In vitro evaluation of intraoral scanning time and accuracy in different arch cases

○ **Juhea Chang[1], SeongHae Kim[2], Shin Hye Chung[2]**

[1]National Dental Care Center for Persons with Special Needs, Seoul National University Dental Hospital

[2]Department of Dental Biomaterials Science, School of Dentistry, Seoul National University

Ⅰ. Object：

The aim of this study was to evaluate the effect of different arch types on the scanning time and accuracy using two intraoral scanners（IOS）.

Ⅱ. Materials & Methods：

Thirteen dentists without intraoral scanning experiences performed full scanning using two different IOS（CS 3600, Carestream；i700, Medit）. Four types of mounting models with complete dentures were randomly allocated to each trial：Group WL, wide arch with large opening；Group WS, wide arch with small opening；Group NL, narrow arch with large opening；Group NS, narrow arch with small opening. The scanning time and operator perception using a visual analog scale were assessed. The datasets of the reference model and test models were superimposed by a best fit algorithm using the GOM Inspect software. The effects of scanners, arch types, trial orders on scanning time and accuracy were statistically analyzed by ANOVA and Mann-Whitney U test with Bonferroni corrected/adjusted post-hoc test（$p<.05$）. Correlation coefficients were determined between scanning time, accuracy, operator perceptions using Spearman's correlation.

Ⅲ. Results：

The mean scanning times were 626±82 sec and 786±69 sec for CS3600 and i700, respectively（$p<.05$）. The mean scanning time of upper arch was longer（455±44 sec）than those of lower arch（332±27 sec）（$p<.05$）. The trueness was different among different arch types（$p<.05$）. CS 3600 exhibited higher trueness than i700 throughout all cases（$p<.05$）. Weak correlations existed between scanning time and accuracy, indicating that longer scanning time resulted in higher accuracy. Operators perceived more difficulties in the cases of smaller mouth opening, and their perception towards each device was different.

Ⅳ. Conclusion：

For beginning users of IOS, different types of cases did not affect their scanning times of full arches. The actual scanning time and accuracy and user's perception were device-specific.

Juhea Chang

National Dental Care Center for Persons with Special Needs, Seoul National University Dental Hospital

juhchang@snu.ac.kr

Evaluation of the accuracy of a digital intraoral scanner according to the different inlay cavity configuration

○ **Yeri Park, Jeong-Kil Park, Sung-Ae Son**

Department of Conservative Dentistry, Pusan National University

Ⅰ. Object：

The aim of this study was to evaluate the influence of the occlusal cavity depth and width of gingival floor of proximal box on the trueness and precision of a digital intraoral scans for inlay cavities

Ⅱ. Materials & Methods：

Artificial teeth were used in this study. Four types of preparations for mesio-occlusal inlay were done on each #36 artificial tooth depending on two different occlusal cavity depths（1 mm, 2 mm）and widths of gingival floor of proximal box（1.5 mm, 2.5 mm）. Artificial teeth were scanned for 10 times each with digital intraoral scanner（Cerec Primescan AC, Dentslpy sirona）and another scanning was done with laboratory scanner（E4, Shape）as a reference data. Standard tessellation language（STL）files were analyzed with a 3-dimensional analysis software program（GOM Inspect 2018）. Experimental data were analyzed by using two-way analysis of variance and the Bonferroni multiple comparison test.

Ⅲ. Results：

Average deviation for trueness ranged from 18.56±1.48 to 20.84±1.16 μm. Narrow shallow group had the highest value. The other groups had no significant differences but particularly wide deep group had the lowest value（$p>0.05$）. The mean maximum positive deviation value ranged from 74.6±4.81 to 88.9±7.20 μm and the mean maximum negative deviation value ranged from 107.5±16.24 to 186±6.17 μm. Mean maximum positive deviation and mean negative were lowest in the wide deep group. For the mean maximum positive deviation, the wide groups had lower values than that of the narrow groups. Average deviation for precision ranged from 4.24±0.79 to 5.56±1.96 μm. Shallow group had lower value had significantly lower value than the wide groups（$p<0.05$）. Trueness was affected by both width and depth while mean maximum positive deviation was affected by width（$p<0.05$）. Mean maximum negative deviation was affected by all the three factors（$p<0.05$）. On the other hand, precision was affected by depth and the interaction between occlusal cavity depth and width of gingival floor（$p<0.05$）.

Ⅳ. Conclusion：

Designs of different inlay cavity configurations did affect the accuracy of a digital intraoral scanner. Highest average deviation for trueness was shown in narrow shallow group and lowest in wide deep group. As for the precision on the other hand, narrow shallow group showed lowest average deviation for precision and shallow groups showed lower values than that of deep groups.

Yeri Park

Department of Conservative Dentistry, Pusan National university

yeriangela@naver.com

Effect of dentin desensitizer containing novel bioactive glass on the permeability of dentin

○ **Duck-Su Kim, Joo-Young Choi, Kyoung-Kyu Choi**

Department of Conservative Dentistry, School of Dentistry, Kyung Hee University

Ⅰ. Object：

The objective of this study was to evaluate the effect of novel bioactive glass（BAG）-containing desensitizers on the permeability of dentin

Ⅱ. Materials & Methods：

Experimental dentin desensitizers containing 3 wt% BAG with or without acidic functional monomers（10-MDP or 4-META）were prepared. Commercial desensitizers, Seal & Protect（SNP）was used as a control. To evaluate the permeability of dentin, real-time dentinal fluid flow（DFF）rates were measured at four different time points（demineralized, immediately after desensitizer application, after two weeks in simulated body fluid, and post-ultrasonication）. The DFF reduction rate（ΔDFF）was also calculated. The surface changes were analyzed using FE-SEM. Raman spectroscopy was performed to analyze chemical changes on the dentin surface.

Ⅲ. Results：

ΔDFF of the desensitizers containing BAG, BAG with 10-MDP, and BAG with 4-META significantly increased after two weeks of storage and post-ultrasonication compared to the SNP at each time point（$p < 0.05$）. Multiple precipitates were observed on the surfaces of the three BAG-containing desensitizers. Raman spectroscopy revealed hydroxyapatite（HAp）peaks on the dentin surfaces treated with the three BAG-containing desensitizers. Novel BAG-containing dentin desensitizers can reduce the DFF rate about 70.84 to 77.09% through HAp precipitations after two weeks of SBF storage.

Ⅳ. Conclusion：

BAG-containing dentin desensitizers are useful to reduce DFF, thus have potential to manage dentin hypersensitivity.

Duck-Su Kim
Department of Conservative Dentistry, School of Dentistry, Kyung Hee University
dentist96@khu.ac.kr

Effect of storage time on the dentin remineralization of mesoporous bioactive glass-containing universal dentin adhesive

○ **Jiyoung Kwon, Kyoung-Kyu Choi, Duck-Su Kim**

Department of Conservative Dentistry, Kyung Hee University Dental Hospital

Ⅰ. Object：

The aim of the study is to evaluate the effect of storage time on dentin remineralization of mesoporous bioactive glass（MBG）-containing universal dentin adhesive.

Ⅱ. Materials & Methods：

1）Materials

Two commercial universal dentin adhesives were used；Single Bond Universal（SBU, 3M ESPE）as a control and Hi-Bond Universal（HBU, MEDICLUS）as an experimental group. In each adhesive, two products with same Lot No. were used immediately and after 6-month storage respectively.

2）Methods

2-1）Micro-tensile bond strength（μTBS）test

Eight experimental groups were assigned according to dentin adhesives, storage time（immediate or 6-month storage）and application modes（etch-and-rinse or self-etch）. Twenty composite-dentin beams with 1x1 mm^2 were produced with high-speed diamond saw（ISOMET 5000；Buehler）per each group. Each specimen was stored in distilled water at 37℃ for 24 hours. μTBS and failure mode analysis were performed.

2-2）Surface change analysis of dentin adhesive

Four experimental groups were assigned according to dentin adhesives, and storage time（immediate or 2-week storage）. Each dentin adhesive was applied to three composite resin blocks per each group. In 2-week storage groups, the specimens were stored in artificial saliva for 2 weeks, changing every 2 days. The surface change was analyzed with field-emission scanning electron microscope（FE-SEM）coupled with energy dispersive spectrometer（EDS）.

2-3）Surface change analysis of demineralized dentin

Four experimental groups were assigned according to dentin adhesive, and storage time（immediate or 2-week storage）. Same composite resin blocks where each dentin adhesive was applied were prepared per each group. They are approximated to demineralized dentin, and stored in artificial saliva, changing every 2 days. After storage, each dentin surface was analyzed with FE-SEM coupled with EDS. In addition, micro-Raman spectroscopy was performed to evaluate chemical change of dentin.

Ⅲ. Results：

In immediate μTBS test, HBU with etch-and-rinse mode showed highest μTBS. Self-etch mode showed lower μTBS than etch-and-rinse mode in each dentin adhesive（$p<0.05$）. In 6-month storage test, all experimental groups showed lower μTBS than in immediate test except HBU with self-etch mode（$p<0.05$）. However, there was no significant difference between dentin adhesive and application mode（$p>0.05$）. Failure mode analysis showed predominant adhesive failure in all experimental groups. Multiple precipitates formed on the adhesive surface of HBU. In addition, demineralized dentin surface was occluded with multiple precipitates. EDS analysis revealed that there were calcium and phosphate ions on the precipitates. Micro-Raman spectroscopy proved that dentin remineralization occurred on the dentin surface.

Ⅳ. Conclusion：

Within the limitation of this study, the bond strength of novel MBG-containing universal dentin adhesive was reliable with maintaining the remineralization potential.

Jiyoung Kwon
Department of Conservative Dentistry, Kyung Hee University Dental Hospital
jykt55@naver.com

Influence of amount of surrounding structures on color blending effect of structural colored resin

○ **Ji-Hyun Lee[1], Deog-Gyu Seo[2], Sung-Ae Son[1], Jeong-Kil Park[1]**

[1]Department of Conservative Dentistry, Pusan National University
[2]Department of Conservative Dentistry, Seoul National University

Ⅰ. Object：

The aim of this study is to evaluate the color blending effect of structural colored resin with different amount of surrounding structures.

Ⅱ. Materials & Methods：

Conventional resin composite（Filtek Z250 A2）and structural colored resin（Omnichroma）was used. Two types of specimens were prepared using nine custom-made silicone molds（diameter：8 mm, thickness：2, 3, 4 mm）. For the dual shade specimen, the outer ring（diameter：8 mm）was filled with Z250 A2 resin, and the inner hole（diameter：4 mm）was filled with Omnichroma resin to different depths（1, 2, 3, 4 mm）. Single shade specimens（diameter：8 mm）were made with only Z250 and Omnichroma respectively. The colors were measured using Commission Internationale d'Eclairage（CIE）$L^*a^*b^*$ system. Color differences according to the cavity depth and translucency parameters were measured. The color differences were analyzed by one-way analysis of variance and Scheffe's *post hoc* test, and a student *t*-test at a significance level of 95%.

Ⅲ. Results：

In the specimen of the same thickness, the ΔE value increased with increasing the cavity depth. At the same cavity depth, as the thickness of the bottom structure increased, the value of ΔE decreased. At the same bottom structure thickness, the ΔE value was decreased as the length of cavity side wall increased. ΔE values were in the range of 1.66 to 5.07 for Omnichroma. The highest translucency parameter was observed in 2 mm thickness specimens.

Ⅳ. Conclusion：

Excellent color blending effect was observed in the Omnichroma resin composite. The color difference of Omnichroma is affected by the length of cavity side walls and the thickness of structures at the bottom of the cavity. As a result, the color blending effect of structural colored resin was influenced by total amount of surrounding material structures.

Ji-Hyun Lee
Department of Conservative Dentistry, Pusan National University
loveshyun@naver.com

Adhesion performance of novel mesoporous bioactive glass-containing universal dentin adhesive

○ **Soyoung Park, Kyoung-Kyu Choi, Duck-Su Kim**

Department of Conservative Dentistry, Kyung Hee University Dental Hospital

Ⅰ. Object：

The purpose is to evaluate adhesion performance of novel mesoporous bioactive glass（MBG)-containing dentin adhesive

Ⅱ. Materials & Methods：

Four groups were prepared according to the dentin adhesives and their application modes；1）SB：Single Bond 2（3M ESPE）as etch-and-rinse control, 2）GB：G-aenial Bond（GC）as self-etch control, 3）HT：Hi-Bond Universal（MEDICLUS）with etch-and-rinse mode, 4）HS：Hi-Bond Universal with self-etch mode. For micro-tensile bond strength（μTBS）test, a total of 60 composite-dentin beams with 1x1 mm^2 were produced with high-speed diamond saw（ISOMET5000；Buehler）per each adhesive. The specimens of each group were divided into three subgroups；1）Immediate（the specimens were stored in distilled water for 24 hours), 2）Thermocycling（undergo 10,000 cyclings between 5℃ and 55℃ for 30 sec), 3）Water storage（the specimens were stored in artificial saliva for 6 months). μTBS and failure mode were evaluated for each group. The bonded interface was analyzed using field-emmission scanning electron microscopy（FE-SEM）and energy dispersive spectrometer（EDS).

Ⅲ. Results：

All adhesives significantly decreased the bond strength after aging treatment（$p<0.05$). The decrease in μTBS due to aging treatment was significantly greater in long-term aging in SB and GB groups（$p<0.05$). There was no significant difference between HT and HS groups in μTBS（$p>0.05$).

In immediate mode, there was no significant difference between SB and HT, and between GB and HE groups in μTBS（$p>0.05$). In water storage, there was no significant difference between GB and HE groups in μTBS（$p>0.05$). There was no significant difference between SB and HT, and between GB and HE groups in thermocycling in μTBS（$p<0.05$).

Failure mode analysis showed that failures occurred predominantly adhesively at the interface. In the FE-SEM analysis, no precipitates were observed in the SB and GB group. In contrast, amorphous precipitates were observed in long-term aging and water aging in HT and HS groups. EDS analysis revealed that these precipitates included calcium and phosphorus.

Ⅳ. Conclusion：

The bond strength of novel MBG-containing universal dentin adhesive showed comparable result to etch-and-rinse and self-etch dentin adhesives respectively.

Soyoung PARK

Department of Conservative Dentistry, Kyung Hee University Dental Hospital

sy031227@gmail.com

Considerations for esthetic aspects of direct resin build-up on anterior diastema

○ **Sua Choi, Jung-Hong Ha, Young Kyung Kim, Sung Kyo Kim, Myoung Uk Jin**

Department of Conservative Dentistry, School of Dentistry, Kyungpook National University

Ⅰ. Object

The presence of diastema between anterior teeth is a common complaint of patients. Esthetic aspects should be especially considered in treatment of diastema, because anterior teeth are easily seen by others. Among various methods, direct resin build-up is selected for treatment, because it has little complication because of little reduction of tooth and less expensive than other methods. Especially, it can satisfy the demand of esthetics.

This report deals with two cases of diastema managed with direct resin build-up.

Ⅱ. Case Presentation：

＜Case 1＞

1. Chief complaint：I want to have the space of my upper anterior teeth closed.
2. Sex/age：M/46
3. Past Medical/Dental History：N/S
4. Present Illness：Space between #11-21
5. Impression：Diastema between #11-21
6. Treatment plan：Direct resin build-up on #11,21

＜Case 2＞

1. Chief complaint：I don't like my smile because of spacing between upper anterior teeth.
2. Sex/age：F/41
3. Past Medical/Dental History：N/S
4. Present Illness：Space between #11-21
5. Impression：Diastema between #11-21 due to irritation fibroma on upper labial frenum
6. Treatment plan：Direct resin build-up on #11,21

Ⅲ. Discussion and conclusion：

This report describes two diastema cases with direct resin build-up. For the restoration of the anterior teeth, various esthetic parameters, such as tooth proportion, width proportions between adjacent teeth, incisal edge position, gingival architecture, occlusion, and the shape and position of the contact should be considered. These esthetic aspects could be achieved by subtle adjustment with direct resin build-up in the two cases. If proper case selection may be accompanied, direct composite build-up can e one of the effective treatment option in clinical situation.

Sua Choi

Department of Conservative Dentistry, School of Dentistry, Kyungpook National University

sssua.choi@gmail.com

Direct resin veneer for peg-shaped maxillary lateral incisors

○ **Hae-In Kim, Jin-Woo Kim, Se-Hee Park, Yoon Lee, Kyung-Mo Cho**

Department of Conservative Dentistry, Gangneung-Wonju National University

Ⅰ. Objective：

Peg-shaped anomaly of lateral incisors is one of the most common form of localized microdontia that affects the shape of permanent maxillary lateral incisors with higher prevalence in Mongoloid（3.1%）. This shape anomaly cause many functional and esthetic major consequences in affected patients. Many treatment options of peg-shaped lateral incisors are available including one or many of these clinical procedures：no treatment, direct or indirect resin composite veneer, bonded ceramic crowns or veneers, and finally, extractions and implant placement. This case report describes direct resin veneer for restoring peg-shaped lateral incisors.

Ⅱ. Case Presentation：

＜Case Ⅰ＞

1. Sex/Age：M/46
2. Chief Complaint（C.C）：Referred from Orthodontic department for restoration of #12
3. Present Illness（P.I）：#12 Peg lateralis, per（－）, mob（－）, cold（n）
4. Impression：#12 Peg lateralis
5. Treatment plan：#12 Direct resin veneer

Ⅲ. Conclusion：

In this case, the labial level of the peg lateralis（#12）was similar to adjacent teeth（#11,13）, so a certain amount of tooth preparation was essential for veneers or crowns. Therefore, direct resin veneer was performed for preservation of sound tooth structure, with good short-term results. Direct resin veneer offers other advantages, lower cost compared to an indirect technique, and be done within a single visit.

Hae-In Kim
Department of Conservative Dentistry, Gangneung-Wonju National University
khi6935@naver.com

Treatment of carious cervical lesion with pulp exposure on maxillary incisor using Endocem Zr

○ **Hee Jae Kwon, Jung-Hong Ha, Young Kyung Kim, Sung Kyo Kim, Myoung Uk Jin**

Department of Conservative Dentistry, School of Dentistry, Kyungpook National University

Ⅰ．Object：

When exposure in vital pulp happens, direct pulp capping, pulpotomy or pulpectomy could be the treatment options. Unlike in the posterior region, esthetics must be considered more important when direct pulp capping is done in the anterior region.

This report presents a clinical case dealing with the direct pulp capping on maxillary incisor using Endocem Zr（MARUCHI, Wonju, Korea）.

Ⅱ．Case Presentation：

＜Case Ⅰ＞

1．Sex/Age：M/53

2．Chief Complaint（C.C）：Dental caries on maxillary incisor

3．Present Illness（P.I）：Resin restoration on #21 with caries of dentin, vital pulp

4．Impression：Secondary caries of dentin on #21

5．Treatment plan：(1) Direct pulp capping (2) Direct composite resin restoration on #21

Ⅲ．Discussion and conclusion：

In the anterior region which require high esthetics, material induced tooth discoloration should be avoided. The discoloration and setting time of the material should be considered. In this case, Endocem Zr（MARUCHI, Wonju, Korea）kind of white MTA, was used which is known to cause less discoloration. Even white MTA was developed to overcome tooth discoloration, it is known to cause it. Also, the presence of blood near to the setting of MTA could intensify discoloration. It has been shown that Biodentine（Septodont, Saint Maur des Fosses, France）has quicker setting time than white MTA which means it could start to block blood component faster. In this case, the use of biodentine may also be a treatment option instead of white MTA.

Hee Jae Kwon

Department of Conservative Dentistry, School of Dentistry, Kyungpook National University

hjkann@naver.com

Management of complicated crown fracture using fragment reattachment

○ **Hyunjoong Kim, Youngmin Kwon**

Department of Conservative Dentistry, Yonsei University Wonju Severance Christian Hospital

Ⅰ．Object：

Crown fracture of maxillary incisor is the most common case in dental trauma. There are several options that can restore tooth structure including fragment reattachment, direct resin build up and crown restoration. Fragment reattachment is one of the most favorable treatment options that can provide reproducibility of the tooth contour and nature colors, preservation of remaining tooth structure, and is faster and less complicated procedure. These two cases present management of crown fracture of maxillary incisor using fragment reattachment.

Ⅱ．Case Presentation：

＜Case Ⅰ＞

1. Sex/Age：M/12
2. Chief Complaint（C.C）：I fell down on my bike and broke my tooth.
3. Present Illness（P.I）：#11 complicated crown fracture, per（＋）mob（－）ice（＋＋）
4. Impression：#11 complicated crown fracture with reversible pulpitis
5. Treatment plan：#11 partial pulpotomy and fragment reattachment

＜Case Ⅱ＞

1. Sex/Age：M/20
2. Chief Complaint（C.C）：I fell down on my bike and broke my tooth. I got pulp extirpation in emergency room 2 days ago.
3. Present Illness（P.I）：#11 complicated crown fracture, per（＋＋）mob（－）, previously initiated state
4. Impression：#11 complicated crown fracture with previously initiated tooth, normal apex
5. Treatment plan：#11 root canal treatment and fragment reattachment with fiber post

Ⅲ．Conclusion：

If fragment is sound and well fit to remaining part, fragment reattachment can be a good option for restoring the appearance of original tooth structure in a short time. When reattaching coronal fragment, hydrating the collagen fibers of fragment, formation of internal dentinal groove on fragment and using overcontouring technique can provide better retention and aesthetics.

Hyunjoong Kim, Youngmin Kwon

Department of Conservative Dentistry, Yonsei University Wonju Severance Christian Hospital

dentkim@yonsei.ac.kr

Fragment reattachment of complicated crown fracture with partial pulpotomy

○ **Jee-Seon Tae, Jin-Woo Kim, Kyung-Mo Cho, Yoon Lee, Se-Hee Park**

Department of Conservative Dentistry, Gangneung-Wonju National University

Ⅰ. Object：

Complicated crown fracture is a dental injury affecting enamel, dentin, and pulp. In initial stage after pulp exposure due to trauma, inflammation is confined within 2 mm of pulp from the exposure site and treatment to preserve vital pulp can be tried. After vital pulp therapy, various treatment approaches are considered to restore the crown portion, depending on the remained tooth structure. This case presents partial pulpotomy and crown reattachment in the tooth with a complicated crown fracture.

Ⅱ. Case Presentation：

＜Case Ⅰ＞

1. Sex/Age：M/16Y
2. Chief Complaint（C.C）：An hour ago I bumped into a friend and broke my front tooth. The broken pieces were brought into the saline.
3. Present Illness（P.I）：Crown fracture, pin point pulp exposure, per（＋）, mob（－）, cold（＋）, EPT d（－）on #11,21
4. Impression：Complicated crown fracture on #11,21
5. Treatment plan：Partial pulpotomy and fragment reattachment on #11,21

Ⅲ. Conclusion：

In complicated crown fracture, even in case of complete root formation, maintenance of pulp vitality may reduce the risk of root fracture in later years. Therefore, in this case with complete root formation, partial pulpotomy was performed using calcium silicate based material. Then the tooth maintained its vitality and normal apical tissue.

Considering the age of the patient, fragment reattachment was performed after partial pulpotomy. Even though there is a risk for reattached tooth to be fallen out, this case shows a favorable esthetic outcome.

Jee-seon Tae

Department of Conservative Dentistry, Gangneung Wonju National University

reblgr414@gmail.com

Deep caries lesion management by using silver diamine fluoride（SDF）: A case report

○ **Jin-Ju Lee, Tae-Young Park, Hyoung-Hoon Jo, Ho-Keel Hwang, Jeong-Bum Min**

Department of Restorative Dentistry, School of Dentistry, Chosun University

Ⅰ. Object：

Large amounts of silver and fluoride are main component of Silver diamine fluoride（SDF）, which also contains ammonia. Due to the ability of SDF formula（$Ag(NH_3)_2F$）to arrest and prevent dental caries with antibacterial action, SDF has been used for children or old people who are hard to get dental treatment. A 12-year-old female visited for mandibular first molar treatment. In periapical radiograph, occlusal caries was close to pulp chamber. And patient had no sign or symptom of pulpitis and incomplete growth of root apex. This case report describes the results of treatment using SDF.

Ⅱ. Case Presentation：

＜Case Ⅰ＞

1. Sex/Age：Female/12
2. Chief Complaint（C.C）：I think i have cavity.
3. Present Illness（P.I）：#36：occlusal deep caries

   Air（＋）per（－）mob（－）EPT（＋）pain（－）
4. Impression：Occlusal dental caries and initial proximal caries
5. Treatment plan：#36：Application of SDF and restoration w/o RCT

Ⅲ. Conclusion：

Managing deep caries lesion of open apex tooth with SDF could be a useful treatment option to avoid unwanted pulp exposure and root canal treatment. Deep caries lesion showed good results without symptoms at 6 months follow-up.

Jinju Lee

Department of Restorative Dentistry, School of Dentistry, Chosun university

wlswn6565@hanmail.net

Management of traumatic crown-root fractured tooth by orthodontic extrusion

○ **Sehun Lim, Youngmin Kwon**

Department of Conservative Dentistry, Yonsei University Wonju Severance Christian Hospital

Ⅰ．Object：

Complicated crown-root fracture is a fracture involving enamel, dentin, cementum and the pulp. Because crown fracture generally extends below gingival margin, three options may be indicated to expose the margins prior to permanent restoration：surgical crown lengthening, orthodontic extrusion, surgical extrusion. Orthodontic extrusion is more non-invasive than the other two options. This case report presents two cases of orthodontic extrusion of traumatic crown-root fractured maxillary central incisor using Mini Tube Appliance.

Ⅱ．Case Presentation：

＜Case Ⅰ＞

1. Sex/Age：M/22
2. Chief Complaint（C.C）：My anterior tooth fractured when I fell off from my bicycle
3. Present Illness（P.I）：#21 per（＋）mob（－）w/pulpal exposure
4. Impression：#21 complicated crown-root fracture
5. Treatment plan：#21 Root canal treatment, Post & Core, Orthodontic extrusion, Zirconia Crown

＜Case Ⅱ＞

1. Sex/Age：M/15
2. Chief Complaint（C.C）：My anterior tooth fractured when I fell off from my scooter
3. Present Illness（P.I）：#21 per（＋）mob（－）w/pulpal exposure
4. Impression：#21 complicated crown-root fracture
5. Treatment plan：#21 Root canal treatment, Post & Core, Orthodontic extrusion, Zirconia Crown

Ⅲ．Conclusion：

Mini Tube appliance was used for traction of crown-root fractured tooth. This approach uses a 3-mm sized mini tube with several advantages compared to the conventional methods. Forced eruption using Mini Tube Appliance can be a satisfactory treatment method in terms of esthetic, comfort and relatively short treatment period.

Sehun Lim, Youngmin Kwon

Department of Conservative Dentistry, Yonsei University Wonju Severance Christian Hospital

isehun@yonsei.ac.kr

Orthodontic extrusion of a subgingivally crown-root fractured maxillary central incisor using hook：A case report

○ **Sun-Joung Jang, Tae-Young Park, Hyoung-Hoon Jo, Jeong-Bum Min**

Department of Restorative Dentistry, School of Dentistry, Chosun University

Ⅰ．Object：

Restoration of a subgingivally fractured central incisor is very difficult. There are four treatment options for subgingivally crown fracture：Extraction, Crown lengthening procedure Surgical extrusion, and orthodontic extrusion. Orthodontic extrusion is considered the most conservative approach among options. Orthodontic extrusion is a good alternative to crown lengthening for restoring the biological width, maintaining the alveolar bone, and restoring esthetics. In the case report describes the result of treatment using orthodontic extrusion.

Ⅱ．Case Presentation：

＜Case Ⅰ＞

1. Sex/Age：Female/26
2. Chief Complaint（C.C）：I heard that the apex of the front teeth has lesion.（Referred from local dental clinic）
3. Present Illness（P.I）：Canal filled and crown loss state
   Periapical radiolucency, per（－）, mobility（－）, pain（－）
4. Impression：loss of dental prosthetic device
5. Treatment plan：Orthodontic extrusion, Clinical crown lengthening, all ceramic crown restoration on #21

Ⅲ．Conclusion：

Crown-root fractures constitute a restorative challenge due to sub-gingival position of the fracture margin. This case demonstrates the functional recovery and esthetic reconstruction of damaged tooth by orthodontic extrusion and prosthetic restoration. Crown-root ratio of the treated tooth was unfavorable, nevertheless it is a valuable treatment option for preserving a natural tooth.

Sun-Joung Jang

Department of Conservative Dentistry, School of Dentistry, Chosun University of Gwangju

65sjoung@naver.com

Fiber reinforced composite resin bridge：Alternative method to restore edentulous area after extraction of periodontally hopeless teeth

○ **Yoon-Joo Lee, Kyung-Mo Cho, Se-Hee Park, Yoon Lee, Jin-Woo Kim**

Department of Conservative Dentistry, Gangneung-Wonju National University

Ⅰ．Object：

When anterior teeth become periodontally hopeless, the most common treatment option is implant-supported crown or fixed dental prostheses（FDPs）after extraction. Implant-supported crown is costly, invasive due to surgery, and requires adequate volume of bone and space. FDPs is also time-consuming and needs preparation of intact adjacent teeth.

Fiber reinforced composite resin bridge can be an alternative method without damaging adjacent teeth and surgery. This conservative and esthetic technique using extracted natural tooth as a pontic, is cost-effective and available with one visit appointment. This case presentation describes Fiber reinforced composite resin bridge to replace periodontally hopeless teeth after extraction.

Ⅱ．Case Presentation：

＜Case Ⅰ＞

1. Sex/Age：M/56Y
2. Chief Complaint（C.C）：My lower anterior teeth are turning black and have mobility.
3. Present Illness（P.I）：#41 external resorption suspected, per（－）, mob（＋＋）, cold（－）, EPT（－）
   #42 per（＋）, mob（＋＋＋）, cold（－）, EPT（－）, hopeless teeth
   #31, 43 per（－）, mob（－）, cold（n）, EPT（4/10）
4. Impression：#41,42 hopeless teeth
5. Treatment plan：#41,42 extraction, Fiber reinforced composite resin bridge

Ⅲ．Conclusion：

Patients with loss of anterior teeth expects immediate and esthetic restoration. Fiber reinforced composite resin bridge is cost-effective, time-saving, esthetic and minimally invasive treatment option. This technique also has advantages in that it can be easily repaired when fracture occurs, and minimal effort is required to consider size, shape, and color of the pontic. But, there are various considerations related to periodontal status including alveolar ridge and gingiva. With these considerations, Fiber reinforced composite resin bridge can be a good alternative method to restore edentulous area after extraction of periodontally hopeless teeth.

Yoon-Joo Lee

Department of Conservative Dentistry, Gangneung-Wonju National University

lyj1642@naver.com

Single cell RNA analysis of dental pulp & dental pulp stem cells

○ **Sukjoon Lee[1], Yunjung Song[2], Sunil Kim[3], Euiseong Kim[3]**

[1]Oral Science Research Center, Yonsei University College of Dentistry
[2]Seoul National University Gwanak Dental Hospital
[3]Department of Conservative Dentistry, Yonsei University College of Dentistry

Ⅰ. Object：

The purpose of this study was to investigate the characteristics and heterogeneity of human dental pulp and human dental pulp stem cells by single cell RNA sequencing.

Ⅱ. Materials & Methods：

Human dental pulp was obtained from caries free third molar and dissociated by digestion solution（2 mg/ml collagenase, 4 mg/ml dispase）. Human dental pulp stem cells were primary cultured from human dental pulp by outgrowth method. Single cell level RNA library was generated by 10X chromium‘controller’and analyzed by‘seurat’R package.

Ⅲ. Results：

Human dental pulp stem cells were separated into 3 clusters, mainly exhibited osteogenic and neurogenic cells populations. Human dental pulp was consisted of 9 clusters：Tissue stem cells, Neurons, Endothelial cells, Smooth muscle cells, and immune cells populations（Macrophages, monocytes, T cells, NK cells, and Neutrophils）. Main populations of immune cells were T cells and Monocyte. Data showed 1：10 CD4 and CD8 T cells ratio and only 12 B cells were observed.

Ⅳ. Conclusion：

Single-cell RNA sequencing of human dental pulp and human dental pulp stem cells revealed that the genes were expressed in specific clusters. The results of these analyses can be used as reference databases and valuable resources for further research in dental therapeutics.

Euiseong Kim
Department of Conservative Dentistry, Yonsei University College of Dentistry
andyendo@yuhs.ac

Anti-inflammatory effect of icariin in LPS-induced inflammation in hDPCs

○ **Guo Liu, Bin-Na Lee, Yun-Chan Hwang**

Department of Conservative Dentistry, Chonnam National University

Ⅰ. Object：

Icariin（4′-O-methyl-8-γ, γ-dimethylallylkaempferol-3-rhamnoside-7 glucoside）is flavonoid glucoside derived from the plant genus Epimedium. Although icariin mechanism of action has not been completely identified, it is widely used for anti-inflammatory and immunomodulatory effects. We examined the anti-inflammatory effects of icariin in lipopolysaccharide（LPS）-induced human dental pulp cells（hDPCs）.

Ⅱ. Materials & Methods：

The cell viability of bromelain was measured using WST-1 assay. We exposed hDPCs to 5 μg/mL of LPS with 2.5, 5, 10, 20 μM of icariin. Reverse-transcription polymerase chain reaction and enzyme-linked immunosorbent assay were used to detect interleukin-1β, interleukin-6, interleukin-8, PGE2, vascular cell adhesion molecules-1（VCAM-1）, and intercellular adhesion molecules-1（ICAM-1）. Western blots were used to detect intercellular adhesion molecules-1 VCAM-1, ICAM-1, and Cox2, and were used to determine Icariin's anti-inflammatory mechanism.

Ⅲ. Results：

Icariin 2.5, 5, 10, or 20 μM did not significantly affect the viability of hDPCs. LPS increased interleukin-1β, interleukin-6, interleukin-8, ICAM-1, VCAM-1, Cox2, PGE2 expression in hDPCs. Icariin significantly inhibited interlukin-1β, interleukin-6, interleukin-8, ICAM-1 and VCAM-1, Cox2, PGE2 in LPS-stimulated hDPCs. Icariin treatment significantly lessened the phosphorylation of IkB and p65. Icariin significantly decreased phosphorylation of AKT.

Ⅳ. Conclusion：

Icariin inhibited the expression of inflammatory mediators in dental pulp cells stimulated with LPS. The inhibitory effect of Icariin on inflammatory cytokines is associated with the inhibition of the NF-κB and the AKT pathway. Therefore, Icariin might be a useful candidate as a vital pulp therapy and for regenerative endodontics.

Yun-Chan Hwang
Department of Conservative Dentistry, Chonnam National University
ychwang@chonnam.ac.kr

Push-out bond strength and intratubular biomineralization of a newly developed hydraulic root-end filling material premixed with dimethylsufoxide as a vehicle

○ **Kyung-San Min**

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

Ⅰ. Object：

This study aimed to evaluate the bonding performances to root dentin including push-out bond strength and dentinal tubular biomineralization of a hydraulic bioceramic root-end filling material premixed with dimethyl sulfoxide（EndocemMTA Premix；Maruchi）in comparison to a conventional powder-liquid type cement（ProRoot MTA, Dentsply Sirona）.

Ⅱ. Materials & Methods：

The root canals of single-rooted premolars were filled with either ProRoot MTA or EndocemMTA Premix（$n=15$）. Two slices of dentin specimen were obtained from each tooth. With the coronal segment, push-out bond strength was measured and the failure pattern was observed under a stereomicroscope. The apical segment was divided into two halves and the split surface was observed under a scanning electron microscope, and then the intratubular biomineralization was examined by observing the precipitates formed in the dentinal tubule. Then, the chemical characteristics of the precipitates were evaluated with energy dispersive x-ray spectroscopic（EDS）analysis. The data were analyzed by Student *t*-test, followed by the Mann-Whitney *U* test（$p<0.05$）.

Ⅲ. Results：

There was no significant difference between the two tested groups in the push-out bond strength and the cohesive failure was predominant. In both groups, flake-shaped precipitates were observed along dentinal tubules. The EDS analysis indicated that the mass percentage of calcium and phosphorus in the precipitate was similar to hydroxyapatite.

Ⅳ. Conclusion：

Regarding the bonding performance to root dentin, EndocemMTA Premix might have the potential to be used as an acceptable root-end filling material.

Kyung-San Min
Department of Conservative Dentistry, School of Dentistry, Jeonbuk National University
mksdd@jbnu.ac.kr

Distribution of crack lines on the labial tooth surfaces depending on age, trauma history, and other habits evaluated by quantitative light-induced fluorescence technology

○ **Soohyun Hong, Soyeon Yang, Ga-Young Oh, Mi-Jeong Jeon, Jeong-Won Park, Su-Jung Shin**

Department of Conservative Dentistry, Gangnam Severance Dental Hospital, Yonsei University, College of Dentistry

Ⅰ. Objective：

Quantitative light-induced fluorescence（QLF）technology detects early carious lesions by irradiating teeth with visible blue light at a wavelength of 405 nm. Recent studies advocated that this technology helps detect crack lines on the tooth surfaces and restorations. This study aimed to evaluate the distribution of crack lines detected by QLF technology.

Ⅱ. Materials & Methods：

This retrospective study was conducted after receiving approval from the Gangnam Severance Dental Hospital（IRB No.：3-2021-0422）. Patients who visited our institution from January 2022 to July 2022 had their teeth inspected using a Qraycam（All-in-One Bio）with three different angled images（one straight and two lateral images）. The labial surface of each tooth was evaluated and classified as one of the following：normal（N）, crack line（s）（C）, noncarious cervical lesion（A）, crack lines（s）＋noncarious cervical lesion（C＋A）, missing tooth or crown restoration（X）. Data regarding patients' age, sex, history of dental trauma, TMJ problem, and eating habit was recorded. Pearson correlation analysis was performed to evaluate the correlation between the distribution of crack lines and cervical lesions and the host factors using SAS version 9.4（SAS Institute, $P<0.05$）

Ⅲ. Results：

One hundred thirty-three patients-89 female and 44 male patients were included in the study. Out of 109 patients whose records existed, 21 patients experienced dental trauma history, 26 patients had TMJ problems, and 15 patients had a habit of eating hard food. Crack lines and noncarious cervical lesions appeared to increase depending on aging. The patients under 20 years old（n＝5）showed crack lines and cervical lesions in 38.2% and 0.8% of the teeth. However, cracks and cervical defects were found in 72.1% and 46.8% of teeth in patients over 60 years old（n＝44）, respectively. There was a significant correlation between the incidence of crack lines combined with noncarious cervical lesions and the history of dental trauma.（$P<0.05$）

Ⅳ. Conclusion

Crack lines and cervical noncarious lesions were frequently found in elderly patients. Based on the current study, dental trauma history appeared to be related to the incidence of crack lines combined with cervical defects. QLF technology seems to be valuable and beneficial in the early screening of crack lines.

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Soohyun Hong, Su-jung Shin

Department of Conservative Dentistry, Gangnam Severance Dental Hospital, Yonsei University, College of Dentistry

soohyunhong@yuhs.ac, sujungshin@yuhs.ac

Can an artificial dura mater be used for vital pulp therapy?
—A pilot study for material selection—

○ YoungKyun Kim, Mi-Jeong Jeon, Jeong-Won Park, Su-Jung Shin

Department of Conservative Dentistry, Gangnam Severance Dental Hospital, Yonsei University, College of Dentistry

Ⅰ. Objective：

Vital Pulp Therapy（VPT）has been more popular, and favorable outcomes of VPT have been reported recently. When calcium silicate cements are used for VPT, calcification or dentinal bridge formation in the rest of the pulp often occurs due to the materials' osteo/dentinogenic activity. Moreover, removing inflamed pulp is critical to maintaining the remaining tissue's vitality. The inflamed dental pulp becomes necrotic because due to its low compliance environment. Brain skull has a similar environment as tooth structure. When inflammation and swelling occur, part of the brain skull is removed, and an artificial dura mater substitute is applied to cover the inflamed brain until the inflammation subsides. With this background, this study was performed to investigate the possibility of using an artificial dura mater as a barrier for VPT to cover the exposed pulp tissue. As a first step, this study evaluated the surface configuration and water absorption ability of selected artificial dura mater substitutes on the market.

Ⅱ. Materials & Methods：

Two types of non-resorbable artificial dura mater substitution- Neuropatch（B.Braun）and Biodesign（Cook biotech incorporated）were selected. Histoacryl（B.Braun）, used for hemostasis and material attachment in the neurosurgery field, was also evaluated. Water sorption of both membranes with and without Histoacryl was estimated by mass change. The initial weight of substitution（m1）was measured. Then the specimen（n＝6）was soaked in distilled water for 10 seconds. Superficial water bubbles were removed gently, and measurement was done（m2）. Mass change of substitution was calculated：（m2－m1）/m1 * 100（%）. The surface morphology of these membranes was observed by Scanning Electron Microscopy（SEM）. To analyze the difference in the water resorption among different materials, repeated measure One-way ANOVA and Šidáks multiple comparisons test were used by Prism 9（Version 9.4.1）（GraphPad Software, LLC）（$P<0.05$）.

Ⅲ. Results：

The mean mass change of Neuropatch was 1.12±3.66%, and Neuropatch with Histoacryl was 1.75±1.05%. Biodesign showed the most significant mass increase by 152±20.4%. Biodesign with Histoacryl showed a mass change of 3.64±4.86%. There was a statistically significant difference among groups（$P<0.05$）. And Biodesign group were a higher water resorption rate than other groups（$P<0.05$）. SEM images of specimens showed different surface morphology of two different products. And adding Histoacryl to these membranes seemed to change the membrane surface.

Ⅳ. Conclusion

It is suggested that Neuropatch and Biodesign can be tested for material for VPT. Based on the current study, Biodesign has the potential for resorbing tissue fluid.

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YoungKyun Kim, Su-jung Shin

Department of Conservative Dentistry, Gangnam Severance Dental Hospital, Yonsei University, College of Dentistry

lancekim117@yuhs.ac, sujungshin@yuhs.ac