that displays the features of the ciliated pseudostratified columnar epithelium. Prevalence of respiratory epithelium-lined cysts among dental cysts has been shown to range from less than 1% to up to 10% of the cyst lesions.

**Case Presentation:** A 41-year-old female, a swollen mass was found at upper left posterior area for years. Tooth 26 was diagnosed as previously treated and acute apical abscess. CBCT revealed a large low-density lesion protrudes in the maxillary sinus and extended the floor of the nose. Due to poor response to retreatment, tooth 26 was treated with periapical surgery. Conservative microsurgical approach with curettage. The histological analysis found respiratory mucosa with inflammation and fibrosis. Another case was also a 41-year-old female, tooth 36 was previously treated and asymptomatic apical periodontitis. CBCT showed a periapical low-density area involving the distal root. Periapical microsurgery using dynamic navigation was performed. Due to intact buccal bone, piezotomy to perform the "bone window technique". The histological analysis showed focal respiratory pseudostratified epithelium.

**Discussion:** Possibilities that the cystic cavity by partially or totally lined by respiratory epithelium may be migration of cells from the maxillary sinuses or from nasal cavity, metaplasia or differentiation from totipotent cells in the jaw bones. The most frequent is the sinus origin. While is very rare to found in the mandible, the respiratory epithelium may arise by metaplasia of epithelium that originated in rests of Malassez.

**Keywords:** radicular cyst, respiratory epithelium, metaplasia, piezoelectric surgery





P-00026

## Effect of Occlusal Trauma on Healing of Periapical Pathoses after Periodontal Regeneration and Endodontic Treatment

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**Introduction:** At present, most scholars agree that Trauma From Occlusion (TFO) is a factor in the deterioration of periodontitis. In contrast, the relationship between excessive occlusal force and the pulp has not been confirmed. Some experts have found that adjusting excessive occlusal force has a beneficial effect on a symptomatic pulp. However, there are very few studies on the impact of occlusal trauma on pathologies of endodontic origin.

**Case Presentation:** This paper reports a symptomatic mandibular second premolar with apical lesion and evidence of chronic occlusal trauma. The tooth was splinted and routine non surgical root canal treatment was done. Occlusal adjustment was performed several times through out subsequent follow ups. However, despite clear signs of a healing apical lesion, a sinus tract reappeared nine months post root canal treatment. Following consultation with a periodontist, regenerative periodontal surgery was suggested and performed without disturbance of the apical tissues. Two and a half years post treatment the apical lesion healed completely.

**Discussion:** When apical periodontitis and occlusal trauma are present at the same time, bone repair over the periapical area may be affected. Reduction of tooth mobility may enhance the effect of periodontal therapy.

**Keywords:** occlusal trauma, sinus tract, apical periodontitis

P-00027

## Management of Maxillary Lateral Incisor with Type IIIa Dens Invaginatus

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**Introduction:** Oehler's type IIIa dens invaginatus is that the invagination extends through the root and communicates laterally with the periodontal ligament space through a pseudo-foramen. Due to the complex anatomy, it is often difficult to properly perform nonsurgical root canal treatment.

**Case Presentation:** This case report describes management of maxillary lateral incisor with Oehler's type IIIa dens invaginatus. With CBCT, we found that the invagination and the main root canal were separated, and there was a large undercut at the apical part of the main canal. Two access cavities were prepared for each root canal and the working length was determined with an electronic apex locator. The undercut area was shaped with bent hand files and the XP endo finisher. Copious irrigation with NaOCl and ultrasonic activation was also performed. After then, the invagination and main canal were filled with gutta-percha cone and calcium silicate-based sealer using sealer-based obturation technique. The XP endo finisher was used for optimal obturation at the undercut region. At 3 and 9 months of follow-up, the patient was asymptomatic and the apical radiolucency was resolved.

**Discussion:** Type IIIa dens invaginatus is difficult to manage because of its complex anatomy. In these cases, it is important to understand anatomic structure using CBCT for successful endodontic treatment. In this case, conventional root canal preparation is limited because it is not a common root canal morphology that narrows toward the apex. Complex anatomic variation is successfully managed with special devices, materials, and techniques.

**Keywords:** cone-beam computed tomography, dens invaginatus, root canal treatment, sealer-based obturation, XP endo finisher

P-00028

## Successful Treatment for Peri-invagination Periodontitis of Dens Invaginatus with Oehlers Type IIIa

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**Introduction:** Dens invaginatus, depending on the degree of invagination and pulp vitality, differs in endodontic treatment. This case report presents a treatment of type IIIa dens invaginatus associated with peri-invagination periodontitis in a permanent maxillary canine.

**Case Presentation:** An 15-year-old male patient was referred with a sinus tract in the labial gingiva of the maxillary canine. On periapical radiograph and cone-beam computed tomographic imaging, Oehler's type IIIa dens invaginatus was shown with peri-invagination periodontitis. Since there was a positive sign in the electric pulp test, we diagnosed the maxillary canine as peri-invagination periodontitis with vital pulp. By treating only invaginated pseudo-root canal, we expected the lesion to heal while preserving the healthy pulp. After small access cavity preparation and determining the working length with electronic apex locator, the invaginated root canal was cleaned and shaped using ultrasonic irrigation device and Ni-Ti rotary files. Canal irrigation and intracanal medication was performed several times and after 6 months, sinus tract disappeared and the lesion was shown to heal by radiograph, the invagination was obturated with mineral trioxide aggregate. At 1 year post-operative recall, the tooth was asymptomatic, and on radiographic examination, there was a significant progression of periapical healing.

**Discussion:** Proper diagnosis and understanding of the complex anatomy with CBCT can help to manage peri-invagination periodontitis. Careful cleaning, shaping, and filling of the invaginated root canal are important for healing while preserving the pulp vitality of the main root canal.

**Keywords:** dens invaginatus, mineral trioxide aggregate, pulp vitality, periapical healing



P-00029

## Treatment of Oehlers Type II Dens Invaginatus in Immature Mandibular Central Incisor: A Case Report

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**Introduction:** Dens invaginatus is an uncommon developmental anomaly, especially rare in the mandibular incisor. When devising a treatment plan, one must consider the depth of the invagination, the spatial relationship with the pulp chamber, but also the vitality of the pulp.

**Case Presentation:** An eight-year-old boy referred to our clinic has had a dull pain in the left mandibular central incisors for the past month. Both periapical radiographs and cone-beam computed tomography (CBCT) images showed that the affected tooth was a type II dens invaginatus (Oehlers classification) in the immature tooth with periapical pathology. However, the tooth still responded to the pulp vitality test. Therefore, only the pseudo canal was treated with root canal therapy and filled with bioceramic sealer using a hydraulic condensation technique, significantly improving the patient's clinical symptoms. At the nine-month follow-up, the affected tooth was asymptomatic, and periapical radiographs showed complete healing of the periapical tissue.

**Discussion:** In this case, the affected tooth was a type II dens invaginatus in an immature mandibular incisor with periapical lesions, but the tooth did not lose pulp vitality. It is necessary to consider whether the pseudo and root canal need simultaneous treatment clinically. This case demonstrates that proper diagnosis, thorough understanding of the morphology of dens invaginatus, and complete debridement while avoiding unnecessary damage to the pulp chamber can reduce treatment complexity and achieve favorable outcomes.

**Keywords:** dens invaginatus, mandibular central incisor, cone-beam computed tomography, pseudo canal, immature tooth, bioceramic sealer

P-00030

## Non-surgical Endodontic Treatment of Fused Supernumerary Tooth with Maxillary Central Incisor after Simple Gingivectomy

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**Introduction:** Fusion is an uncommon anomaly of teeth that is joined together at dentinal level presenting one single large tooth structure and having separate or joined pulp chambers and root canals. Supernumerary tooth is another developmental anomaly which usually require surgical removal due to complications it brings. We present a rare case where left maxillary incisor(#21) fused with supernumerary tooth is treated with a minimally invasive procedure.

**Case Presentation:** A 31-year old female was referred to our clinic with a chief complaint of remaining pain at the apical area of the tooth #21 upon pressing after undergoing root canal treatment for a month at a local dental clinic. There was discomfort upon palpation on the apex of tooth #21 but no sinus tract or swelling was observed. Normal morphology of the crown with normal tooth count was observed but periapical radiographs revealed atypical root canal shape. Cone-beam computed tomography(CBCT) revealed a fusion of tooth #21 with a supernumerary tooth at the palatal side of the tooth #21 with periapical radiolucency. Under local anesthesia, palatal gingivectomy was performed to expose the crown of the supernumerary tooth and access opening was carried out under dental operating microscope. The canal of the supernumerary tooth was enlarged with hand files and canal was obturated using sealer based obturation technique with a calcium silicate-based bioceramic sealer. After 5 months, radiographic examination with CBCT showed resolution of periapical radiolucency without any symptom.

**Discussion:** A fused supernumerary tooth managed by simple gingivectomy and conventional nonsurgical endodontic treatment

**Keywords:** fused tooth, supernumerary tooth, cone-beam computed tomography (CBCT), non-surgical endodontic treatment

P-00031

## Endodontic Management of Mandibular Molar with Taurodontism: A Case Report

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**Introduction:** Taurodontism can be defined as a dental morphologic variation in which the body of the tooth is enlarged, and the roots are reduced in size; results in taurodont teeth with large pulp chambers and apically positioned furcations. The underlying mechanism of taurodontism is the failure or late invagination of Hertwig's epithelial root sheath that is associated with genetic mutations. The prevalence in the general population reportedly ranges from 0.5% to 5%, with the permanent molar most often affected. Taurodontism can be classified as hypotaurodontism, mesotaurodontism, and hypertaurodontism according to the extent of the pulp chamber elongation. It is of little clinical significance unless the taurodont tooth becomes nonvital, in which case it becomes a challenging endodontic problem.

**Case Presentation:** This case report presented a mandibular molar with hypertaurodontism. A 39-year-old male patient without systemic diseases came for treatment due to pain and discomfort over his right back teeth region for 2 weeks. Clinical examination showed right mandibular second molar with negative response to pulp sensitivity test. On radiographic imaging, the molar was recognized as a taurodont tooth with an extensive periradicular radiolucent lesion. Following endodontic treatment, canals were negotiated, irrigated, debrided, and finally obturated. During the 3-month, 1-year and 5-year follow-up, the affected tooth remained asymptomatic with apical radiolucent lesion decreased in size.

**Discussion:** With available radiographic images, clinicians should be alerted to the possibility of taurodontism with its accompanying clinical difficulties and challenge during negotiation, instrumentation and obturation.

**Keywords:** radiographs, syndromes, taurodontism, endodontic therapy

P-00032

## Maxillary Second Molar with Fusion Root Showed MB2 Canal Merged with Distal Canal

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**Introduction:** The roots of the maxillary second molar are generally grouped closer together and are sometimes fused. According to some studies, about half of maxillary second molars may have only one or two roots. The number of canals can range from 1 to 5. Research reported that maxillary second molar with fused roots may present a complicated root canal system as a result of canal merging. The aim of this report is to describe the nonsurgical endodontic treatment of a maxillary second molar with fused roots and special canal anatomy.

**Case Presentation:** A 47-year-old male patient visited our department for his left upper teeth follow-up after an incomplete endodontic treatment that was performed years ago. A clinical intraoral inspection and radiography were carried out on the tooth, and pulp and apical diagnosis are previously treated with asymptomatic apical periodontitis. Four canals (three buccal and one palatal) were found with second mesial buccal canal fused with the distal buccal canal. Root canal treatment was performed under an endodontic microscope, and the anatomical variation of the tooth was confirmed through cone-beam computed tomography.

**Discussion:** Researches has shown different classification systems of maxillary second molar canal morphology. A thorough understanding of the variation of maxillary second molar is vital for dentists to minimize the risk of failing to identify and treat all root canals, which can result in unsuccessful root canal treatment.

**Keywords:** maxillary second molar, root canal treatment, cone-beam computed tomography, fused root

P-00033

## Root Canal Therapy of Mandibular First Premolars with C-shaped root canal

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**Introduction:** Tzj yi lu et al. reported that the cross section of the mandibular premolars, 18% of the teeth had C-shaped canals, and most of them had 2 or 3 root canals separated around 3-6 mm apical, and 94.4% had mesio-lingual grooves. Due to mandibular premolars have a wide range of variability on their anatomic morphology, it is difficult to be treated. This paper reports a endodontic treatment of mandibular first premolar with C-shaped root canal.

**Case Presentation:** A 17-year-old female came to our clinic, with a chief complaint of pain at her left lower premolar. Tooth #34 was diagnosed with pulp necrosis with chronic apical abscess. According to several periapical radiographs with different angles, it indicated the presence of division of the main canal more than one canal at the middle root level. Conventional nonsurgical endodontic treatment was performed. Using a dental microscope, C-shaped three root canals were identified: Buccal, Mesiolinugal, distolingual. The root canals were thoroughly irrigated with 5% sodium hypochlorite solution and cleaning using Passive ultrasonic irrigation (PUI). Root canal filling was performed using gutta-percha cones and AH Plus. The isthmus between the buccal and the distolingual canal can also be observed to be filled with a sealer. After 3 months follow up, the patient was asymptomatic, and radiographs showed progressive repair of the lesion.

**Discussion:** Identify the internal canal system using different angle radiographs, and microscopic aid, and using an auxiliary device such as PUI could help successfully complete endodontic treatment of C-shaped mandibular premolars.

**Keywords:** mandibular first premolars, C-shaped root canal configuration, three canals, dental operating microscope



P-00034

## Regenerative Endodontic Treatment in Necrotic Mature Teeth with Periapical Radiolucencies

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**Introduction:** Regenerative endodontic treatment (RET) has emerged as a viable endodontic therapy for immature permanent teeth with pulpal necrosis. RET has been found to promote continued root development, providing a unique management approach. Furthermore, RET has been effectively employed in the treatment of permanent teeth with necrotic pulp and apical periodontitis.

**Case Presentation:** The case report discusses the treatment outcomes of two patients who presented with necrotic pulps and apical periodontitis. Radiographic examination revealed that the root development of all teeth was almost complete. Complete chemomechanical debridement was performed during treatment visits, and the canals were dressed with calcium hydroxide. Periapical bleeding was induced during the final treatment visit by placing a hand file in the canals, followed by insertion of a dry cotton pellet to facilitate blood clot formation. White mineral trioxide aggregate (ProRoot MTA (Maillfer, Dentsply, Switzerland) or Biodentine (Septodont, Saint Maur des Fosses, France) was placed below the cemento-enamel junction, and a temporary filling material was used to restore the access cavity. The temporary filling and cotton pellet were replaced with a resin composite material on the following day. During follow-up visits at different time points, it was observed that the periapical lesions had healed and there were no clinical signs or symptoms. Additionally, the treated teeth responded positively to cold and electric pulp tests.

**Discussion:** It appears that regenerative endodontic treatment may be a viable option for mature teeth that exhibit periapical radiolucency.

**Keywords:** apical periodontitis, mature tooth, necrotic tooth, pulp revascularization, regenerative endodontic treatment

P-00035

## The Newborn Hard Tissue around Left Mandibular Second Premolar Apex after Apexogenesis Procedure

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**Introduction:** Apexogenesis is a common clinical procedure to encourage continued physiological development and formation of the root end. As for the newborn hard tissue around the root apex, fewer literatures have comprehensive investigation in it's composition. In this case report, Nano- Computed Tomography(nano-CT) and histological analysis were applied to have a better understanding.

**Case Presentation:** A 12 years-old female was referred for a gumboil on lingual aspect of left mandibular second premolar. After clinical and radiographic examination, periapical radiolucent lesion and immature root apex were noted. Pulp necrosis and chronic apical abscess diagnosis were made. Left mandibular second premolar MTA apexogenesis procedure was performed under patient's mother agreement, and gumboil healed after treatment. During follow-up period, periapical radiolucent lesion showed completely healed along with continued root formation in 6 months recall. However, the tooth was extracted due to orthodontic consideration. Under observation around the root apex by surgical operative microscope, we found that there was newborn hard tissue with homogeneous surface texture and similar consistency to dentin. The tooth was sent for nano-CT analysis, and the serial images in axial slices showed that the newborn hard tissue had similar radiopacity to dentin. Also, we send the tooth for histological biopsy analysis, and biopsy report showed the newborn hard tissue were cementum and bone tissue.

**Discussion:** In this case report, we found that the newborn hard tissue formation after MTA apexogenesis procedure were cementum and bone tissue. Nano-CT radiographic image showed limitation for the newborn hard tissue analysis.

**Keywords:** apexogenesis, nano-computed tomography

P-00036

## Management of Invasive Cervical Resorption in a Maxillary Central Incisor

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**Introduction:** Cervical external resorption also called as invasive cervical resorption (ICR) is a relatively uncommon, insidious and often aggressive form of external tooth resorption. In this case report, two different treatment approaches, surgical treatment and glass ionomer (GI) restoration, are presented for management of ICR.

**Case Presentation:** <Case 1> A 15-year-old female patient was referred for a localized gingival growth and pinkish appearance of maxillary right central incisor. The patient took the orthodontic treatment for impacted maxillary right canine. A periapical radiograph revealed an irregular radiolucency at the cemento-enamel junction extending coronally. With gingivectomy, the defect was restored with GI cement. At the 6-months follow-up, root canal treatment (RCT) on #21 was performed. <Case 2> A 32-year-old female patient was referred because of a cervical and periapical radiolucent lesion in the tooth #21. In the past, #21 tooth was avulsed and reimplanted. A periapical radiograph showed a radiolucent lesion in tooth #21 compatible with Heithersay class 3 ICR. RCT was performed on #21. At the 3-month follow-up, the defect was debrided and resorption was filled with resin-modified glass ionomer filling material with flap surgery.

**Discussion:** ICR is a great challenge for clinicians due to its complex root canal system and cervical defect. In both cases, nonsurgical root canal treatment with GI restoration was successfully performed through difference approaches. Therefore, in case of ICR, prudent case ion and sequential excution could lead to the successful treatment and long-term retention of the teeth.

**Keywords:** Invasive cervical resorption, cervical external resorption, glass ionomer cements

P-00037

## Combined Conventional and Regenerative Treatment in a Multirrooted Immature Mandibular Molar: A Case Report

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**Introduction:** The primary goal of endodontic therapy is to eliminate root canal infection and resolve apical periodontitis. However, a complex clinical scenario is an immature permanent molar with varying root formation in both roots. This report describes a personalized endodontic treatment for an immature molar, using regenerative endodontic procedures (REP) combined with non-surgical root canal treatment (NSRCT).

**Case presentation:** A 9-year-old boy was presented for evaluation of a mandibular right first molar with a sinus tract for two weeks. After intraoral and radiographic examination, a diagnosis of chronic apical abscess with abrupt root closure in the mesial (M) root and immature distal (D) root was made. Treatment options include NSRCT in the mesio-buccal (MB) and mesio-lingual (ML) canals and apexification or REPs in the D canal. With the aid of an operating microscope, the severe irreversible inflamed pulp tissue was removed from the D canal preserving only the apical portion. Bleeding in D canal was induced by laceration of both apical papilla and remaining apical pulp tissue. Biodentine was placed on top of the blood clot. At the 19-month recall, the patient had no symptoms and the periapical radiograph showed complete healing of the periapical lesion and D root wall thickening with apical closure.

**Discussion:** With the aid of current technology and the development of new bioactive materials, use of REPs and NSRCT in an immature molar with different pulp status in individual roots may be conservative with favorable outcome.

**Keywords:** immature permanent teeth, regenerative endodontic procedures, non-surgical root canal treatment



P-00038

## Treatment of Refractory Apical Periodontitis in an Immature Root: A Case Report

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**Introduction:** The aim of this report was to reexamine current treatment protocol for refractory apical periodontitis immature roots.

**Case Presentation:** A 15-year-old male came for a persistent sinus tract on tooth 11 buccal gingiva. History showed that tooth 11 had been avulsed and replanted without any follow-up when he was 8 years old. The sinus tract persisted after endodontic treatment by family dentist due to painful swelling of maxillary anterior gingiva recently. After clinical examinations, the diagnosis of previously treated with chronic apical abscess was made on maxillary right central and lateral incisors. Radiography revealed immature root of tooth 11, radiopaque intracanal fillings in tooth 11, 12 with material extrusion and a 10 mm x 12 mm periapical radiolucency. Symptoms improved after 3 weeks of calcium hydroxide followed by 6 weeks of triple antibiotics dressing. However, the subsequent regenerative endodontic procedure was failed. So, treatment was shifted to apexification, unfortunately, symptoms exacerbated at 15-month follow-up. Tooth 12 buccal vestibule swelling was noted and diagnosis of acute apical abscess was made. Only tooth 12 underwent apicoectomy with MTA retrograde filling and guided tissue regeneration. And dentin-like structure formation found at tooth 11 apex. A foreign body was also found during surgery and histopathological reports showed extraradicular infection. After 9-month and 3-year follow-up, tooth 11 and tooth 12 remained complete healed.

**Discussion:** This case reminds us the importance of proper management after dental trauma and refractory apical periodontitis in immature roots may require treatment approach distinct from current protocol.

**Keywords:** immature root formation, refractory apical periodontitis, regenerative endodontic procedures, apexification, apical surgery, extraradicular infection



P-00039

## Vital Pulp Therapy for Internal Resorption over Pulp Chamber of an Upper Right Central Incisor

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**Introduction:** Internal resorption in pulpal space is the destruction of intra-radicular dentine, it rarely happened and is usually noted accidentally during radiographic examination. Common etiology includes dental trauma, orthodontic treatment, and periodontal surgery. Conventional nonsurgical endodontic treatment was usually performed to control the progression of resorption.

**Case Presentation:** This paper reports an upper right central incisor with internal resorption over pulp chamber which was noted for pink color over crown during orthodontic treatment. Radiolucency lesion over pulp chamber without enamel destruction was confirmed with the aid of CBCT, and the remaining canal space was intact below orifice. Vitality test showed tooth 11 reversible pulpitis, without spontaneous pain. After orthodontic appliance removal, conventional nonsurgical endodontic treatment was performed under microscope, soft tissue in lesion was collected for pathological examination, full pulpotomy was performed, remaining pulp status was carefully evaluated and hemostasis was easily achieved. Thus, Biodentine was applied over pulp tissue, and sealing with GIC and composite resin. Orthodontic force was re-applied three months after vital pulp therapy. After 12 months follow-up, patient was symptom-free and responded normally to vitality test, and radiographic image showed intact periodontal ligament and lamina dura.

**Discussion:** In this case, vital pulp therapy was performed for an internal resorption restricted in chamber but not invade root canal space, with good treatment outcome after one-year observation, showed that vital pulp therapy is a reasonable treatment option with preservation for pulp vitality.

**Keywords:** internal resorption, vital pulp therapy

P-00040

## Different Treatments in Each Root of an Immature Maxillary First Molar: A Case Report

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**Introduction:** Immature permanent teeth can be treated with vital pulp therapy, regenerative endodontic procedures (REP) or apexification. In molar teeth, root development stage may be different in each root. Thus, we should evaluate the root development stage and pulpal status of each root and combine different treatment options in a molar sometimes.

**Case Presentation:** This paper reports a left maxillary first molar with severe caries. According to clinical examination, the tooth was free of symptoms but negative to cold test. We took periapical radiographs and cone beam computed tomography and discovered that the offending tooth presented periapical radiolucencies, and both the palatal (P) and distobuccal (DB) roots were still immature. The development of DB root was close to stage IV but P root was close to stage II of Cvek's classification. Therefore, a REP in P root, an apexification in DB root and a conventional nonsurgical root canal treatment in mesiobuccal root were performed. In fourth-month recall, the treatment outcome seems to be pleasing.

**Discussion:** In this case report, different treatment options were involved for different maturation stages of immature roots of multi-rooted molar.

**Keywords:** immature molar, regenerative endodontic procedures, apexification, nonsurgical root canal treatment



P-00041

## Regenerative Endodontic Procedure of a Mandibular Premolar: A Case Report

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**Introduction:** An immature permanent tooth is a newly erupted permanent tooth with incomplete root apex formation. Dental caries and traumatic injuries are common problems which often leads to pulp necrosis. Regenerative endodontic procedure is a manner to manage immature permanent teeth with necrotic pulp.

**Case Presentation:** A 10-year-old girl complaint a sudden discomfort of right lower jaw. Extraoral examination showed no facial swelling or asymmetry. Intraoral examination showed dens evaginatus of tooth 45 with wear facet on occlusal surface, tenderness in palpation with mobility grade I. Probing depth of tooth 45 was within normal limit. Radiographic examination revealed of blunderbuss canal with apical radiolucency. 2.5% sodium hypochlorite was used for disinfection. Calcium hydroxide dressed as inter-appointment medicant. After regenerative endodontic procedure management, mineral trioxide aggregate (MTA) was placed as a canal filling material. Then this tooth was restored with dual-cured resin modified glass ionomer and composite resin. Absence of pain during treatment and follow-up periods, root apex was developed. The periodontal health status was well. After four years follow-up, tooth 45 was extracted due to orthodontics treatment.

**Discussion:** As to the thickening structure, it cannot be told merely from periapical film what the structure it is. This case offers a chance to observe not only the radiographic image but also the clinical examination.

**Keywords:** regenerative endodontic procedure, immature permanent tooth, MTA



P-00042

## Management of Immature Permanent Molars with Different Endodontic Treatment Schemes: Two Cases Report

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**Introduction:** This report describes two cases of immature permanent molars treated with regenerative endodontic procedures (REPs) alone and REPs combined apexification, respectively. The purpose of REPs, which is to continue the root development, and apexification for apical closure of immature roots will be demonstrated.

**Case Presentation:** This 15-year-old female patient had received pulpotomy for maxillary and mandibular left second molars (tooth 27 and 37) due to pulpitis at local dental clinic, and she was referred because of the immature root development. The radiograph showed open apex of roots without apical radiolucency. After access re-entry, empty chamber without vital tissue in coronal third of canals was noted. Under dental operating microscope, vital pulp tissue was only detected in apical third of distal canal of tooth 37. According to different clinical conditions, REPs was performed in distobuccal canal and apexification in mesiobuccal canal as well as palatal canal of tooth 27; REPs for tooth 37, and both teeth were restored with composite resin. After the treatment, the patient was asymptomatic with normal function of occlusion. In the 6-, 12-, 24-, and 36-month follow-up, the patient was symptom-free. Radiographic examination showed complete root development without apical radiolucency.

**Discussion:** Purposes of endodontic treatments for immature permanent tooth included continuous root development and apical closure. Our case report showed favorable three-year follow-up outcome by adopting different treatment modalities depending on pulpal status of individual canal in multi-rooted teeth.

**Keywords:** immature permanent molar, regenerative endodontic procedures, apexification

P-00043

## Combined Root Canal Therapies in a Mandibular Second Molar

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**Introduction:** Preserving pulp tissue aids in maintaining physiological and defensive function of tooth. For multirooted teeth which necessitates endodontic treatment, combination of vital pulp therapy and non-surgical endodontic treatment can be an alternative approaches when it is indicated.

**Case Presentation:** A 16 y/o girl with intellectual disability suffered from pain over lower right second molar and visited local dental clinic for treatment. Endodontic treatment was initiated by the local dentist but she was suggested to come to our department for further treatment plan discussion due to immature root formation. After clinical examination and taking periapical film, tooth 47 distal wide canal and apical foramen were noted. As for mesial root, mature root formation was noted. Mesial and distal root both showed periapical radiolucency. Tooth 47 revealed no tenderness to pain, nor palpation pain. After pulp chamber was opened, active bleeding from distal canal orifice was noted. Examination under microscope and direct observation of distal canal pulp tissue condition, soon achieved hemostasis with sodium hypochlorite irrigation. Hence, vital pulp therapy with MTA capping was done for distal canal. Non-surgical endodontic treatment were done for mesio-buccal and mesio-lingual canal. After 10 months follow-up, tooth 47 remained symptoms free. Periapical film showed periapical lesion healing and increasing of distal root canal wall thickness.

**Discussion:** In this case report, combination of vital pulp therapy and non-surgical endodontic treatment were provided. For multirooted teeth, treatment that combines different therapies chosen according to each canal condition may be more beneficial for patients.

**Keywords:** immature root formation, vital pulp therapy, permanent mandibular molar, previously initiated therapy, apical periodontitis

P-00044

## Potential of iPSC for the Pulp Regeneration Therapy

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**Objective:** Revascularized pulpal tissues, produced by recruited stem cells from PDL and alveolar tissue, are evidently composed of bone-like, cementum-like, and fibrous tissues. Hence, pulp-dentin regeneration would require transplantation of pulpal MSCs. Induced pluripotent stem cells (iPSCs), which are capable of multilineage differentiation and pose less ethical challenges than other stem cell-based approaches, are being explored for the regeneration of pulp-dentin complex. The purpose of this study is to reprogram human dental pulp stem cells (hDPSCs) to iPSC and differentiate the reprogrammed iPSCs into endothelial and epithelial cells for cell transplantation.

**Materials and Methods:** hDPSCs cells were reprogrammed to iPSC by Epi5™ Episomal iPSC Reprogramming Kit. Reprogrammed iPSCs were characterized using RT-qPCR, western blot, and immunofluorescence staining. Embryoid bodies (EBs) were formed from iPSCs as embryo-like aggregates for differentiation into endothelial and epithelial cells. iPSC-derived endothelial and epithelial cells were characterized using RT-qPCR, western blot, and immunofluorescence staining.

**Results and Discussion:** The characterization procedures revealed that hDPSCs were successfully transformed to iPSCs, showing characteristics and gene expressions of iPSCs. The population of iPSC-derived endothelial cells produced had distinguishing features typical of endothelial cells, consistent with the expression of endothelial cell markers. Likewise, the iPSC-derived epithelial cell population showed the characteristics of epithelial cells, consistent with the expression of epithelial cell markers. Further in vivo study is needed to confirm odontogenic capability of iPSC-derived endothelial and epithelial cells.

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**Keywords:** iPSCs, pulp, regeneration

P-00045

## Mechanism of HUVEC-laden Calcium Silicate-Activated Gelatin-based Bioinks for Regulating Dental Pulp Stem Cell Differentiation

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**Objective:** Pulp regeneration is one of the most successful topics in the field of tissue regeneration despite its current limitation. The biocompatibility of endodontic-related biomaterials is critical in securing the oral microenvironment and supporting pulp tissue regeneration.

**Materials and Methods:** In this study, we fabricated 3D cell spheres using human dental pulp stem cells (hDPSCs)-laden gelatin-based bioink and human umbilical vascular endothelial cells (HUVEC) at the periphery with Si ion-infused fish gelatin methacrylate (FGelMa) bioink.

**Results and Discussion:** The results of nuclear magnetic resonance and Fourier-transform infrared spectroscopy demonstrated the successful fabrication of gelatin-based bioink. In addition, Si ions in the bioink were bonded via covalent bonds and the increased number of covalent bonds led to an increase in mechanical behaviors and decreased degradation of gelatin-based bioink. The Si-contained gelatin-based bioink was able to release Si ions, which subsequently significantly not only improved the expressions of angiogenesis-related protein but also secreted some cytokine to regulate odontogenic differentiation. Further, the results showed that the cell blocks permitted HUVEC and hDPSCs cross-talks and taken together, were able to improve odontogenic-related markers expression, such as alkaline phosphatase (ALP), dentin matrix phosphoprotein-1 (DMP-1) and osteocalcin (OC). Subsequent Alizarin Red S stain confirmed the benefits of 3D cell spheres and demonstrated that such a novel combination and modification of biomaterials can serve as a platform for future clinical applications and use in dentin regeneration.

**Funding:** MOST 111-2314-B-040-016

**Keywords:** calcium silicate, bioink, cell differentiation, regeneration

P-00046

## Calcium Phosphate Deposition in Canal Wall for Induction of Dentinogenesis

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**Objective:** The purpose of this study was to form a homogeneous layer of poor crystalized calcium phosphate (CaP) deposits on the canal wall to promote dentinogenesis in pulp regeneration.

**Materials and Methods:** The precipitation method was used to directly form CaP on the canal wall of dentin samples using 0.7 M Na<sub>2</sub>HPO<sub>4</sub>, following by 0.05 M or 0.1 M CaCl<sub>2</sub>. The effects of reaction time and CaCl<sub>2</sub> concentration on the morphology, composition, crystal structure, and behavior of covering the dentin surface of CaPs were evaluated. Additionally, root fragment samples were utilized to examine the deposition behaviors of CaPs on the canal wall.

**Results and Discussion:** Complete coverage of CaP deposition on the canal wall could be achieved with a 15-minute reaction time. SEM and TEM analysis revealed that the CaPs products consisted predominantly of amorphous or poor crystalline structures, with some CDHA present. As the reaction time and concentration of CaCl<sub>2</sub> increased, the CaPs became more crystallized. In the root fragment samples, full coverage of CaPs deposition was observed when the irrigation needle placed in the middle third of the canal.

**Conclusion:** By using 0.05 M CaCl<sub>2</sub> and placing the needle at the middle third of canal for a 15-minute reaction time, a homogeneous layer of amorphous or poor crystalized CaPs could be generated on the entire canal wall. This may have potential benefit in promoting the biomineralization of dental stem cells in pulp regeneration.

**Funding:** This study was supported by Ministry of Science and Technology, Taiwan (MOST 111-2314-B-002-115)

**Keywords:** amorphous, calcium phosphate, dentinogenesis, pulp regeneration, root canal



P-00047

## Effect of Caries on Population and Gene Expression of Dental Pulp Stem Cells: Histological Analysis

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**Objective:** Understand the distribution of stem cells in teeth with caries help to preserve stem cells and improve the success rate of regenerative therapy. The purpose of the study is to compare the sum and gene expression of inflamed pulpal tissue with those of healthy teeth.

**Materials and Methods:** The volunteers with scheduled extracted human molar were collected under informed consent. Teeth with and without caries were fixed and decalcified. The teeth were cut slides from distal to mesial side in longitudinal direction and sent for immunohistochemical stain. Distribution of CD44-positive cell expression was evaluated by TissueFAXS. Pulp space was divided pulp core, odontoblastic layer, cervical zone and coronal zone. The sum, location, and gene expression of stem cell was compared between caries group and control group. One way ANOVA test was used for statics.

**Results and Discussion:** Four carious teeth and four healthy teeth were included. The immunohistological stain of pulp tissues showed the expression of CD44 within pulp core in caries group is stronger than control group, especially in coronal zone. There was no difference of CD44 expression between the caries and control group in odontoblastic layer. The study can provide the useful information in vital pulp therapy.

**Funding:** Supported by the fund of Chi Mei medical center (CLFHR10828)

**Keywords:** dental pulp stem cell, caries

P-00048

## Minimally Invasive Endodontic Therapy of a Lateral Incisor with Type I Dens Invaginatus and C-Shaped

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**Introduction:** Dens invaginatus (dens in dente) is a common form of developmental tooth malformation especially among patients of Asian descent. Dens Invaginatus result in a variety of anatomical considerations making optimal root canal debridement less likely. With the modern advancement of CBCT and Martensitic NiTi Rotary files, these complex anatomies can now be approached with strategically placed minimal invasive access points, making cleaning and shaping much more reliable.

**Case Presentation:** This paper reports a maxillary lateral incisor with pulp necrosis caused by a previously undiagnosed Type 1 dens invaginatus. Radiolucent lesion and aberrant chamber anatomy was identified on the radiographic image. A pre-op CBCT was taken for analysis of canal anatomy. Four separate open chamber access points were chosen based on conservation of tooth structure while maximizing dentin contact by NiTi rotary files. Conventional nonsurgical endodontic treatment was performed through the planned access points and canal obturated using warm vertical technique. Patient was asymptomatic at 1 month follow-up and apical lesion showed signs of healing.

**Discussion:** In this case report, non-surgical root canal therapy was performed on a maxillary lateral incisor with type 1 dens invaginatus through multiple minimally invasive chamber access points.

**Keywords:** minimally invasive endodontic therapy, dens invaginatus

P-00049

## Root Canal Treatment of a Mandibular Second Molar with Hypercementosis: A Case Report

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**Introduction:** Hypercementosis is also called cementum dysplasia which contains the excessive formation of tissue. Endodontic cases with hypercementosis are more challenging to estimate the working length radiographically.

**Case Presentation:** This paper reports a 46 year-old female patient referred from local dental clinic presented the abscess had appeared over her mandibular second molar buccal side which lasted for six months without pain. In addition, the right mandibular third molar besides showed percussion pain and the radiolucency seems to be connected with right mandibular second molar apical lesion. Radiographically, the teeth affected by hypercementosis showed radiopaque area involving the apical region of the roots. The pulpal diagnosis of the teeth is previously treated and the periapical diagnosis is asymptomatic apical periodontitis. The working length was determined using the electronic apex locator and cone beam computed tomography (CBCT) was performed for clearer image of apical region. Root canal filled with gutta-percha and sealer after cleaning and shaping by hand files and rotary instrument. Also the patient was referred to the OS department for right mandibular third molar extraction. After 1 month of follow up, the symptoms and signs subside. The radiolucency involved the mesial root has healing tendency but not fully healed.

**Discussion:** Achieving the working length is difficult in endodontic cases with hypercementosis because of the hardship in establishing a relationship between the external anatomy of the apical third. Chronic periapical infection is considered to be one of the most common local factors that may contribute to the development of hypercementosis.

**Keywords:** hypercementosis, mandibular second molar, root canal treatment



P-00050

## Treatment of Internal Root Resorption in the Maxillary Anterior Tooth with Thermoplasticized Gutta-Percha

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**Introduction:** Internal root resorption is characterized by destruction of intraradicular dentin and dentinal tubules along the pulpal canal. Most IRR is asymptomatic, and detected incidentally by routine radiographic examinations. Nonsurgical root canal therapy is the treatment of choice to arrest the destructive process as vital pulp tissue is required for internal resorption to take place.

**Case Presentation:** The case report discusses the treatment outcomes of two patients who presented with internal root resorption in the apical area of the maxillary anterior teeth and apical periodontitis. Both patients had teeth that were negative on electric and cold pulp testing and tender to percussion, unlike other teeth in the quadrant. Preclinical radiograph showed clearly demarcated ballooning in the apical third of the root canal and periradicular radiolucency. Length determination was performed electronically using electronic apex locator (Root ZX) and confirmed by periapical radiograph. Irrigation was performed with 2% sodium hypochlorite (NaOCl) between instrumentation and calcium hydroxide was placed as temporary dressing during treatment visits. The canals were obturated with thermoplasticized gutta-percha and AH26 sealer. During follow-up visits, both patients were symptom-free, and there were no signs of mobility or pain in response to percussion, palpation, or biting. Furthermore, the periapical radiographs showed no signs of periapical pathosis.

**Discussion:** The cases presented here provide successful examples of treatment of internal root resorption in the apical area of the maxillary anterior tooth with thermoplasticized gutta-percha, both clinically and radiographically."

**Keywords:** internal root resorption, apical periodontitis, maxillary anterior tooth, thermoplasticized gutta-percha



P-00051

## Management of a Tooth with Endodontic-Periodontal Lesion, Perforation, and Pathological Resorption: A Case Report

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**Introduction:** Management of cases with endodontic-periodontal lesion is often a challenge, especially when the tooth is accompanied by perforation and root resorption. Successful treatment requires accurate diagnosis and an appropriate treatment plan for both root canal and surrounding periodontal tissues.

**Case Presentation:** A 33-year-old male suffered from a persistent gum boil of tooth 36 for a period. Clinical examination showed a 13 mm periodontal pocket between tooth 36 and 37 interproximal lingual side. There was a 9 x 6 mm<sup>2</sup> radiolucency around distal (D) root of tooth 36 and mesial (M) root apex of tooth 37 on periapical film. Additionally, two external root resorptions were observed at D root surface of tooth 36 and M root surface of tooth 37. Conventional nonsurgical endodontic re-treatment was performed of tooth 36, and a perforation was noted at MB furcation. The symptoms subsided after intracanal medication placement for 6 months with monthly replaced. After filling the canals with gutta-percha and applying Endoseal® MTA sealer (Maruchi; Wonju, Korea), the perforation was repaired using MTA. After 6 months follow-up, the pocket depth had decreased to 6mm, and radiographically showed healing of the periradicular lesion and external root resorption.

**Discussion:** The present case demonstrates that, even with the presence of an endodontic-periodontal lesion and root perforation, satisfactory results can be achieved by conventional endodontic retreatment and MTA repairing in treating a tooth with questionable prognosis.

**Keywords:** endodontic-periodontal lesion, resorption, perforation



P-00052

## Repair of Iatrogenic Root Perforation Caused by an Orthodontic Miniscrew

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**Introduction:** Orthodontic miniscrews are widely used in orthodontics to improve anchorage. But there are possibilities of potential complications damaging periodontal ligament and root surface during ion. In some cases, irreversible damage may occur, resulting in external root resorption and pulpal necrosis, which requires non-surgical/surgical endodontic intervention.

**Case Presentation:** This paper reports a case where an orthodontic miniscrew inadvertently engaged the palatal root of upper left second molar(#27). A 25-year-old male had multiple miniscrews placed 5 months ago, and the left palatal miniscrew was 'loosen and fallen out' 3 months ago. It was re-placed, but it fell out again after only one month. One month later, the patient complained of a spontaneous pain in the maxillary left molar region. Intraoral sinus tract could be detected at the site where the miniscrew was removed. On CBCT, external root resorption at the middle 1/3 of the palatal root of #27 were observed. Through clinical examinations, #27 was diagnosed as partial necrosis with chronic apical abscess. The patient's symptoms and sinus tract disappeared through non-surgical root canal treatment. The perforation site of the palatal root was repaired with RetroMTA through orthograde placement to provide better sealing effect and induction effect of cementogenesis for root repair, and the remaining canals were filled with gutta-percha. 7-months after treatment, he had no discomfort and there was no sign of recurrence.

**Discussion:** In this case report, non-surgical root canal treatment combined with MTA endodontic repair successfully treated root perforation caused by improper placement of miniscrew.

**Keywords:** orthodontic miniscrew, iatrogenic root perforation, external root resorption

P-00053

## Medication-related Osteonecrosis of Jaw Mimic Endodontic–origin Disease

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**Introduction:** Medication-related osteonecrosis of the jaw (MRONJ) may share similar symptoms with endodontic diseases, particularly during the early stages, which could lead to misdiagnosis.

**Case Presentation:** This paper reports a 65-year-old female patient with a history of breast cancer who underwent modified radical mastectomy and received zoledronic acid injections. Three years ago, she had sequestrectomy for MRONJ caused by canine extraction. Over the past 2 years, she has been receiving denosumab injections every 3 months to manage bone and liver metastases from breast cancer. During a routine dental examination, an abscess with multiple sinus tracts was observed over the buccal gingiva of maxillary right posterior teeth, without bone exposure. The sinus tracts were traced to the root apex of the maxillary right second premolar using gutta-percha. Nonsurgical root canal treatment was attempted due to the absence of pulpal response in both premolars, but the abscess and sinus tracts did not resolve. Subsequent CBCT imaging showed typical signs of osteonecrosis. Pathologic examination after sequestrectomy confirmed the diagnosed of stage III MRONJ. After a follow-up of 1 year, no remaining clinical symptoms was noted.

**Discussion:** In this case report, initial diagnosis was misled by the presence of sinus tract. With the assist of CBCT image of necrotic bone pattern, definite diagnosis and treatment plan were able to be made. The correlation between endodontic-origin disease and MRONJ was still unclear. Clinicians should always keep in mind the possibility of MRONJ when treating patients with antiresorptive medication history.

**Keywords:** bisphosphonate, denosumab, zoledronic acid, osteonecrosis of the jaw, pulp necrosis, sinus tract

P-00054

## Management of Paresthesia induced by Periapical Infections on Mental and Inferior Alveolar Nerves

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**Introduction:** The accumulation of purulent exudate of pulpal inflammation could put local pressure to the mental and inferior alveolar nerve and as a result, paresthesia could be occurred. Endodontics-related paresthesia usually subsides by endodontic treatment, extraction and/or antibiotics. This case report presents the management of paresthesia from periapical infections of mandibular teeth by nonsurgical root canal retreatment with or without pharmacologic therapy.

**Case Presentation:** In the first case, a 26-year-old woman presented with spontaneous dull pain in tooth #36 and numbness on the left side of the lower lip and chin that began a few days ago. Tooth #36 showed positive to percussion and slight buccal gingival swelling, and the tooth had previous endodontic treatment. The diagnosis for tooth #36 was periapical abscess-induced paresthesia and an endodontic retreatment was performed. In the second case, a 44-year-old woman presented with a 1.5-month history of numbness on the left side of the lower lip and chin. Tooth #37 was positive to percussion and biting, and negative to the vital test. The diagnosis for tooth #37 was pulp necrosis and chronic apical periodontitis-induced paresthesia. Subsequently, nonsurgical root canal treatment with pharmacologic therapy was performed.

**Discussion & Conclusion:** The infection of the root canal system is essential for healing of the paresthesia. Nonsurgical root canal treatment could be the first option for elimination of infection. The duration and intensity of paresthesia would vary and, in some cases, pharmacologic therapy could be also used to treat and inhibit secondary infection.

**Keywords:** paresthesia, endodontic treatment, pharmacologic therapy



P-00055

## Surgical Management of Teeth with Root Resorption: Two Cases Report

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**Introduction:** Extensive root resorption is a condition involving tooth structure loss, which can lead to dental pulp infection and even tooth loss.

**Case Presentation:** The first case involves a 48-year-old male patient with external cervical root resorption in the upper left central incisor. The tooth exhibited pulpal necrosis and gingival recession. Non-surgical root canal treatment combined with surgical repair was planned due to the resorptive defect was partially exposed above the gum line. The non-surgical root canal treatment including root canal filling under hydraulic condensation with Ceraseal sealer and gutta-percha. The surgical procedure contained cavity preparation, filling of the defect with composite resin, and flap repositioning. Despite a small portion of the resin filling became exposed during follow-up, the patient reported no discomfort. The second case features a 28-year-old male patient with extensive root resorption in the upper left central incisor. The patient experienced occasional pain and swelling in the front teeth, aggravated by biting on a hard object. Clinical examination revealed percussion pain, a sinus tract, and extensive root resorption. The treatment plan consisted of root canal disinfection, medication placement, and surgical repair. Surgical intervention involved the removal of resorptive tissue, canal shaping, and filling with Biodentine. The patient reported no discomfort during follow-up, and the tooth showed improved probing depth.

**Discussion:** These cases highlight the criticality of effectively managing extensive root resorption through the utilization of suitable materials, comprehensive disinfection, prompt surgical intervention, and consistent follow-up care.

**Keywords:** root resorption, surgical repair

P-00056

## Using Endodontic Microsurgery to Treat Teeth with Persistent Apical Periodontitis

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**Introduction:** As the world population ages, saving natural teeth is the primary goal in dentistry. When facing an endodontically-treated tooth with persistent apical periodontitis, non-surgical retreatment may be the first choice. However, there were some limitations, such as iatrogenic accidents, irretrievable materials or complex root canal system, may interfere with the success of non-surgical retreatment. For these condition, endodontic microsurgery is one of the indispensable options to save the tooth.

**Case Presentation:** This paper reports three cases with persistent apical periodontitis that were previously endodontically treated, and they all had signs and symptoms. The periapical lesion sizes were all larger than 10mm in diameter, and some of them were Class 2 mobility using the Miller Classification. After detailed examinations, we explained to patients the risks and benefits associated with all treatment options. They all gave their consent to save the tooth, so we performed endodontic microsurgery with mineral trioxide aggregate retrograde fillings and one case combined with intentional replantation. Patients were examined clinically and radiographically at intervals after surgery. The follow-up showed good bone healing, and there was an absence of signs and symptoms.

**Discussion:** The clinical decision-making for teeth with apical periodontitis was related with dentists' specialty, work experience and tooth-related factors such as tooth position and size of apical lesion. In this case report, three cases are healing very well even though they are at different tooth position and their apical lesion sizes are quite large.

**Keywords:** endodontic microsurgery, persistent apical periodontitis



P-00057

## Surgical Root Canal Treatment under Target Controlled Infusion Method with Propofol: A Case Report

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**Introduction:** Target Controlled Infusion (TCI) has become more and more popular in dental practice, especially for those who are highly anxious to local anesthesia or dental procedures.

**Case Presentation:** The present report is a case of maxillary right first premolar in a 50 years old male with persistent apical lesion and sinus tract after non-surgical root canal treatment. Patient first noted appearance of a sinus tract over his buccal gingiva of maxillary right first premolar. Radiolucency lesion around the root apex showed no sign of healing 10 months after non-surgical root canal retreatment. Tracing sinus tract with gutta percha point confirmed the source of infection from the first premolar. Surgical intervention was cancelled because patient was unable to go through surgical procedure under local anesthesia. Surgical root canal treatment was then performed under target controlled infusion.

**Discussion:** This case report presents a surgical root canal treatment under target controlled infusion method. Working space was very limited due to multiple anesthesia devices. It was also extremely difficult to adjust patient or operator's posture. With the cooperation of anesthesia team, the surgical operation went successfully. Patient tolerated the procedure comfortably and better patient satisfaction achieved.

**Keywords:** target controlled infusion, surgical root canal treatment



P-00058

## Surgical Treatment of the Mandibular Molar with Cementum Tear

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**Introduction:** Cementum tear often leads to bone destruction around the root. In cases where there is a concurrent root canal infection, non-surgical root canal treatment (NSRCT) may not be sufficient to resolve the condition and surgical intervention may be necessary.

**Case Presentation:** This paper presents the case of a 34-year-old female patient who experienced a persistent buccal gingival abscess with a sinus tract after having tooth 36 endodontic retreatment by an endodontic specialist. The cone-beam computed tomography (CBCT) images revealed a 10 mm x 12 mm apical radiolucent lesion over distal root, with complete loss of the buccal cortical plate, and suspected a cementum tear at lingual surface of the distal root. Therefore, apical surgery was performed after the completion of NSRCT. The procedures involved cyst enucleation, removal of the 3-mm root apex of the distal root and the cementum tear, followed by retrograde cavity preparation and filling with mineral trioxide aggregate (MTA). Guided tissue regeneration (GTR) with bone graft and absorbable membranes was then performed to address the buccal bone dehiscence over the distal root. After a 16 months follow-up, the patient was free of symptoms and signs, and radiographic examination showed complete healed of periapical pathogen.

**Discussion:** When symptoms and signs persist after NSRCT, CBCT examination may be indication for a definite diagnosis, such as a cementum tear. If a cementum tear is suspected, a combination of surgical intervention may be required to achieve successful treatment.

**Keywords:** apical surgery, apico-marginal defect, buccal bone dehiscence, cementum tear, guided tissue regeneration

P-00059

## Challenging Diagnosis of Cemental Tear Associated with Pulp Necrotic Tooth: A Case Report

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**Introduction:** Cemental tear is characterized by the separation of the outer layers of dental root. Cemental tears are usually asymptomatic and hard to notice until the appearance of bony destruction or clinical abscess.

**Case Presentation:** This 74-year-old male had a gumboil over his tooth 41 labial side and the sinus tract was traced to tooth 41 apical radiolucent lesion. Tooth 41 had intact coronal tooth structure but negative response to EPT and cold test. There is a 8mm probing depth at labial side. The tooth 41 was diagnosed with pulp necrosis and chronic apical abscess, and the treatment plan was tooth 41 nonsurgical root canal treatment. The patient subsequently received tooth 41 root canal treatment. However, the sinus tract persisted after canal debridement. Cone-beam computed tomography was taken, and the image showed cemental tear of tooth 41 labial root surface, combined with buccal bone dehiscence. Tooth 41 apical surgery was taken for cemental tear removal. Guided tissue regeneration was also performed to treat the bone destruction of the tooth 41. One week follow up showed the absence of sinus tract, and 3 months follow up showed the healing tendency of bony destruction.

**Discussion:** Cemental tear is a rare but potentially condition that requires careful diagnosis. In cases where the tear occurs in the buccal surface of a necrotic tooth, its symptoms can mimic periapical periodontitis, apical abscess or even vertical root fracture, potentially leading to incomplete treatment plans.

**Keywords:** cemental tear, pulp necrosis, diagnosis, vertical root fracture, localized periodontal destruction, apical surgery



P-00060

## Autotransplantation of Third Molar to Replace Hopeless Periapical Osteoperiostitis Tooth: A Case Report

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**Introduction:** Apical periodontitis with periapical osteoperiostitis (PAO) near the maxillary sinus can lead to inflammation and osteolysis, potentially resulting in oroantral communication (OAC) following tooth extraction. Autotransplantation has emerged as a viable method for replacing non-restorable teeth, and 3D printing technology has found applications in this field.

**Case Presentation:** This case report presented a 23 years-old female patient who received autotransplantation of her tooth 28 to replace her unrestorable tooth 27 due to the insufficient remaining coronal structure. The cone beam computed tomography (CBCT) images revealed a 12mm x 13mm PAO lesion with associated mucosal edema of the left maxillary sinus. The hard tissue dome of the PAO lesion was found to be fragile. In order to minimize the risk of OAC after tooth extraction and provide a viable treatment option for restoring the missing tooth, we discussed and agreed upon the treatment plan of autotransplantation using the adjacent tooth 28. To reduce the extra-oral time, we utilized CBCT data and 3D printing technology to create a replica model of the donor tooth 28, which helped in preparing the recipient site accurately. On the 14th day after the surgery, we initiated endodontic treatment on the transplanted tooth and dressed the root canal with calcium hydroxide for one month before filling it. Eight months post-treatment, the patient expressed satisfaction with the outcome, and radiographic examination demonstrated evidence of periapical healing.

**Discussion:** This case demonstrates the successful use of autotransplantation to prevent OAC following maxillary molar extraction and restore the missing tooth.

**Keywords:** autotransplantation, CBCT, periapical osteoperiostitis, 3D printing, oro-antral communication

P-00061

## Management of Maxillary Sinusitis of Endodontic Origin: Two Case Reports

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**Introduction:** Maxillary sinusitis of endodontic origin (MSEO) is a common condition that sometimes poses diagnostic and treatment challenges for dental and otorhinolaryngology specialists. A thorough evaluation, including history, physical examination, imaging studies, and treatment response observation, is crucial for optimal outcomes.

**Case Presentation:** We present two cases of MSEO, highlighting the clinical presentation, workup, and management. Case 1 involves a 23-year-old female referred by her ENT doctor for persistent right maxillary sinusitis suspected to be of odontogenic origin. Despite receiving antibiotics, the patient's stuffy nose persisted. Radiographic examination revealed an incompletely treated tooth 16 with a periapical radiolucent lesion and thickening of the adjacent sinus membrane. Non-surgical endodontic treatment was proposed based on the clinical impression of MSEO. Case 2 features a 36-year-old female with a persistent buccal gingival abscess at tooth 25. The patient previously underwent tooth 25 root canal treatment for dental caries five years ago but experienced discomfort, leading to retreatment. Although symptoms improved after the retreatment, the gingival abscess and maxillary sinusitis relapsed last year. Cone-beam computed tomography (CBCT) showed a periapical lesion at tooth 25 with thickening of the adjacent sinus membrane. The patient was tentatively diagnosed with MSEO and received surgical root canal treatment for tooth 25.

**Discussion:** The diagnosis and treatment of MSEO require careful examination and planning. Optimal treatment outcomes may necessitate considering multiple modalities and multidisciplinary cooperation.

**Keywords:** maxillary sinusitis of endodontic origin (MSEO), cone-beam computed tomography (CBCT), periapical lesion



P-00062

## Multidisciplinary Treatment of Severe Recurrent Odontogenic Sinusitis: A Case Report

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**Introduction:** Odontogenic sinusitis is a diagnosis sometimes missed by otolaryngologists or dentists. Patients with this disease may suffer from persistent or recurrent sinusitis if they were misdiagnosed.

**Case Presentation:** This case report presents a paranasal sinusitis caused by upper right first molar with pulp necrosis. In the beginning, right side sinusitis with pus discharge from nose was noted. Odontogenic sinusitis was suspected after head and neck computed tomography was taken. Functional endoscopic sinus surgery (FESS) was performed by otolaryngologist, but the symptoms persisted. The patient then came to dental department for evaluation, and upper right first molar pulp necrosis with asymptomatic apical periodontitis was diagnosed. Periapical osteoperiostitis (PAO) of mesiobuccal, distobuccal, and palatal roots was identified on cone beam computed tomography (CBCT). Conventional nonsurgical endodontic treatment of upper right first molar was performed. After root canal debridement, symptoms of sinusitis relieved. However, foul smell from nose was still noted, so we referred the patient to his otolaryngologist for evaluation. FESS was performed again for sinus debridement and turbinectomy. After complete relief of symptoms, root canal filling was performed. The apical lesion size decreased and bony density increased with healing tendency was found at 9-months follow-up.

**Discussion:** This is a severe sinusitis case infecting right side maxillary sinus, nasal cavity, ethmoid sinus, and frontal sinus. In this case report, endodontic treatment combined with sinus surgery is necessary for successful treatment. Odontogenic sinusitis could only be cured when the dental infected origin is eliminated, otherwise it may persist or often recur.

**Keywords:** maxillary sinusitis of endodontic origin, maxillary sinusitis of dental origin



P-00063

## Interdisciplinary Treatment of Root Canal Treated Teeth

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**Introduction:** Forced eruption of the subgingival decay allow the gingival tissue and attachment apparatus coronal displacement to preserve the natural connective tissues and esthetic even gingival margin.

**Case Presentation:** In this presentation, we show cases with the simple designed forced eruption technique, to preserve root canal treated teeth even with a large apical radiolucent lesion. After the complete endodontic treatment, a hook cemented the root canal with zinc phosphate cement, anchor bar bonded to the adjacent teeth with composite resin. Controlled eruptive force were activated by elastic thread.

**Discussion:** Restoring the extensively damaged teeth due to dental decay requires the interdisciplinary treatment of endodontic, periodontic, orthodontic, prosthodontic to obtain the excellent esthetic and periodontal healthy result.

**Keywords:** interdisciplinary treatment, forced eruption

P-00064

## Management of Large Radicular Lesion with Decompression : A Case Report

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**Introduction:** Non-surgical root canal treatment is the priority in the treatment of large radicular lesions, but if the treatment result is not good and surgical intervention is required. The relationship between the lesion, adjacent teeth and anatomical structure should be considered, and the possibility of postoperative complications should be evaluated. Decompression may provide a conservative treatment option for large radicular lesions.

**Case Presentation:** This case reports a 37-year-old male suffered from a periradicular lesion on the mandibular right first and second molars which had been endodontically treated 10 years previously in the local dental clinic. The periapical films indicated a large periradicular lesion involved teeth 46 to 47, 39 mm x 22 mm in size. Non-surgical root canal retreatment of mandibular right second molar was combined with a decompression procedure. After 7 months follow-up, the decompression tube was removed. The healing of the periradicular tissues with intact periodontal ligament and lamina dura without clinical symptoms and signs was found at 24-month follow-up. This case will receive regular follow up.

**Discussion:** In this case report, non-surgical root canal therapy combined with decompression successfully treated large radicular lesion. Decompression enables healing of large, persistent periradicular lesion after root canal treatment.

**Keywords:** decompression, periradicular lesion, non-surgical root canal treatment



P-00065

## Effect of Butyrate on Various Inflammation-related Genes' and Proteins' Expression in Vascular Endothelial Cells

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**Objectives:** Butyric acid, as one kind of short-chain fatty acid (SCFA), was produced by pathogenic pulpal/periodontal microorganisms during metabolism of fibrous food, and may have potentially detrimental role in the pulpal/periodontal tissues. Butyric acid has been detected in gingival cervical fluid and showed significant association with the occurrence and progression of periodontitis. However, whether butyric acid induces inflammation in vascular endothelial cells, and its role in the pathogenesis of pulpal/periodontal infectious diseases is less studied.

**Materials and Methods:** Cultured EAhy.926 vascular endothelial cells were treated with different concentrations of butyrate. Cell viability was evaluated by MTT assay. The mRNA expression of various inflammation-related genes was assessed with the help of Real-Time Polymerase Chain Reaction (RT-PCR). Protein expression was studied by Immunofluorescence staining.

**Results and Discussion:** We found that butyrate inhibited the growth of endothelial cells at concentrations higher than 4 mM. Butyrate stimulated the expression of various inflammation-related genes such as IL-1, IL-1, IL-18, cyclooxygenase-2 (COX-2) of vascular endothelial cells at concentrations ranging from 2 to 8 mM. Accordingly, butyrate also induced the protein expression of IL-1, IL-1, IL-18, and COX-2 in vascular endothelial cells as revealed by immunofluorescent staining. Conclusion: These results indicate that butyrate may have adverse effects on the periodontal and pulpal/periapical tissues by inducing vascular inflammatory responses. Butyric acid generated by pathogenic microorganisms may possibly contribute to the pathogenesis of periodontitis and pulpal/periapical diseases via inducing inflammation.

**Funding:** This study is supported by grants from National Science Council (NSC) & Chang Gung Memorial Hospital, Taiwan

**Keywords:** apical periodontitis, butyrate, endothelial cells, inflammation, pathogenic microorganisms, periodontitis



P-00066

## Analysis of Lateral Canal Detection with Electronic Root Canal Length Measurement Device

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**Objectives:** The purpose of this study was to analyse the lateral canal detection of the Justy IV (YOSHIDA Co., Ltd., Japan) root canal length measuring device using human extracted teeth.

**Materials and Methods:** This study was approved by the Kanagawa Dental University Medical Research Ethics Review Committee (No. 913). Human extracted teeth were observed for the morphology of the lateral canal using micro-CT images by ScanXmate-L080 (Comscan Tec., Japan). Indicated and impedance values were measured by the Justy IV. Measurements were performed using Endo Training Model Castillo (VDW, Germany) and saline solution. A direct-reading height gauge (Mitutoyo, Japan) was used to measure the exact distance from the root apex. The analysis method was based on a comparison of the distance from the root apex hole to the lateral canal using micro-CT data and the distance at which changes in the indicative and impedance values detected by the Justy IV.

**Results and Discussion:** In this study, the position and morphology of the lateral canal of human extracted teeth were analyzed precisely on the basis of micro-CT images. No significant differences were found in the comparison of micro-CT data and the indicative and impedance values obtained from Justy IV. The results showed that precise analysis of the lateral canal detection function is possible by observing the exact morphology and position of the lateral canal with micro-CT and using the Justy IV. This may be useful for the detection of lateral canal and accurate location.

**Keywords:** lateral canal, electronic root canal length measurement device, micro-CT

P-00067

## The 4-META/MMA-TBB Resin Containing Nano Hydroxyapatite Regenerates Wounded Periodontal Tissue at the Perforation Site

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**Objectives:** We aimed to develop and evaluate new materials for the repair of perforation at pulp chamber floor (PF) using 4-methacryloxyethyl trimellitate anhydride/methyl methacrylate tri-n-butylborane [4-META/MMA-TBB; Super-bond (SB)] and nano hydroxyapatite (naHAp).

**Materials and Methods:** SB and naHAp were mixed in the mass ratio of 10% or 30% to produce naHAp/SB. Human periodontal ligament (PDL) stem cells (HPDLSCs) were cultured on resin discs of SB or naHAp/SB to analyze the effects of naHAp/SB on cell adhesion, proliferation, and cementoblastic differentiation of HPDLSCs. In addition, a PF model in rat was used for analyzing the effects of naHAp/SB on the regeneration of defected periodontal tissues, including cementum and PDL, at the site of PF.

**Results and Discussion:** HPDLSCs were spindle-shaped and adhered to all resin discs. The naHAp/SB induced the same levels of cell proliferation as SB. Both 10% and 30% naHAp/SB were more effective than SB in promoting mineralization and the expression of cementum-related factors, such as cementum attachment protein (CAP), cementum protein 1 (CEMP1), osteocalcin (OCN), and osterix (OSX) in HPDLSCs. In the PF model, 30% naHAp/SB was more effective than SB in promoting the formation of Sharpey's fiber-like structures, and cementum-like structures, showing the increased expression of cementum-related factors, such as OCN and OSX, at the site of PF. These results suggest that 30% naHAp/SB can be an ideal restorative material for root perforation because of its biocompatibility and bioactivity. This is the first report on the development of an ideal material for the repair of PF.

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**Keywords:** nano hydroxyapatite, cementum, 4-META/MMA-TBB resin, periodontal ligament, root perforation

P-00068

## Chemomechanical Properties and Biocompatibility of Various Premixed Putty-type Bioceramics

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**Objectives:** This study aimed to evaluate the chemomechanical properties and biocompatibility of recently introduced premixed putty-type bioceramic (PPB) materials.

**Materials and Methods:** Including ProRoot MTA(PMTA) as a control, BC RRM fast set putty (BCPT), Well-Root PT(WRPT), One-Fil PT (OFPT), Endocem MTA premixed (ECPM), and CeraPutty (CRPT) were compared to evaluate setting time, radiopacity, pH change, and microhardness. Biocompatibility on human dental pulp cells was compared using CCK-8 assay. Mineralization potential was evaluated using alkaline phosphatase activity, Alizarin red S staining, and quantitative real-time polymerase chain reaction for the expression of marker genes. For data analysis, one-way analysis of variance and Tukey's post hoc test was used. The significance level was set at 95%.

**Results and Discussion:** Among the PPB, BCPT presented longest setting time ( $552.43 \pm 27.23$ ,  $p < 0.05$ ) and others showed significantly shorter setting time than PMTA( $334.85 \pm 22.04$ ). WRPT( $6.20 \pm 0.54$ ) and OFPT( $5.82 \pm 0.50$ ) showed significant higher value of radiopacity ( $p < 0.05$ ) and others showed similar value compared with PMTA( $4.82 \pm 1.02$ ). All PPB showed high alkaline pH from fresh materials, and tended to increase according to time periods from 30min to 12hrs. ECPT showed the highest value of microhardness ( $81.62 \pm 5.90$ ,  $p < 0.05$ ). Whereas, WRPT( $50.52 \pm 5.24$ ) showed similar and others showed lower than PMTA( $53.47 \pm 4.27$ ,  $p < 0.05$ ). All PPB showed biocompatibility in CCK-8 assay. Except for CRPT, all PPB showed similar or better value compared with PMTA in ALP and ARS staining, and ALP and DSPP marker expression ( $p < 0.05$ ). In conclusion, the PPB showed clinically acceptable chemomechanical properties and favorable mineralization potential.

**Keywords:** premixed putty-type bioceramics, setting time, radiopacity, microhardness, biocompatibility, mineralization potential

P-00069

## Optimal Fixation and Decalcification Protocols for Dental Tissues

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**Objectives:** Due to the close proximity of diverse soft and mineralized tissues within dental structures, histological techniques have been a challenging part of dental research, such as in vivo dentin-pulp regeneration. Inappropriate sample fixation and decalcification can significantly affect study outcomes. This study aims to develop an optimal fixation and decalcification protocol for human teeth or root samples, in order to apply in future research.

**Materials and Methods:** Twelve human teeth were extracted and prepared by creating artificial cavities over the root surface only, or by creating bilateral open ends with artificial cavities over the root surface, to ensure sufficient penetration of fixative the pulpal tissue. The teeth were then fixed with 4% paraformaldehyde solution for 24~72 hours and subsequently decalcified using either 17% EDTA or Morse's solution. The weight loss and radiography of samples were recorded weekly to monitor demineralization progress. Finally, the samples were then dehydrated, embedded in paraffin wax, and stained with hematoxylin-eosin (H&E) for evaluation.

**Results and Discussion:** The preparation of artificial cavities and bilateral open ends were essential for pulp fixation. Optimal decalcification of the samples in Morse's solution could be achieved within 2 to 4 weeks, while those in 17% EDTA solution required 5 weeks or more. Samples using both decalcification protocols with H&E staining demonstrated a good overview of the histological characteristics of pulp and dentin tissues. The faster decalcification of Morse's solution is beneficial for histological processing, particularly when using H&E staining for histological evaluation.

**Funding:** This study was supported by Ministry of Science and Technology, Taiwan (MOST 111-2314-B-002-115)

**Keywords:** human teeth, histological techniques, pulp tissue fixation, decalcification, hematoxylin-eosin staining



P-00070

## Endodontic Retreatment for Teeth with Periapical Lesion Before Orthodontic Treatment: Cases Report

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**Introduction:** For patients evaluating or undergoing orthodontic treatment, teeth could have undergone endodontic therapy but still with periapical lesions. To date, there is limited literature relevant to the topic for clinicians to make an evident-based decision. However, existing literature suggests that teeth with poor root canal filling quality or existing periapical lesions may worsen after the orthodontic force is applied, resulting in enlarged periapical lesions.

**Case Presentation:** The patient had received root canal treatment on the upper right canine and lateral incisor years ago, but small apical lesions were still present. Root canal retreatment was performed on the canine prior to orthodontic treatment; however, the lateral incisor was followed up and not retreated based on patient preference. After two months of orthodontic force application, the canine's apical lesion was healing, but the lateral incisor's lesion had rapidly increased in size, resulting in tooth extraction. The other patient's lower left first molar was diagnosed as root fracture after post removal. After consulting with the orthodontist, we placed  $\text{Ca}(\text{OH})_2$  at distal canal and started the orthodontic treatment. This patient had no clinical symptoms and periapical lesion showed a similar size during orthodontic treatment.

**Discussion:** The main reason for the failure of healing is probably due to the limitation of endodontic treatment. For teeth that have received root canal treatment in the past without tendency for periapical lesion healing, it is crucial for the endodontist, orthodontist, and patient to discuss and strongly recommend the patient retreat the teeth before undergoing orthodontic treatment.

**Keywords:** periapical lesion, endodontic retreatment, orthodontic treatment

**PC1001**

## Endodontic and Orthodontic Combined Management of Surgical-replanted Impacted Mandibular Second Premolar with Curved Root

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**Introduction:** Treatment of impacted teeth with curved roots poses a major challenge in orthodontic therapy. Excessively curved roots can impede tooth eruption, sometimes necessitating further surgical and endodontic treatments intervention.

**Case Presentation:** A 16-year-old male complained of abnormal mobility in his lower left teeth. Clinical and radiographic examination revealed the presence of a retained deciduous second molar and an underlying impacted permanent second premolar with a curved root in the lower left quadrant. After extraction of the deciduous second molar, multiple attempts were made to orthodontically align the impacted tooth, but these efforts proved unsuccessful even after one year. Surgical removal of the impacted tooth was performed eventually, and the curved apical portion of the root was resected before replantation. Within two weeks, access opening of the replanted tooth was performed, followed by copious irrigation of sodium hypochlorite and calcium hydroxide intracanal medication. The apical portion of the root canal was orthograde-filled with mineral trioxide aggregate (MTA), while the rest space of the root canal was obturated with gutta-percha. The access cavity was restored with composite resin. After a six-month follow-up period, the tooth remained asymptomatic, with normal tooth mobility and complete resolution of the peri-radicular radiolucency.

**Discussion:** This case report aims to assist clinical practitioners in future treatment planning for similar cases. It emphasizes the importance of considering surgical and endodontic approaches when faced with challenging cases involving impacted teeth with curved roots during orthodontic therapy.

**Keywords:** orthodontic traction, curved root, tooth impaction

PC1002

## Locating Second Mesiobuccal Canal in Upper Molar with Modified Static-guided Endodontic Technique: A Case Report

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**Introduction:** Calcified root canals often cause difficulties when negotiating for root canal patency, which is often seen in mesiobuccal root of a molar. This case report is to present managing the calcified second mesiobuccal canal with modified static-guided endodontic technique.

**Case Presentation:** A 61-year-old female patient complained of persistent pain on her left posterior area after endodontic treatment four months ago. Clinical findings showed symptoms of percussion pain and palpation pain on her left maxillary second molar. The pulpal diagnosis was previously treated and the periapical diagnosis was symptomatic apical periodontitis. A missing calcified second mesiobuccal canal was suspected and guided endodontic treatment was scheduled. CBCT and surface scan were taken to fabricate a translucent guide. The guide can fit on the target tooth with a drill path directed to the designated root canal. Then, composite resin was filled into the access cavity. Before curing, the guide was replaced and a pin was penetrated through a sleeve to the pulp floor. After curing, a drill path was constructed through the composite resin. The missing canal was successfully identified and negotiated. At the last appointment, the four canals were obturated with lateral condensation technique. After 3 months follow-up, the apical lesion of the tooth showed signs of healing and the molar was asymptomatic.

**Discussion:** The successful treatment of the calcified second mesiobuccal canal using modified static-guided endodontic technique presents a potential solution to effectively solve such difficult cases.

**Keywords:** static-guided endodontics; canal calcification

PC1003

## Lemoval of a Separated Instrument from Curved Distal Buccal Canal of the Maxillary Second Molar

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**Introduction:** Endodontic procedures are associated with various mishaps, one of which is instrument breakage. It can act as an obstruction to mechanical and chemical cleaning of an infected root canal, thereby hampering the prognosis of treatment. Instrument retrieval must be performed with minimum damage to a tooth and surrounding tissues, minimal loss of radicular dentine and simultaneously maintaining the original canal shape as much as possible.

**Case Presentation:** This paper reports the procedure in retrieving a separate instrument located in the apical third of a curved distal canal in maxillary second molar by using loop devices and ultrasonics under microscopic management. The patient was referred to our hospital for endodontic treatment due to the separate instrument. She had no symptoms before our treatment. Under the microscope the tip of the separate instrument was visible. Straight line access was done by using ET25 to expose the broken instrument. Staging platform was created by using Ultrasonic #15 file, the ultrasonic file was slightly precurved to create the staging platform at the distal site of separate instrument. The separate instrument was pulled out with BTR pen. Protaper gold SX file was used for coronal enlargement. Hyflex-CM and wave one gold rotary files were used for shaping and cleaning. Root canal filling were done using hybrid technique. Patient showed no symptom after 6-months follow-up.

**Discussion:** In this case report, loop devices and ultrasonic files proved to be efficient in retrieving separate instrument in curved canal, while minimizing damage to the tooth structure.

**Keywords:** instrument separation, instrument retrieval, ultrasonic, curved canal



PC1004

## Separated Root Tip Formation after Regenerative Endodontic Therapy of a Traumatized Immature Central Incisor

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**Introduction:** Regenerative endodontic therapy (RET) has played an important role in the treatment of immature permanent teeth with necrotic pulp. The intent of disinfection and revascularization is to promote continued root formation. The present case describes an uncommon segmental root development in which the separated root tip continued maturing after RET.

**Case Presentation:** A 6-year-old patient suffered from extrusive luxation two months ago, and a gumboil presented on the buccal side of upper right central incisor (tooth 11). Tooth 11 was sensitive to percussion and lacked a response to the pulpal test. It was mobility grade II, and the buccal sinus tract was traced to the apex of tooth 11. Radiographically, tooth 11 showed incomplete root development. Tooth 11 was diagnosed as pulp necrosis with chronic apical abscess. Regenerative endodontic procedures with intracanal medication were performed according to guidelines set by the American Association of Endodontics. At the 22-month follow-up, periapical film revealed apical hard tissue barrier and slight canal wall thickening of the main root. The newly formed apical segment resembling a root tip was separated from the body of main root, and had continued thickening, lengthening and closure of the apex.

**Discussion:** Severe trauma or increased tooth mobility may result in detachment of Hertwig's epithelial root sheath and apical papilla from the root apex. Proper disinfection creates a favorable environment that may not only allow for the hard tissue barrier formed on the main root but also for the continued maturation of the separate apical root segment.

**Keywords:** separated root tip, segmental root development, regenerative endodontic therapy, immature permanent tooth, open apex

PC1005

## Removal of Two Separated Instruments from Root Canal with Modified Loop Device

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**Introduction:** Ultrasonic tips are widely used in separated instrument retrieval. However, removing an extra-long separated instrument solely with ultrasonic tips can be challenging. We have developed a modified loop device that can provide sufficient mechanical force to successfully remove two separated instruments from the root canal.

**Case Presentation:** This case report presents a previously treated mandibular first molar with two separated instruments in the mesiolingual (ML) canal. A radiographic image showed a radiolucent lesion around the apex of the mesial root. The separated instruments were successfully removed using a modified loop device consisting of a screen separating wire, a dispensing needle, an adapter, and a file retrieval pen. The lengths of the separated instruments were 6.5 mm and 3 mm, respectively. Subsequently, the old root canal filling material was removed, and the canals were shaped, cleaned, and obturated with gutta-percha and sealer by warm vertical compaction technique. The final radiograph showed minimal dentin sacrifice and good obturation quality. After a 6 months follow-up, the radiographic image revealed healing of the radiolucent lesion around the apex of the mesial root, with no clinical symptoms.

**Discussion:** In this case report, a modified loop device was used to retrieve separated instruments. The device allows for the combination of various wire and dispensing needle sizes based on the instrument's size. By adhering to the principles of minimally invasive endodontics, an affordable and robust loop device with a smaller tip can offer extra mechanical force, leading to a more efficient and predictable file retrieval procedure.

**Keywords:** ultrasonic tips, separated instrument retrieval, extra-long separated instrument, modified loop device, minimally invasive endodontics

PC1006

## Non-Surgical Treatment of Maxillary Premolars with Complex Root Canal Anatomy and Instrument Fracture: A Case Report

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**Introduction:** Instrument separation during root canal treatment is one of the most unpleasant mishaps. Furthermore, the presence of complex root canal anatomy and instrument fracture poses challenges to the successful outcome of treatments. This case report aims to provide an idea of the teeth with complex root canal anatomy along with the problem of separated instrument, focusing on the associated factors, techniques, and potential solutions.

**Case Presentation:** A 63-year-old male patient visited us to have his maxillary first premolar endodontic treatment due to the presence of a separated instrument. The clinical examination revealed that the left maxillary first premolars had a temporary crown. The patient was asymptomatic, and the tooth was not tender to percussion or palpation. The intraoral periapical radiograph revealed the presence of a radiolucency around the root apex and a separated instrument which was located beyond the curvature of root canal, approximately 4 mm in length. The images from cone beam computerized tomography (CBCT) showed Vertucci type VI canal configuration in the root. Based on the above examination results, the diagnosis was previously initiated therapy, asymptomatic apical periodontitis and suspect separated instrument. Treatment plan was nonsurgical endodontic treatment with bypass or removal of the separated instrument. After the application of ultrasonic tip and The Broken Tool Remover Pen (BTR pen), the separated file was successful retrieval. Root canal treatment was completed after separated instrument removal and the radiograph showed well healing during follow-up time.

**Discussion:** In conclusion, non-surgical treatment of maxillary premolars with complex root canal anatomy and presence of separated instrument significant challenges in endodontics. However, with careful planning, advanced techniques, and proper case management, successful outcomes can be achieved.

**Keywords:** separated instrument, premolar, Vertucci type VI, Broken Tool Remover Pen system (BTR pen)

PC1007

## Combined Vital Pulp Therapy and Regenerative Endodontic Procedure in an Immature Mandibular First Molar

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**Introduction:** This report is a case of treatment procedure combined with vital pulp therapy (VPT) and regenerative endodontic procedures (REP) in an immature mandibular first molar. Clinical procedures included VPT to preserve vital pulp tissues and REP to keep root formation.

**Case Presentation:** A nine-year-old girl suffered from lower left biting pain and sinus tract over left mandibular first molar buccal gingiva for several months. Occlusal composite resin restoration with secondary caries was noted. After intraoral and radiographic examination, diagnosis of pulp necrosis and chronic apical abscess was made and apexification or REP was suggested. Access opening with rubber dam application was performed, pulp necrosis was confirmed in distal canal, and vital pulp tissue was found in mesial canals. Treatment plan was revised in the first appointment, VPT was done with Biodentin capping over mesial orifices and distal canal dressed with Calcium Hydroxide. REP will be performed in distal canal if symptoms and signs subsided. Two weeks later, no symptom was found, and sinus tract disappeared, so the REP in distal canal was completed. The cavity was restored with light-cured composite resin at 1-week follow-up. The apical radiolucency decreased, and root formation was found in periapical film at 3-year follow-up.

**Discussion:** In immature multirrooted teeth, the clinicians could have individual treatment plan depends on the tissue status in different root canal space to preserve vital pulp tissue and allow root formation as possible.

**Keywords:** immature permanent tooth, regenerative endodontic procedures, vital pulp therapy

PC1008

## Regenerative Endodontic Procedures in Traumatized Immature Tooth: A Case Report

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**Introduction:** Dental trauma is a common injury in adolescents, which may cause pulp necrosis or root resorption. Due to inadequate root length and wall thickness, endodontic intervention in necrotic immature permanent teeth is usually a clinical challenge. The emergency treatment, timing of root canal treatment, and favorable disinfection are all important for desirable outcomes. This article presents a case of regenerative treatment in the traumatized immature tooth, which showed continued root maturation without symptoms and signs after 5-year follow up.

**Case Presentation:** A 9-year-old girl suffered lateral luxation to immature maxillary right and left central incisor, which were repositioned and splinted in the emergency room. Maxillary left central incisor developed inflammatory resorption at 4 weeks, and was treated with non-surgical root canal treatment, using 1.5% sodium hypochlorite as disinfection irrigant and calcium hydroxide as intracanal medication. Four weeks after root canal treatment, the patient was asymptomatic and regenerative endodontic procedures (REPs) were performed. At 5-year follow up, increased root length and wall thickness with a blunt apex of maxillary left central incisor were noted.

**Discussion:** In this case report, despite of severely traumatized injury, REPs provided a satisfactory outcome after appropriate treatment and disinfection.

**Keywords:** regenerative endodontic procedures, dental trauma

PC1009

## Endodontic Management of a Fused Mandibular Second Molar: A Case Report

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**Introduction:** Fusion is a dental anomaly where two discrete tooth germs unite into one during odontogenesis, resulting in a single tooth. Although fusion is not always complete, the fused teeth can share portions of the enamel, dentin or even the pulp complex. The altered morphology increases the susceptibility of the tooth to caries and periodontal diseases. When the pulpal health is compromised, obtaining thorough canal debridement becomes a significant challenge for the clinician.

**Case Presentation:** A 30-year-old female patient complained of moderate pain in the lower left posterior tooth. Clinical findings revealed a fused mandibular second molar with a supernumerary tooth. The diagnosis of the tooth was pulp necrosis and symptomatic apical periodontitis. Cone-beam computed tomography of the fused teeth showed the continuity of the pulp chamber, with one canal in the distal root and C-shaped canals in the single enlarged mesial root. Under operative microscopic magnification, the access cavity was carefully prepared, and the tooth perforation was repaired. Mechanical and chemical canal debridement was performed, followed by root canal filling and coronal restoration with composite resin.

**Discussion:** Familiarity of the morphology and delicate manipulation are prerequisites for endodontic treatment of an anomalous tooth. The use of three-dimensional imaging and a dental operative microscope can help the clinician achieve precise diagnosis and provide a higher quality of care. The treatment plan should be based on various factors and the patient's need, while long-term follow should be maintained to ensure the success of the treatment.

**Keywords:** fusion, double tooth, dental anomaly, morphology

PC1010

## Partial Pulpotomy in Cariously Exposed of Mature Permanent Molars

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**Introduction:** The aim of vital pulp therapy is to preserve the vitality of the the dental pulp in teeth with deep caries. Partial pulpotomy is a method of vital pulp therapy in which 1-3 mm of inflamed pulp tissue is removed after deep caries removal and the remaining healthy pulp tissue is preserved.

**Case Presentation:** This 24-year-old woman was referred from the LDC for deep caries close to the pulp in the right maxillary second molar. The tooth was non-tender to percussion and palpation. Pulp examination compared with the adjacent tooth was within normal limits. The treatment plan was discussed with the patient and she agreed to undergo a partial pulpotomy. The deep caries was removed under local anesthesia and tooth isolation, and pulp exposure was noted over the mesial pulp horn. The partial pulpotomy was performed by removing 2 mm of inflamed pulp tissue using a low-speed diamond bur and a sharp excavator. Infected dentin was completely removed until the remaining dentin was hard and firm. After copious irrigation with 2.5% sodium hypochlorite, hemostasis was achieved with sterile moist cotton compression. The ProRoot MTA (Dentsply Sirona, Switzerland) was carefully placed over the healthy pulp tissue and Lime-Lite(Pulpdent Corporation, USA) was applied as a base material prior to the final restoration. The final restoration was fabricated with composite resin( 3M Filtek Z350XT )

**Discussion:** The partial pulpotomy technique saves the tooth from root canal treatment after partial pulp exposure. MTA showed excellent sealing ability and biological properties to preserve pulp viability.

**Keywords:** partial pulpotomy technique, MTA

PC1011

## Correction after Failed Attempts to Locate Obliterated Root Canal by Using Navigation

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**Introduction:** In the past, we use dental microscope and Cone Beam Computerized Tomography to locate obliterated root canals. However, in cases where deeper exploration towards the apex was required, there was still a risk of not finding the canal. Some dentists use navigation guides similar to those used in implant surgery to locate obliterated root canals. However, even a tiny deviation can result in failure. This case report discusses how to correct the situation if navigation fail.

**Case Presentation:** This case was a 27-year-old female patient who had been to a clinic due to pain over the right mandibular second premolar. The dentist was unable to locate the root canal and referred her to our hospital. Periapical film examination didn't show obvious canal space. We suggested the patient receive a CBCT scan to determine the possible location of the root canal. It revealed a suspicious canal space approximately 4 millimeters from the apex. The options of navigated root canal treatment or surgical intervention were presented to the patient, and the former one was chosen. With the aid of navigation, initial attempts to locate the canal were unsuccessful during the second appointment. After adjusting the direction more distally, we eventually located the root canal. At the third appointment, the tooth became asymptomatic and root canal obturation was performed in this visit.

**Discussion:** Although navigation did not directly locate the root canal initially, it still provided a close approximation of the pathway. With a slight adjustment, the canal was subsequently located.

**Keywords:** navigation, canal obliteration, microscope



PC1012

## Minimally Invasive Management of Double Dens Invaginatus in a Maxillary Lateral Incisor with CBCT

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**Introduction:** Dens invaginatus is a developmental anomaly that presents a challenge when performing nonsurgical root canal therapy. Pre-operative cone-beam computed tomography (CBCT) provides clinicians with a more precise and minimally invasive root canal treatment option.

**Case Presentation:** An unique case of double dens invaginatus in the maxillary lateral incisors of a 32-year-old female is presented. The patient's chief complaint was dissatisfaction with the aesthetics of her front teeth. A CBCT scan and 3D segmentation model were utilized to comprehensively assess the anatomy of the lateral incisor, exhibiting a barrel-like crown appearance with two invaginations. One of the dens invaginations was classified as Oehler type II, while the other was Oehler type III a, located mesially and displacing the true canals towards the distal side. The pulpal and periapical diagnosis for the tooth was pulp necrosis and asymptomatic apical periodontitis. With the help of CBCT images, the complicated root canals and invaginations were accessed through four openings. After thorough cleaning and shaping, the invaginations were obturated with mineral trioxide aggregate (MTA), while the root canals were obturated with gutta-percha and bioceramic sealer.

**Discussion:** This case report presents a non-surgical, minimally invasive root canal treatment of a case of double dens invaginatus with the assistance of CBCT images and a microscope. The utilization of advanced imaging techniques enables clinicians to achieve enhanced accuracy in diagnosis and anatomy-based treatment planning, thereby optimizing the treatment outcome for complex root canal anatomy.

**Keywords:** dens invaginatus, cone-beam computed tomography, 3D segmentation

PC1013

## NSRCT of a Molarized Upper Premolar in Patient Previously Subjected to Radiotherapy: A Case Report

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**Introduction:** Patients who undergo head and neck radiotherapy of malignant neoplasms are subjected to numerous tissue changes; whereas healing of periapical radiolucency may be compromised.

**Case Presentation:** The present report is a case of maxillary right first premolar in a 53 years old male with nasopharyngeal carcinoma after concurrent chemoradiotherapy. The tooth first underwent root canal treatment in September 2021 due to pulp necrosis and chronic apical abscess. Sinus tract persisted after initial treatment and a missed buccal canal was seen on 2 months follow up film. CBCT was taken and patient was referred for microscope assisted root canal treatment. C-shape buccal canal configuration with missed DB canal was found during retreatment. Sinus tract still presented 4 months after retreatment regardless the use of oral antibiotics. Local treatment by povidone-iodine irrigation through sinus tract was performed, and closure of sinus tract and other signs of healing appeared at 8 months follow up.

**Discussion:** In this case report, complex root canal anatomy was encountered in combination with apical radiolucency. Signs of osteoradionecrosis also appeared after non-surgical root canal therapy. Healing of sinus tract and periapical radiolucency took place after local treatment by povidone-iodine irrigation through sinus tract.

**Keywords:** head and neck radiotherapy, molarized premolar, c-shape configuration, osteoradionecrosis

PC2001

## Maintenance of Stem Cell Properties of DPSCs and SCAPs Using a Low Serum-Containing Medium Formula

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**Objectives:** This study aimed to investigate the maintenance of stem cell properties in dental pulp stem cells (DPSCs) and stem cells from the apical papilla (SCAPs) using a low serum-containing medium formula (2%) for subculture since the high serum-containing medium (10%-20%) may lead to spontaneous differentiation and malignant transformation of stem cells during subculture.

**Materials and Methods:** DPSCs and SCAPs were isolated from impacted third molars of subjects aged 17 to 20, following Grontho's protocol. Different passages of DPSCs and SCAPs were subcultured using a low serum-containing medium formula, and their expression of stem cell markers, growth characteristics, and multipotent differentiation ability were investigated.

**Results & Discussion:** Up to passage 20, all DPSCs and SCAPs were CD44+, CD105+ and CD34-. The growth patterns of DPSCs and SCAPs were similar until passage 18, but became slower after passage 20 with larger cell morphology. Compared to DPSCs, SCAPs demonstrated a higher proliferation rate and colony forming efficiency. All passages of DPSCs and SCAPs up to passage 20 exhibited multipotent capacity, including osteogenic, adipogenic, and chondrogenic differentiation. Adipogenic and chondrogenic differentiation abilities did not significantly differ between DPSCs and SCAPs or among the passages. However, SCAPs showed stronger signals for early induction of osteogenesis compared to DPSCs in later passages after 20.

**Conclusion:** The stem cell properties of DPSCs and SCAPs can be maintained when using a low-serum medium formula for subculture, but the cell growth behaviors and morphology may be affected.

**Keywords:** low serum-containing medium, DPSCs, SCAP, growth characteristic, differentiation

PC2002

## Influence of Root Canal Treatment on Vertical Root Fracture: A Case-control Study in a Taiwanese Population

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**Objectives:** The purpose of this study was to analyze the influence of root canal treatment (RCT) on the occurrence of vertical root fracture (VRF).

**Materials and Methods:** This case-control study collected data from 4207 teeth extracted at the Department of Stomatology, Taipei Veterans General Hospital, Taiwan. Patient's details including patients' age, gender, tooth positions and the reasons of extraction were recorded. A total of 115 teeth diagnosed with VRF were as the case group, and 4092 teeth without VRF were as the control group. The independent variable was the history of RCT, and confounding factors were age, gender and tooth position. A multivariate logistic regression analysis with the odds ratio (OR) and Chi-square test were used to estimate the risk of VRF associated with RCT and confounding factors.

**Results and Discussion:** RCT and tooth position were the factors identified that significantly predict the occurrence of VRF ( $p < 0.005$ ). After adjustment for potential confounding factors including age and gender, RCT teeth had 32.21 times higher odds for occurrence of VRF compared with non-RCT teeth (OR = 32.21; 95% confidence interval [CI] = 18.66-55.62,  $p < 0.000$ ). The result indicated that RCT could be considered as a predictor of occurrence of VRF. The risk may be related to the loss of radicular dentin after root canal instrumentation and excessive force during filling procedure, which may had caused dentinal defects and cracks.

**Keywords:** vertical root fracture, endodontically treated teeth

PC2003

## Development of 3D Printed Teeth for Preclinical Endodontic Training

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**Objectives:** The ideal properties of 3D printed teeth are similar hardness, mechanical properties and radiopacity to human dentin. If replicas have good transparency, operators can observe the quality of root canal filling directly. The purpose of this study was to add different kinds of fillers to improve the properties of resin for endodontic training tooth replica.

**Materials and Methods:** There are 7 experiment groups (experimental resin and SS splint adding different filler, including 15% barium borosilicate, 10% non-silanized or silanized soda lime solid glass in different combination), and 10 samples in each group. All materials were prepared into disk-like specimens (1 mm in thickness) and investigated radiopacity, translucency, and hardness. We used aluminum step wedges to estimate gray value of samples, and transformed into thickness of aluminum(mm-Al). Translucency was tested by SpectraLight III and Topcon SR-UL1R to compare color under different backgrounds, and was presented by translucent parameter (TP) and contrast ratio (CR). Shore-D test was used to measure hardness.

**Results and Discussion:** The results showed the groups with silanized filler (group 5, G5 and group 7, G7) had highest radiopacity ( $p < 0.05$ ). Pure resin groups (group 1 and group 2) had significant better translucency. SS splint with silanized filler (G7) had better hardness value. The silanized group (G5 and G7) had higher values of radiopacity and hardness. Adding silanized fillers can improve the mechanical properties, but adding filler would decrease the translucency of resin. The type of resin used for training tooth replica depends on the need of preclinical endodontic training.

**Keywords:** preclinical endodontic training, 3D printed teeth, filler

PC2004

## Micro-CT Evaluation of Nano-diamond Irrigants with Sonic Agitation Systems on Hard-tissue Debris Removal

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**Objectives:** To investigate the efficacy of nano-diamond irrigation solutions with sonic agitation in removing hard-tissue debris (HTD) from mesial roots of human mandibular molars using micro-CT analysis.

**Materials and Methods:** Forty mesial roots of extracted human mandibular molars with isthmuses type I or III were selected based on micro-computed tomography scans (9- $\mu$ m). The mesial canals were mechanically prepared with ProTaper® Gold nickel–titanium rotary instruments and divided into four groups (n = 10) according to the final irrigation protocol: sonic agitation with nano-diamond irrigation solutions for 3 × 20 seconds, sonic agitation with 17% EDTA for 3 × 20 seconds, sonic agitation with 3% NaOCl for 3 × 20 seconds, and conventional irrigation with NaOCl using a 30-G needle syringe. The samples were scanned again after canal preparation and after the use of the final irrigation protocols, and the data were collected to evaluate the percentage of HTD. Statistical comparisons were made using the ANOVA post hoc Tukey test (p < 0.05).

**Results and Discussion:** None of the irrigation protocols were able to completely eliminate HTD from mesial canals of mandibular molars. However, sonic agitation with nano-diamond and sonic agitation with 17% EDTA irrigation solutions showed higher mean reductions of HTD (68.0% and 68.9%, respectively) compared to sonic agitation with 3% NaOCl and conventional NaOCl syringe irrigation (43.4% and 13.7%, respectively) (P < 0.05). These results suggest that sonic agitation with nano diamond irrigation solution can be an alternative approach for removing HTD in root canal treatment.

**Keywords:** nano-diamonds, hard-tissue debris, endodontic, irrigation, sonic agitation, micro-CT

PC2005

## Prognostic Factors in Apical Surgery of Anterior Teeth: A Retrospective Study

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**Objectives:** Apical surgery is a treatment for teeth which had persistent signs and symptoms after non-surgical root canal treatment. This retrospective study aims to evaluate the potential factors affecting outcomes, including patient factors, pre-operative factors, intra-operative factors, and post-operative factors.

**Materials and Methods:** Patients who received apical surgery were selected at the Department of Endodontics in Chi-Mei Medical Center between January 2017 and December 2021 and at least 1-year follow-up. Apicoectomy and retrograde filling were performed under microscope. Statistical analysis was performed to assess the outcomes using Student's t-test for continuous variables and Fisher's exact test for categorical test.

**Results and Discussion:** Total 120 patients and 178 teeth were included in this study. The mean follow-up period was 30.5 months (range, 12–78 months). The long-term success rate were 93.82%. The factors including: pre-operative percussion pain, lesion surface area of bone evaluated in X-ray, quality and density of previous root canal filling and final restoration have significant effects on treatment outcome. In our study, pre-operative signs and symptoms, lesion size, the quality and density of previous root canal filling, and final coronal restoration are important prognostic determinants of successful apical surgery. However, more studies are still needed for further evaluation of prognostic factors.

**Keywords:** apical surgery, apicoectomy, prognostic factors, anterior teeth



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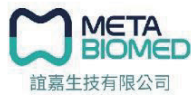


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