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Residual dentine thickness

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Abstract
The thickness of the remaining dentine following intraradicular procedures may be the most important iatrogenic factor that correlates to incoming fracture resistance of the root. A thorough knowledge of the root canal anatomy is essential for successful endodontic therapy. The thickness of root canal walls is an important factor since any false assumptions about it may lead to problems such as strip perforation.

Keywords: Residual dentine, iatrogenic factor, root canal

1. Introduction

1.1 Residual Thickness in Restorative Dentistry

Remaining dentin thickness approximately 2mm of dentin or an equivalent thickness of materials should exist to protect the pulp. This thickness is not always possible, but 1-1.5mm of insulation is accepted as a practical thickness. As the tooth preparation extends closer to the pulp, a thick liner or a base is used to augment dentin to the proper thickness range. When caries has progressed into deep dentin areas, the remaining dentin thickness after excavation can be distinctly reduced. The remaining dentin thickness estimated to be necessary for protection of the dental pulp against injury or inflammation has changed over the years [1]. Stanley *et al* suggested that the remaining dentin under the cavity preparation should be at least 2 mm thick to guarantee protection of the pulp. Other investigations found a minimum thickness of 1 mm or even 0.5 mm to be necessary for pulp protection [2].

1.2 Residual Thickness in Endodontics

Root canal preparation has been considered the most important step in endodontic therapy for dentin removal. It is a challenge for even the most experienced endodontist to achieve optimum cleaning and shaping [3]. Residual dentin thickness indicates the mechanical limits of instrumentation, to enlarge the diameter of the root canal, to approximately predetermined values that would not significantly weaken the dentinal walls [4].

A direct relationship exists between the residual dentin thicknesses to the strength of the root. Preservation of sound dentin is of utmost importance. At least 1 mm of root dentin should remain in all root aspects along its entire length after all intra-radicular procedures are completed [5]. Knowledge of the root canal anatomy is essential for successful endodontic therapy. The thickness of root canal walls is an important factor since any false assumptions about it may lead to problems such as strip perforation. Strip perforations and vertical root fractures are possible outcomes of excessive removal of radicular dentin especially in zones that have been termed danger zones [6].

1.3 Clinical Significance

Pulp reactions to the tooth preparation techniques are still a major concern in restorative dentistry. The term “stressed pulp” used in the literature means a bad prognosis from the beginning, because, previous to the prosthesis, caries, old restorations, occlusal trauma, abrasion or periodontal disease already exhausted the pulp adaptability. For such a tooth, any additional trauma, even a small one, can cause a degenerative process in the pulp. The reactivity of the dental pulp is reported in almost all stages of the prosthetic treatment, the pulp response being influenced by the thickness of remaining dentin. Remaining dentin thickness approximately 2mm of dentin or an equivalent thickness of materials should exist to protect

the pulp. This thickness is not always possible, but 1-1.5mm of insulation is accepted as a practical thickness. As the tooth preparation extends closer to the pulp, a thick liner or a base is used to augment dentin to the proper thickness range. When caries has progressed into deep dentin areas, the remaining dentin thickness after excavation can be distinctly reduced. The remaining dentin thickness estimated to be necessary for protection of the dental pulp against injury or inflammation has changed over the years [1]. Stanley *et al* suggested that the remaining dentin under the cavity preparation should be at least 2 mm thick to guarantee protection of the pulp. Other investigations found a minimum thickness of 1 mm or even 0.5 mm to be necessary for pulp protection [2].

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Zollner *et al* demonstrated experimentally that, actually, the critical thickness of the remaining dentin must be ensured on the direction of the dentinal tubules opened by the preparation. Irrespective of the mechanism involved, the results of this experiment showed that the displacement of odontoblastic nuclei occurs even in the case of a superficial preparation (0.4 mm) with water-cooling. High-speed teeth preparation produces immediate pulp modifications even an adequate water-cooling is used. The severity of the changes is dependent on the thickness of the remaining dentin (the depth of the preparation) [7].

Pulp injuries caused by preparations are a major concern in restorative injuries because of the high rate of vital teeth exhibiting typical signs of endodontic complications following restoration. The distance between the preparations of the pulp usually referred to as the remaining dentin thickness has long been recognized as an important factor influencing pulp reactions to the cavity preparation and restorative events. A unique, medical-grade polymer bur, Smart Bur II is a self-limiting caries removal bur for use in a slow-speed handpiece operating at up to 4,000 rpm. Research demonstrates that when compared to a carbide metal bur and ceramic bur, the polymer bur is truly dentin safe and will not cut sound, healthy dentin. Using the Smart Bur II allows for preservation of sound, healthy tooth structure and can protect against unnecessary pulp exposures.

Fig 1: Smart Burs

Air abrasion for restoration preparation removes tooth structure using a stream of aluminium oxide particles generated from compressed air or bottled carbon dioxide or nitrogen gas. The abrasive particles strike the tooth with high velocity and remove small amounts of tooth structure. Efficiency of removal is relative to the hardness of the tissue or material being removed and the operating parameters of the air abrasion device.

Reductions in the RDT of preparation increasingly sensitize the pulp to cavity preparation injuries such as frictional heat generated by the bur and vibration injuries. A reduction in RDT always sensitize the pulp to cytotoxic injuries from the effect of acid etching, air drying and restorative materials. This is probably because of the decreased buffering properties of the dentin to potential sources of injuries. Pulp injury from restorative materials is depended on the structure, RDT and quality of dentin between the axial wall of prepared tooth and the pulp. RDT of 1mm is sufficient to protect the pulp tissue from the cytotoxic effect of resin modified glass ionomer. An RDT of 0.5mm or more is sufficient to protect the pulp tissues from cytotoxic injuries from zinc oxide eugenol and calcium hydroxide [8].

Use of lasers in dentistry is now a day’s broad, varying from caries diagnosis, disinfection of periodontal pockets or root canals, photodynamic therapy of oral tumors, soft-tissue surgery, caries removal, and cavity preparation. Several advantages have been related to the use of laser irradiation in operative dentistry, such as a more conservative cavity design, an alleged antibacterial activity, and a significant decrease of enamel solubility, therefore also possibly playing a role in the prevention of recurrent caries.

Knowledge of the root canal anatomy is essential for successful endodontic therapy. The thickness of root canal walls is an important factor since any false assumptions about

it may lead to problems such as strip perforation. Excessive removal of radicular dentin causes strip perforation and vertical root fractures. Stripping is a lateral perforation caused by over instrumentation through a thin wall in the root. In the danger zone there is less tooth structure compared with more peripheral portion of the root dentin. To minimize the risk of stripe perforations in the roots with Figure-eight cross section and thin walls, anticurvature filing should be employed [6].

Radicular and coronal tooth structure should be preserve to the greatest possible extent during endodontic procedures. Root canal preparations should attempt to preserve dentin in the coronal one-third of the root. There is no reason to prepare a ‘‘coke bottle’’ type of canal preparation that weakens the tooth unnecessarily. (Fig 2) Access preparations similarly should be made in such a way that cervical dentin is preserved. The roof of the pulp chamber should be removed carefully, preserving the walls of the chamber as much as possible. The chamber walls should be prepared only to the extent that is necessary for adequate access for endodontic treatment [9].

Fig 2: Coke Bottle Appearance

2. Discussion

Stanley (1994) suggested that a RDT of 2mm would protect the pulp from injury caused by most restorative materials and procedures. Pameijer *et al* (1991) reported during luting procedures that a RDT of 1mm or more would be sufficient to protect the pulp tissue from the cytotoxic effects of zinc phosphate and resin-modified glass ionomer. Shallow cavities were restored with amalgam, deeper cavities or pulp exposures were restored with amalgam lined with calcium hydroxide or with zinc oxide eugenol. Reparative dentine was observed following pulp exposure and reactionary dentine was observed with a mean RDT of 0.77 mm [10].

Indirect pulp treatment is a successful technique and should be considered as an alternative pulp therapy procedure in deeply carious primary posterior teeth. The use of a base over the liner in addition to a Stainless steel crown dramatically increases the success of an indirect pulp capping [11].

In endodontics the issue of RDT after root canal and dowel preparation is equally important. Excessive removal of radicular dentin compromises the root. A direct relationship exists between the RDT to the strength of the root [5].

Remaining dentin thickness following various intraradicular procedures may be the most important iatrogenic factor that correlates to future root resistance against fracture [12]. The variation of root dentin thickness in different areas supports the notion that it is very important for practitioners to increase their knowledge in regard to root canal anatomy [6].

3. Conclusion

There is worldwide interest in and increasing usage of the conservative atraumatic restorative treatment technique or approach for the restoration of primary and permanent teeth. High-strength esthetic conventional glass-ionomer restorative cements marketed for the procedure. The atraumatic restorative treatment technique or approach is an innovative; largely pain free, minimal intervention approach for treating carious teeth. The minimally invasive procedure is largely pain-free and readily accepted by children, and GICs demonstrate sustained fluoride release, pulpal biocompatibility, and chemical adhesion to tooth substance [13].

In Endodontics excessive removal of radicular dentin compromises the root. A direct relationship exists between the RDT to the strength of the root. Thus, preservation of sound dentin is of utmost importance. At least 1 mm of root dentin should remain in all root aspects along its entire length after all intra-radicular procedures are completed [5]. The distolingual aspect is a danger zone for instrumenting the mesiobuccal canal of the mesial root in mandibular molar teeth, and preparation of that area should be performed with caution [10].

There is appreciable loss of dentine while preparing the access cavity and during canal preparation. The root thickness may be thin especially where grooves are present or between two fused roots [14]. The thickness of the remaining dentine following intraradicular procedures may be the most important iatrogenic factor that correlates to incoming fracture resistance of the root. A thorough knowledge of the root canal anatomy is essential for successful endodontic therapy. The thickness of root canal walls is an important factor since any false assumptions about it may lead to problems such as strip perforation [6].

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