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Practice Limited to Endodontics

Bacteria in Dentinal Tubules of Root Filled Teeth

In an attempt to find root canal filling materials that provide a superior seal against coronal leakage, a significant number of studies have been performed. However, numerous contradictions in clinical outcomes have been found between the results of studies using similar methodologies. The validity of comparing root filling materials and techniques using 2-chamber model studies has been questioned. Kwang and Abbott from the University of Western Australia investigated the presence and distribution of bacteria within dentinal tubules following exposure of teeth roots to bacteria using a 2-chamber model to assess the dentin tubular network as a possible route for bacterial penetration.

Root canals of teeth in the experimental group ($n = 16$) were instrumented and filled using AH26 sealant and gutta-percha. Canals in the teeth serving as positive ($n = 1$) and negative ($n = 1$) controls were instrumented, but not filled. A 2-chamber model was fabricated for each root. The upper chambers were inoculated weekly with *Streptococcus gordonii* in brain-heart infusion broth for 90 days. Turbidity of the lower chamber was checked daily.

Samples that showed turbidity during the experimental period and those that showed no signs of turbidity at 90 days were fractured and prepared for scanning electron microscopic examination for the presence of bacteria within the dentinal tubules in the cervical, middle and apical root thirds. During the examination of each root third, the depth of bacterial penetration was recorded as inner, middle or outer dentin. The negative control showed no signs of turbidity at 90 days, and the positive control showed signs of turbidity within 2 days.

Bacteria were most commonly observed within the inner dentin of the cervical and middle thirds of the roots (Figure 1). This spatial distribution of bacteria suggested that bacteria from the exposed cervical dentinal tubules penetrated the main root canal. Cervical dentinal tubules were observed to travel in a corono-apical direction from the sectioned root face exposed to the bacterial challenge toward the main root canal.

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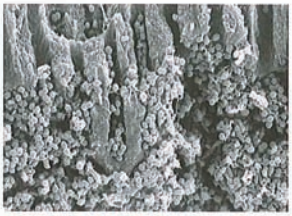

Figure 1. Scanning electron micrograph showing bacteria penetrating the dentinal tubules in the coronal third of the root. *(Image courtesy of Dr. Frederic Barnett.)*

Conclusion

The dentin tubular network provides a potential pathway for bacteria to penetrate the tooth root in a coronoapical direction, as demonstrated in this study using a 2-chamber model. This provides an alternative explanation for the results of other coronal leakage studies. Host immune defenses against bacterial penetration also play a role, but it is not possible to explore the impact of these factors in a laboratory-based model.

Kwang S, Abbott P. The presence and distribution of bacteria in dentinal tubules of root filled teeth. Int Endod J *2014;47:600-610.*

Treating Intrusive Luxation of Permanent Teeth

Intrusive luxation is the displacement of the tooth into the alveolar bone along the tooth's long axis and is accompanied by an alveolar fracture. Despite comprising only 0.3% to 1.9% of all dental traumas affecting permanent teeth, this injury is one of the most severe dental injuries.

Traumatic intrusion often affects a single tooth, especially the central or lateral incisor, and is usually caused by falls during which the tooth is hit and displaced into the bone. The pulp tissue loses its vascular supply, and the periodontal ligament is crushed against the socket walls.

The prognosis for this injury is poor, and severe complications predominate in the long term. However, in some cases, the intruded tooth can heal and function normally, without leading to eventual tooth loss.

Treatment for this type of trauma can be performed either actively, by repositioning (surgical or orthodontic extrusion), or passively (by spontaneous re-eruption). The International Association of Dental Traumatology has recommended active repositioning of teeth that fail to show signs of spontaneous re-eruption within 2 to 4 weeks. However, the choice of treatment is controversial, and previously published recommendations are often contradictory or unclear.

AlKhalifa and AlAzemi from the Ministry of Health, Kuwait, conducted a systematic review of the literature on intrusive luxation of permanent teeth. They assessed various treatment methods by the risk of complications and other important factors that need to be taken into consideration when determining the choice of treatment. Structured electronic and hand searches were performed for publications in English that included all age groups. Included studies compared spontaneous re-eruption to surgical and orthodontic extrusion and had follow-up periods of ≥6 months.

Of the 117 studies identified, only 3 cohort studies were suitable for inclusion. No meta-analysis could be conducted because of methodological and clinical heterogeneity. It was found that spontaneous re-eruption resulted in the fewest complications, with a low failure rate of 5% to 12%.

The following factors affected the prognosis of intrusive luxation:

1 Deeper intrusion significantly increased the risk of root resorption (replacement root resorption, inflammatory root resorption and surface root resorption).

2 Root development was strongly correlated with pulp survival (the chance of revascularization increased in roots with open apices).

3 Patient age was more strongly related to marginal bone loss; older patients had greater bone loss.

There was insufficient evidence that either of the 2 active treatment options, surgical repositioning or orthodontic extrusion, is superior to the other.

Conclusion

Current treatment guidelines are not based on strong evidence. Given that infection can be controlled by endodontic therapy, it appears that spontaneous re-eruption results in the fewest complications in immature teeth, regardless of the degree of intrusion. But high-quality observational studies with large numbers of patients must be conducted before any firm recommendations can be made about treating intrusive luxation.

AlKhalifa JD, AlAzemi AA. Intrusive luxation of permanent teeth: a systematic review of factors important for treatment decision-making. Dent Traumatol *2014; 30:169-175.*

Oral Rehydration Salt-liquid as a Storage Medium

Avulsion injuries, which account for as many as 0.5% to 16% of all traumatic injuries to permanent anterior teeth, occur most often in children from 7 to 9 years of age. Ideally, immediate replantation of the avulsed tooth gives the best prognosis. However, immediate replantation of the tooth is not always feasible.

The factors that play a significant role in the healing of the periodontal ligament (PDL) after the replantation of an avulsed tooth are

- the amount of physical damage to the root surface
- the type of medium in which the avulsed tooth is stored
- the length of extraoral dry time

Ideally, a storage medium should be a physiological solution that closely replicates the oral environment. This helps preserve the viability of PDL cells following avulsion. Subramaniam et al from the Oxford Dental College and Hospital, India, studied the potential of oral rehydration salt-liquid (ORS-L) as a storage medium for avulsed teeth.

The study aimed to evaluate the efficacy of ORS-L as a suitable medium for maintaining the PDL cell viability over different time periods and to compare its efficacy with that of 2 other storage media: Hank's Balanced Salt Solution (HBSS) and milk.

A total of 130 intact and caries-free premolars indicated for orthodontic extraction were collected from healthy children aged 13 through 18 years. Informed consent was obtained from patients and parents for the use of these teeth, which were extracted atraumatically. Of these teeth, 120 premolars were randomly divided into 3 experimental groups (n = 40) for immersion in three different storage media:

1. HBSS
2. cold, pasteurized whole cow's milk
3. ORS-L

Each tooth was then placed in a sterile test tube and subjected to 30 or 60 minutes of extraoral dry time. Each experimental group was further subdivided into 2 groups of 10 teeth each, based on immersion times of 45 and 90 minutes, respectively. The remaining 10 premolars were divided into 5 positive and 5 negative control teeth.

All teeth were subjected to collagenase type II and dispase grade II assays. The trypan blue dye exclusion test was used to determine the viability of PDL cells. The number of viable cells was counted using a hemocytometer. Data obtained were subjected to statistical analysis using 1-way analysis of variance and post hoc Tukey's tests. The mean number of viable cells using different storage media following extraoral dry time can be seen in Table 1.

Conclusion

ORS-L was found to be as efficient as HBSS in maintaining the viability of PDL cells at all time intervals. ORS-L was also found to be more efficient at maintaining a significantly higher number of viable cells than was milk.

Subramaniam P, Girija P, Eswara U, Babu KLG. Oral rehydration salt-liquid as a storage medium for avulsed tooth. Dent Traumatol *2014;doi:10.1111/edt.12127.*

Table 1. *Mean number of viable cells using different storage media, following extraoral dry time*

	Number of viable cells							
	Extraoral dry time 30 min (*n* = 60)				Extraoral dry time 60 min (*n* = 60)			
Storage medium	Immersion time 45 min (mean ± SD) (*n* = 10)	Immersion time 90 min (mean ± SD) (*n* = 10)	Difference	*p* value	Immersion time 45 min (mean ± SD) (*n* = 10)	Immersion time 90 min (mean ± SD) (*n* = 10)	Difference	*p* value
HBSS	348.0 ± 19.25	331.1 ± 6.90	16.9	.086	293.1 ± 20.43	268.9 ± 10.80	24.2	.006[a]
Milk	297.5 ± 12.47	263.2 ± 10.13	34.3	.001[a]	235.3 ± 5.72	210.6 ± 8.93	24.7	.001[a]
ORS-L	343.5 ± 11.66	323.9 ± 7.65	19.6	.001[a]	276.4 ± 7.25	242.7 ± 5.68	33.7	.001[a]

[a]*Significant at p < .05. Min, minutes; SD, standard deviation.*

Coronal Restorations and Fracture Resistance Of Endodontically Treated Teeth

The survival rates of endodontically treated teeth over a 2- to 10-year period vary from approximately 86% to 93%. With regard to apical healing, sufficient root canal treatments in combination with sufficient postendodontic coronal restorations show success rates of up to 91.4%. But the success rate can decrease to 44% for teeth with an insufficient postendodontic restoration. The coronal restoration has had a statistically significant influence on the success rate of root canal treatments.

In a retrospective study, Dammaschke et al from the University of Münster, Germany, evaluated the influence of coronal restorations on the fracture resistance of root canal-treated teeth. They attempted to reach conclusions regarding the correlation of root canal treatments and postendodontic restorations, and then gave clinical recommendations based on those findings.

Based on the dental records of patients treated at the university's dental school between January 1991 and December 2000, 1033 endodontically treated posterior teeth (690 patients) received postendodontic restorations. Restoration materials included glass ionomer cement (GIC), amalgam fillings or composite restorations; prosthodontic restorations included gold partial crowns, full crowns, bridges, and bridges and crowns with additional individual posts and cores or prefabricated metal posts.

Inclusion in the study was based on the following criteria:

- Teeth had been treated continuously at the university dental school.
- All treatments and examinations had been fully recorded.
- The patient(s) had participated in the recall system after completing endodontic treatment.
- Only 1 restoration per patient was included in the study to avoid clustering of teeth within patients.
- The latest examination occurred after January 2006 to ensure a minimum postendodontic treatment observation period of 5 years.
- Each treated tooth had at least 1 approximal contact and opposing dentition with occlusal load.

Only teeth extracted because of a fracture or hard-tissue damage due to the coronal postendodontic restoration were included in the study. Teeth extracted because of insufficient root canal treatment or for periodontal reasons were excluded.

Approximately 86.2% ($n = 583$) of the examined teeth survived the observation period of 9.7 years without fractures. A binary logistical regression analysis showed that only the type of restoration and the cavity size had a statistically significant influence on the fracture rate of the teeth (Figure 2). The mean fracture rate of teeth restored with full crowns was significantly lower than that of teeth restored with GIC or amalgam ($p < .05$).

Conclusion

Teeth with cavities on >3 surfaces should be provided with a full crown or partial crown because the survival rates with a composite filling material decreased in these teeth.

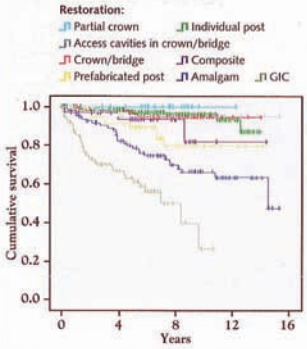

Figure 2. Survival (teeth without fracture) in relation to type of restorations.

Dammaschke T, Nykiel K, Sagheri D, Schäfer E. Influence of coronal restorations on the fracture resistance of root canal-treated premolar and molar teeth: a retrospective study. Aust Endod J *2013; 39:48-56.*

In the next issue:

- Middle mesial canals in mandibular molars
- Internal root resorption
- Management of sodium hypochlorite injuries

Do you or your staff have any questions or comments about **Update on Endodontics**? Please call or write our office. We would be happy to hear from you.

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