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Aim and Scope

The Columbia Dental Review (CDR) is an annual publication of Columbia University College of Dental Medicine (CDM). This journal is intended to be a clinical publication, featuring case presentations supported by substantial reviews of the relevant literature. It is a peer-reviewed journal, edited by the students of the school. The editors are selected on the basis of demonstrated clinical scholarship.

Authors are primarily CDM students from pre-doctoral and post-doctoral programs, CDM faculty and residents, and attendings from affiliated hospitals. Peer reviewers are selected primarily from the CDM faculty. Submissions undergo a blind peer review system whereby the authors are not known by the reviewers (at least two per manuscript). Instructions for authors wishing to submit articles for future editions of the CDR can be found on the last page of this journal. Opinions expressed by the authors do not necessarily represent the policies of Columbia University College of Dental Medicine.

Editors’ Note

Dear Readers,

The CDR was created to give Columbia dental students a voice in current dental research. In an effort to create a diverse dental journal, our authors, in collaboration with faculty, have researched a wide array of topics covering many different facets of dentistry. This publication represents CDM’s commitment to collaboration, education, and providing optimal dental care supported by evidence-based research.

On behalf of all the editors and assistant editors, we would like to thank Dr. Letty Moss-Salentijn for all her guidance and expertise on journal publications, which has kept this award-winning student publication alive and well. Finally, we would like to thank the authors, faculty reviewers, assistant editors, and graphic designer. Certainly, this seventeenth volume of the CDR would not have been possible without their contributions.

Sincerely,

Jose Castillo ’14 and Pasha Shakoori ‘14

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A Simple Technique to Fabricate an Oral Radiation Shield Using Triad Custom Tray Material

Maria Helena Brachowicz[1], Paul Jones Jr DDS[2], Jason J. Psillakis DDS, MS[3], Javier Urquiola, DDS[4]
[1]Class of 2013, College of Dental Medicine, Columbia University, New York, NY
[2]Prosthodontics Resident, Division of Prosthodontics, College of Dental Medicine, Columbia University, New York, NY
[3]Associate Professor of Clinical Dental Medicine, Division of Prosthodontics, College of Dental Medicine, Columbia University, New York, NY
[4]Private Practice, Englewood, NJ

Abstract

Radiation therapy for treatment of oral cancers is a well-established, common and highly effective modality due to high responsiveness of these tumors and ease of access[1-3]. Unfortunately, post-radiation damage to healthy tissues surrounding the tumor can range in severity from slight post-treatment discomfort to life-threatening necrosis[4-7]. Thus, a radiation shield should always be fabricated to reduce the dose and severity of radiotherapy's side effects on surrounding healthy tissue. Reconstruction and rehabilitation after radiotherapy has been studied extensively[8] whereas literature on radiation shielding during therapy is not as widespread and well-established as would be desired to reduce radiotherapy side effects[9]. This article presents an easy approach to making a customized radiation shield for these select cancer lesions that is easy to create, place and remove, adjust, clean, repair, use multiple times, and is of minimal weight.

Introduction

Epidemiology of oral cancer

One in 4 deaths in the US is due to cancer, which is the 2nd leading cause of deaths in the US (following cardiovascular disease)[10]. Of all malignant cancers, head and neck ones represent 4% in the US. However, India and Southeast Asia report numbers of about 35%[11]. Similar numbers are reported in Brazil and similar developing countries. In the world, head and neck cancer it is the sixth most common cancer. Additionally, over 90% of head and neck cancers are squamous cell carcinomas (SCC) and this number is rising in females8. Although chemotherapy is increasingly being incorporated into SCC therapy, surgery and radiotherapy are still the standard treatment[11].

Radiation therapy and side effects

Radiation therapy is commonly used in treating oral cancers as a means of controlling cancer cells and preventing the spread of cancer to adjacent cells. While proven successful in treating cancerous cells, high doses of radiation is equally damaging to non-cancerous cells in the radiation field causing acute and late toxicities[11]. When treating patients with oral cancers, one primary goal is to obtain control of the neoplasm while preserving the surrounding tissues and structures of the oral cavity.

Table 1
Oral Complications of Cancer Therapy

Complication	Symptoms
Acute	
Mucosal	Mucositis, pain, dysphagia, limited oral function
Saliva change	Viscosity, volume
Neurosensory	Taste alteration, taste loss, neuropathic pain
Infection	
Dental/periodontal	Acute exacerbation of chronic infection
Mucosal	Candida, herpes, other
Limited movement	Opening of the jaw, tongue function
Chronic	
Mucosal pain	Atrophy, neuropathy
Saliva	Viscosity, hyposalivation
Neurosensory	Taste alteration, taste loss, halitosis, mucosal neuropathy, trismus
Limited movement	Lip aperture, mucosa, musce/TMJ, neck, shoulder, tongue, trismus
Infection	
Mucosal	Pain, halitosis
Dental	Demineralization, caries
Periodontal	Advanced attachment loss, mobility
Risk of mucosal injury	
Necrosis	Soft tissue, bone
Esthetic impact	Social withdrawal, low quality of life, depression
Speech	Social withdrawal, depression
Mastication/ dysphagia	Impact on energy and nutrient intake

TMJ indicates temporomandibular joint.

Adapted from Epstein et al.[14]

The structures of the oral cavity most sensitive to radiation are the mandibular bone, mucosa of the floor of the mouth, teeth and surrounding gingiva, salivary glands and the jaw muscles. If a patient has metallic restorations, its backscatter raises radiation exposure locally, resulting in more aggressive mucosal reactions that can be avoided with the radiation shielding[12].

Common acute toxities include mucositis, stomatitis and dermatitis whereas late toxic effects include chronic xerostomia, dysguesia, dysphagia, skin fibrosis, trismus, aspiration, altered salivary gland function, and radiation caries. There is a potential for osteoradionecrosis of the jaw from infection or trauma to the irradiated bone[13]. Table 1 shows a full list of oral complications seen after radiotherapy.

Radiation shielding

Radiation shielding is an effective modality in preventing and limiting the co-morbidities associated with radiation therapy. Prior studies have demonstrated the dose reduction capabilities of radiation shields composed of dental materials such as acrylic resin and silicon that were fabricated for other areas of the body[15]. This article outlines the simple and time-efficient technique of using two traditional dental materials, base plate wax and Triad Custom Tray material, in conjunction with Cerrobend metal to fabricate a radiation shield for a patient undergoing radiation treatment for squamous cell carcinoma of the lower lip.

These shields can be used for patients with primary cancer of the oral cavity, oropharynx, paranasal sinuses and salivary glands[15].

Components of the radiation shield

Triad custom tray material and Cerrobend are materials that are commonplace and accessible to prosthodontists, making them ideal for the creation of radiation shields[15].

Cerrobend (Lipowitz's metal – 50% bismuth, 26.7% lead, 13.3% tin, and 10% cadmium) is the ideal metal of choice when creating intraoral radiation shields because it is very effective in shielding electron beams and has a low melting point of 158°F (70°C), which allows the molten alloy to be placed in the triad material without damaging it[12,13]. The thickness of Cerrobend needed for effective shielding depends on the energy of the electrons used and is determined by the radiotherapist[16]. Ideally, 1cm or greater in thickness is preferred, as 1cm thickness of Cerrobend will prevent transmission of 95% of an 18-MeV electron beam[17]. After cooling, the metal is coated with at least 0.5cm of the acrylic resin (the triad material) in order to minimize electron backscatter and to prevent metal contact with mucosa[15].

Case Report

A patient diagnosed with squamous cell carcinoma was referred by the radiation oncology clinic for the fabrication of a radiation shield to protect the non-cancerous structures surrounding the patient's cancerous lesion on the lower lip (Figure 1).

Figure 1 *Squamous cell carcinoma of the lower lip*

Prior to fabricating the radiation field the physician consulted/collaborated with the prosthodontist to discuss the nature of the patient's radiation therapy. Consideration was given to the duration of treatment, the location and size of the radiation field, and the dose of radiation when evaluating the patients overall risk. Moreover, a pretreatment assessment of all teeth, especially those located within the radiation field, was conducted to identify caries and periodontal involvement as the patient would be more susceptible to dental caries, periodontal disease and oral infections following radiation therapy.

Alginate Impressions of the mandibular arch were made and poured up in Type II stone (Figure 2).

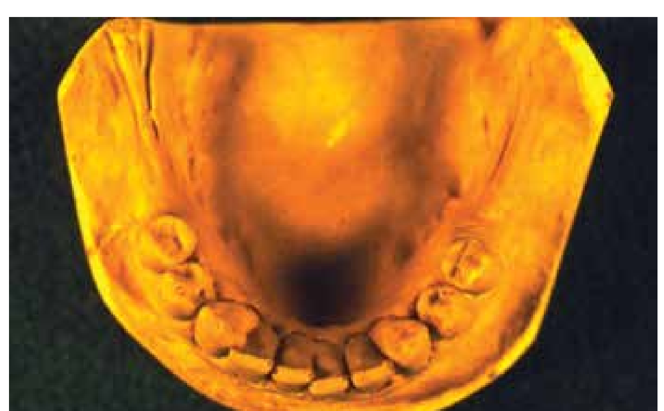

Figure 2 *Stone cast of patient's mandible*

The stone cast was lubricated with petrolatum jelly and two layers of base plate wax were adapted around the existing dentition (Figure 3A). Triad Custom Tray material was molded around the wax and extended slightly onto the ridge and lingual areas and cured (Figure 3B). Base plate wax built up to a thickness of 5mm was adapted around the cured Triad (Figure 3C). This thickness of base plate wax will later be replaced by Cerrobend metal which shields the tissues from radiation.

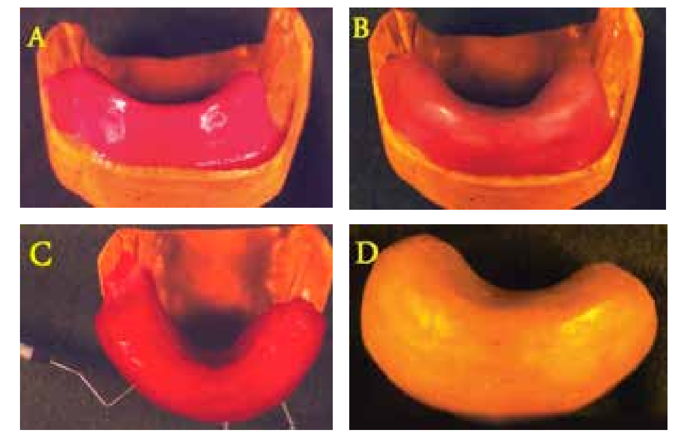

Figure 3 ***A)*** *Base plate wax on dentition.* ***B)*** *Triad custom tray material is then added on top and extended onto ridge.* ***C)*** *5mm of wax is adapted on cured Triad.* ***D)*** *A final layer of Triad is molded on wax and attached to the under layer of triad.*

The thickness of metal, and thereby wax, is prescribed by the radiation oncologist, and is related to the amount of shielding needed. Another layer of triad is molded around the base plate wax and attached to the under layer of triad at the area of the ridge and lingual aspects (Figure 3D). An opening is made along the incisal/occlusal area from teeth #21-28 (Figure 4). This is then cured. The wax is removed by washing with boiling water.

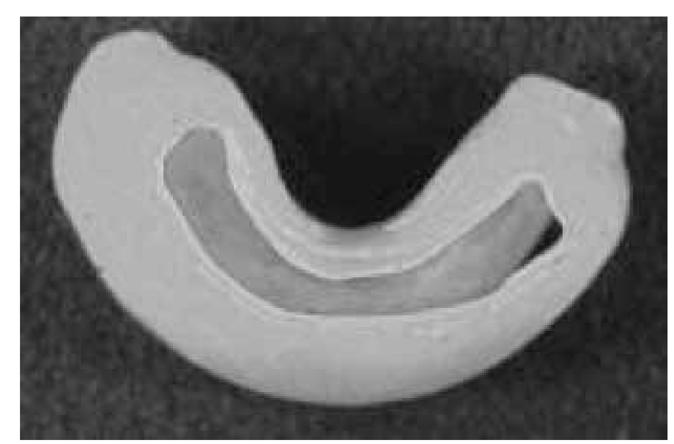

Figure 4 *Top view of tray is shown. Wax from inside of Triad material was removed and will be replaced with Cerrobend metal through the opening on the top. This opening will then be closed with more triad material to seal the metal inside.*

Water was poured in to the reservoir to test for leakage. Molten Cerrobend metal was poured into the reservoir and allowed to cool. The incisal /occlusal opening was sealed with Triad (Figure 5). The shield was delivered and checked by the radiation therapist.

Figure 5 *Radiation shield containing Cerrobend metal is now ready to be checked by the radiation therapist. Both sides of shield are shown (top and bottom).*

Figure 6 *Radiation shield in place and ready to be used*

Discussion

There are very little studies and randomized clinical trials that determine the extent of attenuation intra-oral radiation shields provide on healthy tissues. Some studies have shown various thicknesses of Cerrobend that prevent a percentage of radiation passing through the shield to non-cancerous tissues[18,19].

There are, however, several related studies with mucosa-sparing shielding blocks of tumors of the oral cavity, oropharynx, and nasopharynx that show statistically significantly reduction in acute toxicity onto healthy tissues without compromising tumor control[20].

A review of the literature shows numerous articles focusing on treatment of post-radiation complications that include anti-inflammatory and mucosa-protecting agents as well as locally and systemically applied pharmacotherapeutics21. Many of these treatment modalities are still in the experimental stages and there are yet more advancements that need to occur in the field. Yet, very little literature and studies exist on preventing these same side-effects by using of radiation shields during radiotherapy, which would be preferred over treating them after radiotherapy, once they already occurred[20-21].

Radiation shielding can also improve the success, time and course of the treatment. Studies have reported that acute toxicities can lead to interruption in treatment in some cases of 15% and last 5 days on average, allowing for tumor repopulation and reducing local tumor control by about 14%[20]. Thus, shielding, which reduces these acute toxicities can also lead to less treatment interruption for the patient. Thus, the purpose of this manuscript was to describe an easy approach to making a customized radiation shield for these select cancer lesions that is easy to create, place and remove, adjust, clean, repair, use multiple times, and is of minimal weight.

Conclusion

Radiation shields can attenuate or prevent multiple post-radiation oral complications on healthy tissues surrounding malignant tumors. At times, the medical specialists are not aware of the services the prosthodontist or dentist can provide to create these shields. Consequently, it is very important that the radiotherapist and medical team work closely with the prosthodontist/dentist in order to maximize the patient's treatment outcomes and ultimately their quality of life.

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Obtaining Root Coverage of Miller Class III recession defects using Allografts and the Tunnel technique: A Case Report

Tina Jung[1], Alain Jureidini DDS[2], Daniel Royzman DDS, MMSc[3]
[1]Class of 2014, College of Dental Medicine, Columbia University, New York, NY
[2]Periodontics Resident, Division of Periodontics, College of Dental Medicine, Columbia University, New York, NY
[3]Assistant Clinical Professor, Division of Periodontics, College of Dental Medicine, Columbia University, New York, NY

Abstract

Gingival recession is a common problem that affects a majority of Americans. A predictable way of treating recession is root coverage surgery such as guided tissue regeneration and subepithelial grafts. The use of allografts and the tunnel technique have become more prevalent due to their many advantages of treating recession defects. This case report aims to evaluate the use of allograft material with the tunnel technique in order to obtain root coverage for multiple Miller Class III defects.

Introduction

Gingival recession is a pathological condition in which the roots of teeth are exposed due to apical migration of the gingival tissue. According to data from NHANES III (National Health and Nutrition Examination Survey), 58% of American adults over 30 years old (61.3 million) have at least 1 mm of gingival recession, with the extent reaching 38.4% teeth per person. The prevalence, extent, and severity of gingival recession was found to increase with age: recession affected 37.8% of adults age 30-39 years old, whereas it affected 90.4% of adults age 80-90 years old (Albandar and Kingman, 1999). Treating gingival recession is important because it can potentially lead to increased tooth sensitivity, plaque retention, root caries, and gingival bleeding (Tugnait and Clerehugh, 2001). It can also compromise esthetics for 10% of the population who have high smile lines (Tjan et al, 1984).

The Miller classification is widely used today in order to categorize gingival recession (Miller, 1985; Table 1).

Table 1
Miller classification of gingival recession

Class I	Recession that does not extend to the mucogingival junction
Class II	Recession that extends to or beyond the mucogingival junction, but without loss of interproximal clinical attachment
Class III	Recession that extends to or beyond the mucogingival junction, with either loss of interproximal clinical attachment or tooth rotation
Class IV	Recession that extends to or beyond the mucogingival junction, with either interproximal clinical attachment or tooth rotation that is severe

Currently, in order to treat the hypersensitivity and reduced tooth structure associated with gingival recession, Class V composite restorations are frequently placed onto the exposed area of the tooth (cementum) in cases where root coverage can be achieved with a soft tissue graft. These restorations cause subsequent destruction to the periodontium by increasing plaque retention and gingival inflammation (Peumans et al, 1998). The better option to treat gingival recession is to restore the gingival tissue to its pre-recession condition through root coverage periodontal surgery. Root coverage procedures offer various advantages such as arresting further recession and increasing keratinized tissue (Camargo et al, 2001). Despite good oral hygiene, untreated recession sites have been shown to be susceptible to future gingival recession (Daprile et al, 2007) and further loss of approximal periodontal support of the tooth (Serino et al, 1994). Moreover, increased keratinized tissue increases the success rate for submarginal restorations (Stetler and Bissada, 1987; Maynard and Wilson, 1979) and prevents inflammation (Lang and Loe, 1992).

Variable techniques are available to achieve root coverage: pedicle grafts (Allen and Miller, 1989), free gingival grafts (Holbrook and Ochsenbein, 1983), guided tissue regeneration (Harris, 1998), and subepithelial connective tissue grafts (Langer and Langer, 1985). Subepithelial grafts are still considered the gold standard since they achieve the best long-term predictability in terms of root coverage (Chambrone, 2008) along with superior esthetics. Although subepithelial grafts offer many advantages, they have a few shortcomings. They cannot cover multiple recession defects due to the limited amount of tissue from the donor site, and they increase patient discomfort due to the additional surgical site taken from the palate. Therefore, the use of acellular dermal matrix (ADM) allografts has been on the rise. ADM allografts are a non-vital structure from human skin where the cells are eliminated but the extracellular matrix is left structurally intact. Allografts can treat multiple recession defects, offer unlimited supply, provide excellent tissue color match, and reduce postoperative morbidity since it does not need a second surgical site (Henderson 2001).

Since allografts differ from subepithelial grafts in their structural composition, new surgical techniques have been introduced in order to accommodate the different characteristics of allografts. The tunnel technique is one method where the interdental papillae are left intact and the graft is tunneled in and secured with sutures. Some advantages of the tunnel technique are that it provides better blood supply, quicker healing, less scarring, and less postoperative discomfort (Mahn, 2001). The tunnel technique proves to be a predictable technique for root coverage (Modarressi and Wang, 2009).

This case report describes the placement of allograft using the tunnel technique in order to obtain root coverage of teeth #4 to #13 with Miller Class III defects.

Case Report

A 46-year-old healthy female patient presented to PG Perio for root coverage periodontal surgery of teeth #4 to #13 because of "sensitivity to cold on root surface." Clinical examination and x-rays showed that teeth #4 to #13 had mild bone loss with 1-4 mm of recession coronal to the mucogingival junction on the buccal surfaces (Fig 1 and 2). Although the patient's gingival defect does not extend to or beyond the mucogingival junction, we classify this patient as Class III due to her bone loss and mild gingival recession.

***Figure 1** Clinical examination reveals numerous Class V restorations with 1 – 4 mm of gingival recession on maxillary teeth # 4 - #13.*

***Figure 2** Patient's radiographs show mild bone loss on teeth #4 - #13.*

3 cartridges of 2% lidocaine with 1:100K epinephrine and 2 cartridges of septocaine with 1:100K epinephrine was administered via local infiltration. Root surfaces from teeth #4 to #13 was planed with Younger-Good 7/8 curette to eliminate existing composite restorations.

Intrasulcular incisions were made facially and interproximally with an End-cutting Intrasulcular knife from the distal of tooth #4 to the distal of tooth #13. A full-thickness flap was reflected with the interdental papillae still intact and further elevated with an Allen elevator (Fig 3). Then the pouch was further apically extended 10 mm by using the Modified Orban knife. The interdental papillae were further separated from the osseous crest with a Younger-Good curette. The buccal frenum was removed and an opening was created to provide a location to insert the allograft (Fig 4a and b). The flap was passively positioned over teeth #4 to #13 without tension in order to completely cover the allograft.

***Figure 3** Flap release after removal of Class V restoration and full thickness flap reflection while keeping the interdental papillae intact.*

***Figure 4a** Frenum intact prior to frenectomy.*

***Figure 4b** Frenectomy performed for allograft insertion.*

Two 4x1 cm pieces of Alloderm (ADM) were prepared by hydration for 30 minutes in saline bath as per the manufacturer's instructions. The allograft was tunneled under the buccal flap through the incised frenum and positioned to the CEJ of the teeth using a Younger curette (Fig 5). The flap was coronally advanced by simultaneously suturing it with the allograft with subpapillary interrupted 6-0 vicryl sutures (Fig 6).

Patient showed uneventful healing at 1 week and 2 week post-operative evaluation. The majority of the gingiva showed 100% root coverage at 4 months after surgery

***Figure 5** Allograft positioned and trimmed before insertion into the tunnel.*

***Figure 6** Allograft positioned to cover defect and sutured via subpapillary interrupted technique.*

(Fig 7a, 7b, 7c). The patient has enamel and dentin defects coronal to the CEJ on the premolars and tooth #9 that were caused from the removal of the previous composite restorations, so Class V composite restorations will be done in the future to fill in those defects.

***Figure 7a** Root coverage at 4 months post-operative–frontal view.*

***Figure 7b** Root coverage at 4 months post-operative–right lateral view.*

***Figure 7c** Root coverage at 4 months post-operative–left lateral view.*

Discussion

Given the high prevalence of gingival recession within the U.S. population and the negative consequences it potentially brings, it is imperative to treat it correctly. If gingival recession is not treated, it can cause pain, compromise esthetics, and even lead to loss of vitality of teeth (Albandar and Kingman, 1999). This becomes a greater problem especially if multiple teeth are affected by recession. Therefore, developing a root coverage technique that allows for treatment of multiple sites with minimum postoperative morbidity and maximum root coverage is of paramount importance. In our case, the patient had ten maxillary teeth that had 1-4 mm of gingival recession that required root coverage.

According to Miller and his classification of gingival defects, only Class I and II defects can achieve 100% root coverage through periodontal surgery, whereas Class III defects can achieve only partial root coverage (Miller, 1985). Contrary to previous assumptions, multiple Class 3 recession defects can actually achieve 100% root coverage (Aroca et al, 2010). Our case report obtained 100% root coverage for the majority of the teeth 4 months post surgery. The reason this discrepancy exists may be due to varying patterns of bone loss that cannot be applied to one set of classification done by Miller, and also due to variable factors such as patient habits, different surgical techniques, and different operator skills (Pini-Prato, 2011).

In our case, we used ADM allografts to achieve maximum root coverage for multiple recession defects. ADM allografts contain connective tissue and vascular supply that retain their original configuration (Henderson, 2001) so that revascularization occurs only when the graft is in direct contact with the periosteum and the inner aspect of the flap (Felipe et al, 2007. We used allografts over subepithelial grafts because in addition to producing similar amounts of root coverage as subepithelial grafts (Harris, 2000; Tal et al, 2002), it can treat multiple recession defects at the same time and significantly reduce the amount of postoperative morbidity (Papageorgakopoulos, 2008). It is important that the allograft receive maximum blood supply by having the flap cover it entirely; otherwise, the exposed area of the graft cannot re-vascularize and will slough (Tal et al, 2002).

The tunnel technique seems to preserve maximum blood supply for allografts and thus was used in our case. The tunnel technique has frequently been compared to coronally positioned flaps (CPF). CPF allows for coronal advancement of the flap and has high predictability of obtaining root coverage. Unlike CPF, the tunnel technique leaves the interdental papillae intact and so there is less disruption of blood supply to the flap. This fact is relevant when we use allografts because they need adequate cellular and vascular supply for survival and to ensure maximum root coverage. Since the allograft has to be completely covered, the flap must be tension free (Pini-Prato et al, 2000) in order to achieve maximum root coverage. The tunnel technique is more technique-sensitive, but when performed correctly, it produces the same amount of root coverage as the successful CPF technique (Papageorgakopoulos, 2008).

Conclusion

Various techniques have been proposed in order to obtain root coverage for gingival recession. In our case, allografts were used in order to cover the patient's multiple recession defects and to reduce post-operative discomfort. A tunnel technique was used to best accommodate the graft. Creating a "tunnel" beneath the buccal mucosa allows for coronal repositioning of the soft tissue and maximum blood supply to the graft, and thus can achieve predictable root coverage and esthetics. The combination of allografts and the tunnel technique produced full root coverage for the majority of our patient's teeth at 4 months, and thus proves to be a reliable technique for obtaining root coverage for gingival recession.

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Multidisciplinary Treatment Approach of Extruded Immature Permanent Tooth: A Case Study

Wing Hei Chan[1], Jeffrey Fong DDS[2], Maria Velasco DMD, MSEd, MS[3]
[1]Class of 2014, College of Dental Medicine, Columbia University, New York, NY
[2]Class of 2013 Pediatric Dental Resident, College of Dental Medicine, Columbia University, New York, NY
[3]Instructor of Dental Medicine and Pediatric Dentist, College of Dental Medicine, Columbia University, New York, NY

Abstract

This case report describes the multidisciplinary and successful management of a luxated (extruded) immature permanent maxillary central incisor in a 7-year old girl. The patient's first assessment was at the Pediatric Dental Clinic of Columbia University's College of Dental Medicine a week after falling off her bicycle and hitting her maxillary anterior teeth. The pediatric dental resident, as the primary care provider, assessed the medical and dental history of the patient, obtained the sequence of events regarding the injury, arrived at the necessary diagnosis, and subsequently referred her to the Endodontic and Orthodontic clinics. The endodontist performed root canal treatment and required the patient to avoid any type of tooth movement for three weeks to prevent root and/or external resorption. The patient was then treated in the Pediatric Dental Clinic under the supervision of an orthodontist for bracket placement and use of slow and steady forces to intrude the traumatized tooth. The orthodontic treatment allowed for intrusion, and repositioning of the traumatized tooth, and correction of an existing diastema. Once treatment was completed, brackets were removed and a lingual retainer was placed. This report highlights the success of a multidisciplinary treatment approach with care coordinated by the pediatric dentist as the primary care provider among the different specialists at Columbia University's College of Dental Medicine.

Introduction

Trauma to the primary dentition occurs in 30-45% of all dental injury cases, with the peak incidence of trauma between the ages of two and three years.[1] Trauma to the mixed and permanent dentitions occur in 20% of cases, and males are more likely to experience dental trauma in the permanent dentition compared to females.[2] The most frequent type of injury is simple crown fracture of the maxillary central incisors in the permanent dentition (53%) while injuries to the periodontal tissues are more common in the primary dentition.[2]

Extrusion is a dental injury characterized by partial axial displacement of a tooth.[3] Clinically, the tooth appears elongated. It is usually displaced palatally and may demonstrate excessive mobility. Radiographically, the extruded tooth appears to have an increased periodontal ligament space. Extrusive luxation is often described as "partial avulsion" based on severance of the periodontal ligament that has not yet been affected by desiccation or disconnection of the tooth from the blood supply.[3] The term "partial avulsion" is useful in treatment approach where the pulpal outcome of severe extrusion may be comparable to that of a replanted tooth.[4]

The treatment objective for minor extrusion (less than 3mm) of primary teeth and immature developing teeth is to allow for spontaneous repositioning and healing.[4] An extraction of extruded primary teeth may be indicated for severe extrusion or mobility, near exfoliation of the tooth, full formation of succeeding permanent tooth, or a child's inability to cope with the emergency situation.[4] The treatment objectives for permanent teeth are to reposition as soon as possible and to stabilize the tooth in its anatomically correct position.[4] While correct positioning optimizes healing of the periodontal ligament and neurovascular supply, it also maintains esthetic and functional integrity.[4] Repositioning may be achieved with slow and steady apical pressure to gradually displace coagulum formed between the root apex and floor of the socket.[4] The splint may be used for up to two weeks to ensure no further injury, to protect the attachment apparatus, and to further allow regeneration of the periodontal fibers.[4]

The stage of apical development is a key factor in pulp healing after extrusive luxation.[5] In teeth with open apices, the pulp has greater potential for healing. In teeth with closed apices, the likelihood of pulp revascularization is low and usually leads to pulp necrosis.[5] Once pulp necrosis is diagnosed, endodontic therapy should be initiated to eliminate infection and facilitate healing and retention of the affected tooth. Pulpal necrosis in an immature tooth leads to cessation of root development.[6] If the affected tooth's root development is incomplete, apexification is indicated to induce formation of a calcific barrier at the apex.[7] An alternative to apexification in immature necrotic teeth is revascularization, an emerging regenerative endodontic treatment approach that aims to allow continuation of root development and tissue regeneration.[6,7]

Although evidence suggests that endodontic treatment of luxated teeth does not present a problem for orthodontic tooth movement, traumatized maxillary incisors have higher susceptibility to pulp necrosis during orthodontic intrusion

than non-traumatized teeth.[8,9] Pulpal necrosis of traumatized maxillary incisors occurs most frequently during the initial phase of orthodontic intrusion. Therefore, a utility archwire with low intrusion forces should be used to intrude the tooth and pulpal vitality should be monitored regularly until the end of the retention period.[8,9]

The purpose of this case report is to describe the successful management of a 7-year old child who had trauma to a permanent maxillary central incisor by a multidisciplinary team approach at the Columbia University College of Dental Medicine ("CU-CDM"). The collaborative interdepartmental effort allowed for improved prognosis of the affected tooth and optimized treatment outcome in a case of a traumatically extruded immature permanent maxillary central incisor.

Case Report

HJ is a 7-year old female Hispanic patient who presented with her father for emergency treatment at the Pediatric Dental Clinic ("PDC") of CU-CDM due to facial dental trauma. HJ's father stated that, "She fell off of her bike five days ago. She hit her face and front teeth." Her past medical history included an allergic reaction to penicillin and no other medical problems. Her dental history showed no history of caries. The extraoral exam indicated minor abrasions to the forehead and face, and a 2mm laceration of her chin. Her father stated she suffered no loss of consciousness. The intraoral exam indicated grade II mobility of the lower anterior incisors, grade III mobility of teeth #8 and #9, and 5mm extrusion of tooth #8 (Fig. 1). Sutures were placed in the chin region and no tooth repositioning was done at the time of the first visit in the ER. A periapical radiograph of tooth #8 (Fig. 2a) and a panoramic radiograph (Fig. 2b) were taken to rule out any bone fractures. HJ was instructed to return in ten days for a follow-up appointment. Trauma sequelae were explained to the parent.

Figure 1. *Intraoral photograph of extruded tooth # 8 at initial visit*

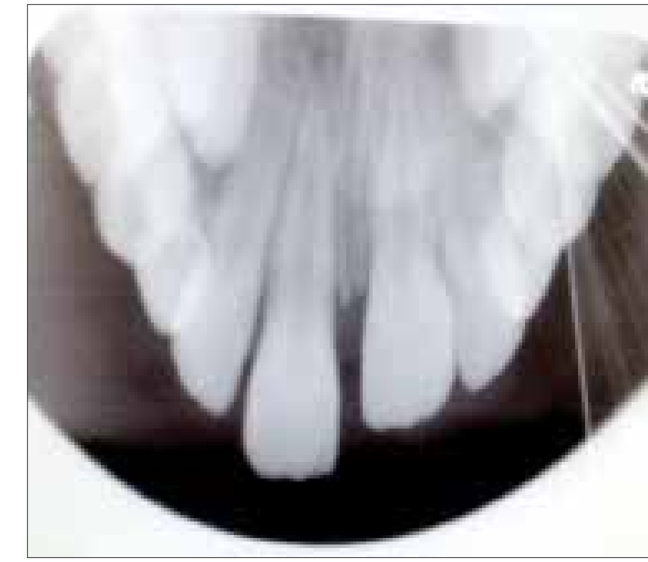

***Figure 2a**. Periapical radiograph of tooth #8 five days after the bicycle accident.*

***Figure 2b**. Panoramic radiograph of tooth #8 five days after the bicycle accident.*

Figure 3. *Periapical radiograph of tooth # 8, eighteen days after trauma.*

HJ returned to the PDC of CU-CDM twelve days later and tooth #8 was re-evaluated. Tooth #8 had Grade II mobility, and tested positive for percussion and sensitivity to cold. After radiographic examination, a periapical radiolucency was observed on tooth #8 (Fig. 3). HJ was referred to the Endodontic Clinic and Orthodontic Clinic at CU-CDM for further evaluation and consultation.

Three weeks after her second PDC visit, HJ appeared for her orthodontic consultation. No intraoral pathology was found and tooth #8 was asymptomatic, but it displayed Grade I mobility. HJ was once again referred back to the Endodontic Clinic, where she had root canal treatment initiated by the endodontic resident five weeks later. The endodontic resident stressed that there should not be any teeth movement for 3 weeks after treatment to prevent root and/or external resorption. Two weeks after RCT was initiated, HJ returned to the PDC to take additional records in preparation of her subsequent orthodontic treatment. The following week, she returned to the endodontic clinic and the obturation was completed (Fig. 4).

Figure 4. *Tooth #8 post-endodontic treatment.*

Three weeks after root canal treatment completion she returned to the Orthodontic Clinic for bracket placement on teeth #7-10 with NiTi Arch Wire. On subsequent and periodic visits HJ worked mainly with the orthodontic attending and pediatric dental residents at PDC to intrude tooth #8. After 4 months of orthodontic treatment, tooth #8 was successfully intruded to its pre-trauma level (Fig. 5). During the subsequent months HJ's diastema of 2-3 mm was also corrected using a 0.16 steel arch wire. A year after the root canal treatment was completed, all brackets were removed and a lingual retainer was placed. Lastly, a permanent restoration was placed at the completion of endodontic and orthodontic treatment, and study models were taken of the final results.

Figure 5. *Periapical radiograph of tooth # 8 post-orthodontic treatment.*

Six months later at her recall visit it was noted that the diastema between teeth #8 and #9 reappeared due to debonding of the lingual retainer. The attending orthodontist advised to enter phase 2 of orthodontic treatment as soon as all primary teeth exfoliate.

Discussion

An extruded permanent tooth should be repositioned within 24 hours to improve prognosis, and should be splinted into its anatomical position to optimize healing of the periodontal ligament and neurovascular supply while maintaining esthetic and functional integrity.[10] Pulpal necrosis is relatively uncommon in immature permanent teeth with open apices that sustained extrusive luxation.[6] Evidence supports the possibility of residual viable pulp tissue in the open root canal and apical region of immature teeth which allows for continued apical development.[7] Due to the presence of an open apex, it allows for the ingrowth of small blood vessels and regeneration of more local tissues, and a higher likelihood of revascularization.[7] Subsequently root development in these teeth are expected.[6] In HJ's case, she reported to the PDC five days after trauma. Her immature extruded tooth with open apex showed a periapical radiolucency 18 days after trauma. Due to the tooth's non-vitality and risk of pupal necrosis, root canal treatment was initiated. After performing root canal treatment with subsequent bracket placement, it was successfully intruded back into its pre-trauma position with correction of the diastema.

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Conclusion

The pediatric dentist has a dual role: primary care provider ("PCP") and specialist. The Institute of Medicine defines primary care as "the provision of integrated, accessible health care services by clinicians who are accountable for addressing a large majority of personal health care needs, developing a sustained partnership with patients, and practicing in the context of family and community."[11] As a PCP, the pediatric dental resident acted as the case manager, which provided increased care coordination and efficiency among the different specialty departments. HJ was seen for diagnosis, treatment and follow-up many times by the pediatric dental, endodontic and orthodontic departments at CU-CDM. Patient compliance was vital in this case. It was fostered through the interpersonal relationship built between the family and the dental care providers.

Furthermore, the specialized knowledge of the pediatric dental resident allowed for the timely referrals and follow-up visits at the appropriate specialty clinics. Communication between the residents in the different specialties was done via phone and notes in the electronic health records. The easy accessibility of the radiographs and all chart notes facilitated communication and appropriate and timely treatment.

The organizational structure at CU-CDM provides patients with a PCP, who not only provides care, but acts as a liaison among all the dental specialty departments. In addition, the academic setting and the enhanced information flow through digital records allows for efficient patient care and successful treatment outcomes.

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The case report should be organized
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Author Information

A description of each author's degrees, titles, department, and affiliation should be given.

Introduction

The introduction should provide a brief description of the topic, as well as any relevant epidemiology and current opinion as documented in the literature.

Case Report

A description of the case(s),including pertinent photographs.

Discussion

A thorough review of the literature, including other reported cases that are relevant to the case(s) presented or reported.

Conclusion

Based on the present case(s) and the discussion.

References

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