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1. Dental radiography

The dental profession is committed to delivering the highest quality of care to each of its individual patients and applying advancements in technology and science to continually improve the oral health status of the U.S. population. These guidelines were developed to serve as an adjunct to the dentist’s professional judgment of how to best use diagnostic imaging for each patient. Radiographs can help the dental practitioner evaluate and definitively diagnose many oral diseases and conditions. However, the dentist must weigh the benefits of taking dental radiographs against the risk of exposing a patient to x-rays, the effects of which accumulate from multiple sources over time. The dentist, knowing the patient’s health history and vulnerability to oral disease, is in the best position to make this judgment in the interest of each patient. For this reason, the guidelines are intended to serve as a resource for the practitioner and are not intended as standards of care, requirements or regulations.

The guidelines are not substitutes for clinical examinations and health histories. The dentist is advised to conduct a clinical examination, consider the patient’s signs, symptoms and oral and medical histories, as well as consider the patient’s vulnerability to environmental factors that may affect oral health. This diagnostic and evaluative information may determine the type of imaging to be used or the frequency of its use. Dentists should only order radiographs when they expect that the additional diagnostic information will affect patient care.

Radiographs and other imaging modalities are used to diagnose and monitor oral diseases, as well as to monitor dentofacial development and the progress or prognosis of therapy. Radiographic examinations can be performed using digital imaging or conventional film. The available evidence suggests that either is a suitable diagnostic method.2-4 Digital imaging may offer reduced radiation exposure and the advantage of image analysis that may enhance sensitivity and reduce error introduced by subjective analysis.
A study of 490 patients found that basing selection criteria on clinical evaluations for asymptomatic patients, combined with selected periapical radiographs for symptomatic patients, can result in a 43 percent reduction in the number of radiographs taken without a clinically consequential increase in the rate of undiagnosed disease.

The development and progress of many oral conditions are associated with a patient’s age, stage of dental development, and vulnerability to known risk factors. Therefore, the guidelines in Table 1 are presented within a matrix of common clinical and patient factors, which may determine the type(s) of radiographs that is commonly needed. The guidelines assume that diagnostically adequate radiographs can be obtained. If not, appropriate management techniques should be used after consideration of the relative risks and benefits for the patient.

The clinical circumstances and oral diseases that are presented with the types of encounters include: clinical caries or increased risk for caries; no clinical caries or no increased risk for caries; periodontal disease or a history of periodontal treatment; growth and development assessment; and other circumstances. A few examples of “Other Circumstances” proposed are: existing implants, other dental and craniofacial pathoses, endodontic/restorative needs and remineralization of dental caries. These examples are not intended to be an exhaustive list of circumstances for which radiographs or other imaging may be appropriate.
Orthodontic tooth movement occurs as a result of a force being placed on a tooth. It is composed of three phases: initial tipping, lag phase and progressive tooth movement. When the force is placed on the crown of the tooth, initial tipping occurs. The periodontal ligament (PDL) is compressed adjacent to the alveolar bone on the side toward which the force is directed. On the opposite side, away from the force direction, the PDL is widened, experiencing tension. The center of resistance of the tooth is defined as the point at which a direct force would cause the tooth to move completely linearly in the direction of the applied force. Because the force is applied at the crown of the tooth, away from this center of resistance, the tooth tips. The location of the center of resistance changes depending on the length of the root and amount of periodontal bone support, thus changing the exact type of movement that occurs. These factors, in addition to the PDL width and force magnitude, affect the amount of initial tipping that occurs.

The lag phase represents a delay in movement, which reflects recruitment of cells and the establishment of a microenvironment that will allow the PDL and bone to remodel. This is when osteoclasts are recruited to the area and osteoblasts are activated. The length of this phase is partially dependent on the amount of force applied. If excessive forces are applied, the root approaches the alveolar wall more closely on the compression side, and the vasculature to the area is compromised. As a result, a cell-free zone or hyalinized area is formed. The hyalinized tissue must be removed for tooth movement to occur. This occurs via undermining resorption, where osteoclasts present within the adjacent bone marrow spaces and resorb bone adjacent to the cell free area. This lag phase can last from several days to several weeks. The use of light forces can minimize the appearance of hyalinized tissue and therefore reduce the length of this phase.
The final phase represents the actual remodeling of bone, consisting of bone formation in the areas of tension and resorption in the areas of compression. This process results in the movement of the tooth, reduction of the applied strain, and appliance deactivation. In summary, bone resorption occurs on the side of compression in the PDL while formation occurs on the side of tension.

An acute inflammatory response is typically present in the early phase of orthodontic tooth movement. Cytokines, which are secreted by mononuclear cells, are chemical mediators that may interact directly or indirectly with bone cells. Cytokines, such as IL-1, can evoke the synthesis and secretion of numerous substances, including prostaglandins and a variety of growth factors. Prostaglandins have been shown to stimulate bone resorption and increase the rate of orthodontic tooth movement.
Evaluation of Surface Microhardness Following Chemical and Microwave Disinfection of Commercially Available Acrylic Resin Denture Teeth

Denture disinfection has been recommended as an indispensable procedure for preventing cross contamination and the maintenance of a healthy oral mucosa in patients rehabilitated with removable dental prosthesis. Removable dentures are susceptible to colonization of microorganisms including pathogenic and opportunistic bacteria and fungi resulting in cross contamination between patients, dentists and laboratory technicians. Denture base surface retaining microorganisms are difficult to clean with conventional toothbrushing methods necessitating disinfection procedures. A microorganism commonly associated with dentures is *Candida albicans* whose colonization is significantly predisposed to insufficient oral hygiene. To bring about effective disinfection, literature suggests the use of various chemical disinfectants that include glutaraldehyde, sodium hypochlorite, iodoform, carbon dioxide, chlorhexidine, or alcoholic solutions. Few denture cleansers such as alkaline peroxide solutions, hypochlorite, vinegar solutions have also been proven to be effective chemical disinfectants. Alternative to chemical disinfection, various studies have recommended microwave irradiation which is a proven method to kill microorganisms.

Introduced in the early 1930s, acrylic resin teeth are still used today in removable dental prostheses due to their superior aesthetics, high adhesion to the denture base material, excellent impact absorption and passivity to occlusal adjustment and polishing [11]. This, ideally, demands an inherent inertness of physical and mechanical properties of poly methylmethacrylate copolymer, commonly used material in denture base resins and acrylic resin denture teeth following the disinfection process [12]. However, immersion of a denture in a suitable chemical disinfectant solution or by undergoing microwave irradiation for an adequate length of time have known to cause changes in different physical and mechanical properties of acrylic resins.

One such commonly examined mechanical property indicator for synthetic artificial tooth materials is hardness.
Considering the clinical scenario wherein several disinfection procedures may be necessary for infection control, the effect of repeated exposure of the materials to the disinfection methods should be evaluated. Thus, the current study aims to assess the surface hardness of acrylic resin teeth of three different commercial brands used in dental prostheses following chemical (2% glutaraldehyde, 1% sodium hypochlorite) and microwave disinfections. The null hypothesis of this study was that different disinfection methods would not cause any effects on the surface hardness of acrylic resin teeth of different commercial brands.

The hardness of acrylic resin teeth plays a crucial impact on comfort and superior quality of mastication by aiding in the maintenance of stable occlusal relationship over time. In the present study, the effect of disinfection methods (by chemicals and microwave energy) on hardness property of conventional and cross linked acrylic resin denture teeth were evaluated. Different disinfection methods depicted varied effects on the surface microhardness of the teeth. Glutaraldehyde and sodium hypochlorite disinfection caused a decrease in microhardness of very small value of about 1 Vickers hardness number which is not significant. The results of our study can be corroborated with the results of the studies conducted by Azevedo A et al, da Silva FC et al, Davi LR et al and Campanha NH et al. They concluded that immersion of a denture base acrylic resin in 2% alkaline glutaraldehyde and 1% sodium hypochlorite disinfectant solutions resulted in no significant effect on hardness values. In the current study, 2% glutaraldehyde and 1% sodium hypochlorite concentrations were included as part of our experiment based on the previous study [6].

The greater decrease in the surface microhardness caused by microwave irradiation than chemical disinfection in all the brands can be reasoned by the additive actions of increased temperature and the plasticising effect of water. Temperature affects the rate at which polymer based materials absorb water [6]. Hydrolysis of ester bonds interfering with entanglement of polymer chains permits the relaxation of stresses incurred during polymerization.
Dentin bonding agent with improved bond strength to dentin through incorporation of sepiolite nanoparticles

The most important aim of using dental adhesives is to bond dental restorative materials to tooth structure (1). Adhesion to tooth structure prevents postoperative sensitivity, secondary caries, discoloration and microleakage (2). Because of dynamic and hydrated nature of dentin, bonding to enamel is more durable than dentin (3,4). Hybrid layer which forms by polymerized bonding monomers penetrated into dentin structures, is the basis of dentin adhesion (5,6). Among resin-dentin components, adhesive layer has the lowest elastic modulus. During stress application on resin-dentin complex, adhesive layer shows the greatest level of strain (7). Stress concentration on this weakest layer during occlusal loading or composite polymerization, may cause defects, cracks or resin-dentin bond failure.

It has been suggested that incorporation of fillers into dental adhesives would enhance the mechanical properties of the adhesive layer. Filled adhesives improve mechanical strength by shock-absorbing effect.

Sepiolite, a nano-clay with the formula of Mg8Si12O30(OH)4(H2O)4•8H2O is a needle-like structure which is based on the units of phyllosilicates: silica tetrahedral and Mg2+ or Al3+ octahedral (14,15). Its properties provide solutions for applications ranging from carrier for chemicals, as a rheological additive for industrial paints, as processing aids, and binding additives. But a very new application is the use as nanofillers in polymer systems (14). Because of the great number of active centers on its surface (silanol groups and Mg2+-coordinated water), sepiolite has a high potential interaction level between both nanofillers-nanofillers and nanofillers-matrix components. This excellent adhesion/compatibility with polymeric matrices and the strong anisotropy of this mineral material provides the excellent reinforcing effect on polymers, increasing the mechanical properties of the final compounds (15).

In this study the sepiolite nanoparticles were incorporated into an experimental dentin bonding as reinforcing filler. The bond strength of the bonding agents to the human dentin was then evaluated by microtensile test.
The Effect of Platelet-Rich Fibrin, Calcium Sulfate Hemihydrate, Platelet-Rich Plasma and Resorbable Collagen on Soft Tissue Closure of Extraction Sites

Tooth extraction leads to vertical and horizontal ridge resorption that can make implant placement difficult or impossible [1]. However, it is well established that post-extraction ridge preservation can be beneficial prior to implant placement [1,2]. Although some studies have shown that ridge preservation does not completely prevent bone loss post-extraction, such procedures aid in reducing the extent of that loss [3].

Ridge preservation can be performed using a variety of materials. Ideally, graft materials provide osteogenic, osteoinductive, and/or osteoconductive properties, and also provide mechanical support and supply a framework for osteogenic cells to stimulate bone production [4]. In addition, rapid socket closure and re-epithelialization may assist in graft retention and exclusion of debris, as well as improve patient comfort.

A variety of graft materials are available for ridge preservation within extraction sockets. Autogenous bone can be transferred from one position to another within the same individual. Allogenic bone grafts (allografts) are transferred from one individual to another in the same species. They can be fresh-frozen or freeze-dried, and mineralized or demineralized. Xenografts are derived from other species and are derived from a variety of animals including bovine, porcine, and equine sources.

Alloplasts are synthetic bone substitutes that act as a biologic filler, such as medical grade calcium sulfate hemihydrate (CSH) or hydroxyapatite. When CSH is implanted, it dissolves into calcium and sulfate ions. Calcium ions subsequently combine with phosphate ions from the host to form calcium phosphate, which provides a scaffold for bone ingrowth into the defect. In addition, CSH has angiogenic and hemostatic properties [5].
The incorporation of growth factors during regenerative therapy provides the potential to accelerate new bone formation and enhance ridge preservation [4]. Examples include platelet-rich plasma (PRP), platelet-rich fibrin (PRF), bone morphogenic proteins, and enamel matrix proteins. PRP is obtained by mixing blood and utilizing a two-stage centrifugation protocol that isolates the platelet concentrate, which contains 6–8 times the amount of growth factors compared to whole blood [6].

However, the use of an anticoagulant to obtain PRP is disadvantageous to wound healing. PRF potentially enhances wound healing because it does not contain an anticoagulant and, in addition, it contains more white blood cells than PRP, leading to higher numbers of white blood cells, which translates to having an increased number of macrophages that are responsible for releasing growth factors such as transforming growth factor beta, platelet-derived growth factor, and vascular endothelial growth factor [6]. Those cells and cytokines are critical to wound healing. PRF has been reported to maintain and stabilize grafts, integrate into regenerative sites, facilitate cellular migration, and enhance soft tissue healing.

We wished to determine if factors potentially influencing bone regeneration and preservation could be applied to the overlying soft tissues of extraction sockets. Suttapreyars and Leepong found that recent extraction sockets given PRF had accelerated soft tissue healing compared to control at four weeks [9]. Dutta et al. observed that extraction sockets receiving PRP and PRF were associated with less pain, swelling, and faster soft tissue healing compared to hydroxyapatite at the third, seventh and fourteenth day [10].

However, we could not find any studies comparing PRP and PRF over a three-week period in potential future implant non-third molar implant sites. Consequently, the aim of this pilot study was to compare the soft tissue closure of human tooth extraction sites by measuring the extent of socket epithelialization immediately grafted with platelet-rich fibrin-calcium sulfate hemihydrate (PRF-CSH), platelet-rich plasma-calcium sulfate hemihydrate (PRP-CSH), resorbable collagen dressings (RCD), and at sites with no graft placement, after three weeks.
The teaching of management of the pulp in primary molars across Europe

As childhood caries remains a significant oral health issue in Europe, the need for high quality, evidence-based pulp therapy is still necessary and important today. With dmft in 5 year-olds as high as 3.7 in Turkey, 0.8 in England and 1.8 in Germany (6 year-olds), European dental schools must be proficient in teaching the best available techniques to dental students. During the last decade, developments in the understanding of primary pulp structure, inflammation, healing processes and concerns of the toxicity of dental materials, have led to significant changes in therapeutic choices. Existing guidelines such as the British Society of Paediatric Dentistry and the American Academy of Pediatric Dentistry have an important role in guiding clinicians through the evidence and advising on adequate management. Delivery of primary pulp therapy, however, is not without controversy as no single therapy is applicable to all clinical situations. Moreover, recent Cochrane reviews on pulp therapy support this variation. A Cochrane review reported no superiority of one pulp therapy in comparison with others, but it should be remembered that only randomized controlled trials are eligible for inclusion in a Cochrane review, of which there are very few in the relevant paediatric dental literature. However, Smail-Faugeron et al. concluded that although no material had been proven to be superior, there was a tendency for mineral trioxide aggregate (MTA) to have performed better than other pulp therapy products. A survey initially developed by Primosch et al. investigated methods of primary pulp therapy taught in predoctoral dental programmes in the USA. The authors highlighted the lack of consensus in the management of primary pulp tissue. Subsequent studies in the USA and Brazil shared the same finding. The present authors have previously conducted a preliminary investigation in the United Kingdom and the Republic of Ireland and reported that all respondents taught the technique of vital pulpotomy, 92% of which used ferric sulphate. There was however, no uniformity regarding pulpectomy, indirect and direct pulp capping. Formocresol and MTA were taught by a minority of respondents.

In order to further assess this area of paediatric dental education, and explore the variation between countries, regions and paediatric departments, it was decided to carry out a pan-European survey of the methods of primary pulp therapy currently taught in dental schools.
Clinical outcomes for primary molars treated by different types of pulpotomy: A retrospective cohort study

Pulpotomy is the amputation of coronally infected pulp tissue to maintain the vitality and function of the radicular pulp. The main goal of this therapy is to sustain carious primary teeth survival until natural exfoliation. There are several techniques for pulpotomy with different protocols including nonpharmacotherapeutic options such as electrosurgery and laser ablation. Pharmacotherapeutic approaches involve dressing the pulp tissue with formocresol, glutaraldehyde, ferric sulfate, calcium hydroxide, mineral trioxide aggregate (MTA), freeze-dried bone, or sodium hypochlorite (NaOCl). Formocresol was introduced in 1904 by Buckley. Formocresol pulpotomy has been popular since its introduction by Sweet in 1930. However, it also has some adverse effects such as potential carcinogenicity, mutagenicity, and cytotoxicity. Formocresol has been shown to be potentially damaging to permanent teeth. This is the reason why many studies have been trying to find alternatives to replace formocresol for primary teeth pulpotomy.

In Taiwan, formocresol and ferric sulfate have not been available during the past decade because they failed to obtain drug licenses from the Taiwan Food and Drug Administration. Pulpotomy treatment cost is covered by National Health Insurance and is approximately 20 US dollars per tooth. Although MTA is known to be superior to the above pharmacotherapeutic dressing materials, it is still too costly for most parents.

Lasers were introduced in medicine and dentistry in the 1960s. They have wide applications in dentistry such as caries diagnosis, composite resin curing, soft tissue surgery, and cavity preparation. Low-power lasers have also been used in stimulation and inhibition of biological processes. Diode laser offers the benefits of minimal or no bleeding, faster healing, reduced postoperative infections, and minimal or no anesthesia. Infrared light beams emitted from the diode laser can produce localized ablation of soft tissue through conversion of the laser energy to heat. The advantages of laser pulpotomy are hemostasis, preservation of vital tissues in the root canal, and absence of unpleasant odor.
Neodymium-doped yttrium aluminum garnet (Nd:YAG) laser, Er:YAG laser, CO2 laser, and diode laser can be used for primary tooth pulpotomy. NaOCl has been commonly used as a root canal treatment irrigant. The advantages include antimicrobial and detergent action, tissue-dissolving ability, and homeostatic characteristics in a pulpomized tooth. Moreover, NaOCl pulpotomy is more biocompatible as dentin bridge formation and less severe pulpal inflammation than formocresol pulpotomy are found by histopathologic examination. However, only a few clinical trials have evaluated NaOCl as a medication for pulpotomy. There are two different NaOCl concentrations, 3% and 5%, used for pulpotomy. In our department, 6% NaOCl is used for pulpotomy because the solution is from commercially available bleach.

Some practitioners eliminate the additional medication step after hemostasis achieved by sterilized cotton pellets. The zinc oxideeugenol (ZOE, Miltex, Inc, York, PA, USA) acts as an antimicrobial material and is placed into the pulp chamber over the radicular pulp stumps. In our Department of Pediatric Dentistry, we used diode laser, NaOCl, or no medication to perform pulpotomy. The aims of this study were to assess the clinical and radiographic success rates of primary molars treated by pulpotomy using diode laser, NaOCl, or no medication after a follow-up period of 24 months, and to verify whether the aforementioned pulpotomy methods can substitute for formocresol pulpotomy for primary molars.
Generalized Aggressive Periodontitis and Its Treatment Options:
Case Reports and Review of the Literature

Aggressive periodontitis, as the name implies is a type of periodontitis where there is rapid destruction of periodontal ligament and alveolar bone which occurs in otherwise systemically healthy individuals generally of a younger age group but patients may be older. Although its prevalence has been reported to be much less than that of chronic periodontitis, it can result in early tooth loss in the affected individuals if not diagnosed in the early stages and treated appropriately [3]. The disease is generally found to have a racial and sex predilection, with blacks and male teenagers having higher risk for the disease compared to whites and females, although reports vary between different ethnic groups and populations, with some populations showing prevalence as high as 28.8%. Aggressive periodontitis, first described in 1923 as “diffuse atrophy of the alveolar bone” [6], has undergone a series of terminology changes over the years to be finally named as “aggressive periodontitis” in 1999. The disease which includes both localized and generalized forms was previously known as “early onset periodontitis” which included the three categories of periodontitis—prepubertal, juvenile, and rapidly progressing periodontitis.
It is interesting that the first ever reported detailed description of a recognized disease in early hominid evolution is a case of prepubertal periodontitis in a 2.5–3-million-year-old fossil remains of a juvenile *Australopithecus africanus* specimen which showed the typical pattern of alveolar bone destruction with migration of the affected deciduous molars [10, 11]. Generalized aggressive periodontitis (GAgP) is characterized by “generalized interproximal attachment loss affecting at least 3 permanent teeth other than first molars and incisors” [12].

It is a multifactorial disease where interplay of microbiologic, genetic, immunologic, and environmental/behavioral risk factors decides the onset, course, and severity. Pathogenic bacteria in the dental plaque especially *Aggregatibacter actinomycetemcomitans* and *Porphyromonas gingivalis* [13, 14] have an indispensable role which elicits an aggravated host response which in turn is determined by the genetic and immunologic profile of the patient modified by environmental risk factors like smoking. This paper attempts to describe the diagnostic features along with the periodontal management options of generalized aggressive periodontitis with the help of case reports with different clinical presentation and patterns of involvement and managed with different treatment modalities available. Finally an attempt to summarize the available protocol for a comprehensive management of GAgP is done which can serve as a guideline till more definite clear-cut guidelines are established for the disease in the future.
Current opinions concerning the restoration of endodontically treated teeth: basic principles

A lot of different parameters which influence the prognosis of endodontically treated teeth have to be taken into consideration: apical status, position of the tooth in the dental arch, number of adjacent teeth, occlusal contacts, amount of hard tissue loss, remaining dentin wall thickness, collagen degradation and intermolecular cross linking of the root dentin, type of long-term coronal restoration, type of post (only if needed) and core material used, presence, if necessary, of a ferrule preparation [1].

Coronal restoration of endodontically treated teeth may be considered one of the main aforementioned parameters, since it represents a major concern, for both practitioner and patient. The best way to restore teeth after root canal treatment has long been and still is a controversial subject of debate to this day. To begin with the end in mind, it seems to be the most appropriate plan for success [2]. Before initiating endodontic treatment, the tooth should be assessed for restorability, occlusal function, and periodontal health, and aspects such as biological width and crown-to-root ratio should be evaluated. If satisfactory, these factors will allow the tooth to be included in a comprehensive oral rehabilitation treatment plan [3].

The advisable clinical approach is to completely remove previous restorations and all existing caries before initiating root canal treatment, therefore a more accurate evaluation of the tooth status will be possible. Extensive absence of sound hard dental tissues leading to important coronal destruction often requires surgical crown lengthening or orthodontic eruption prior to endodontic treatment, in order to fulfill the basic principles of endodontically treated teeth restoration. Thus, the adequate guidelines for the root canal treatment will be upheld [3]. When immediate restoration is not possible, the root canal system should be protected from saliva contamination. Orifice sealing using bonded materials such as composite resin or glass ionomer cements are usually recommended choices. Traditional temporary materials, such as IRM, Cavit, Citodur, Fermin, used for the coronal access cavity, do not protect the tooth against fracture and the practitioner has to be aware that such temporary restoration should be avoided for prolonged time.
Significance of remaining coronal tooth structure

The amount of remaining tooth structure is probably the single most important predictor of clinical success [6]. In most cases, it is limited as a result of trauma, caries, prior restoration and endodontic procedures, reducing the fracture resistance of the tooth. Endodontic access in combination with the earlier loss of one or both marginal ridges leave the tooth at serious risk of fracture, even if it was reduced out of direct occlusal contact before endodontic treatment began. The post design probably has a limited role in the fracture resistance of the restored tooth, if more than 2mm of tooth structure remains.

Furthermore, the strength of an endodontically treated tooth is reported to be directly related to the bulk of remaining dentine. To ensure functional longevity, endodontically treated teeth must have at least 5 mm of tooth structure coronal to the crestal bone: 3mm are needed to maintain a healthy soft tissue complex and 2mm of coronal tooth structure incisal to the preparation finish line are necessary to ensure structural integrity.

When remaining coronal tooth structure is less than 5mm in height, it may be increased either surgically through a crown lengthening procedure or orthodontically through forced extrusion of the tooth. Both procedures result in a satisfactory and predictable increase in coronal tooth structure but may not be recommended in situations in which the crown-to-root ratio is compromised or where further exposure of tooth structure will have adverse esthetic results. As coronal tooth structure is increased by crown lengthening, the corresponding osseous-supported tooth structure is decreased. This change in the crown-to-root ratio may render the tooth less resistant to lateral forces. A 1:1 crown-to-root ratio has been advocated as the minimum ratio necessary for resisting lateral forces that may occur during function [8].

There is convincing evidence that cuspal coverage after root canal treatment should be provided for posterior teeth. Access preparations result in greater cuspal flexure, increasing the probability of cuspal fracture. The presence of cuspal coverage is the only significant restorative variable to predict long-term success for such teeth. This conclusion is based on an independent, retrospective study of 608 endodontically treated teeth that evaluated the factors that affected survival during a 10-years period. Another retrospective study of 400 teeth during a 9-years period found that endodontically treated teeth with cuspal coverage were six times more likely to survive than those with intracoronal restorations [10].