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RESEARCH ARTICLE

CORONAL SEAL IN ENDODONTICS

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ABSTRACT

A plethora of patients undergo root canal procedures on a day to day basis. The drop out from the treatment protocols is even higher due to patient and/or doctor incompliance or even failure of treatment. This results in patients referring themselves elsewhere with symptoms due to incomplete treatment. In most of the cases it is noticed that the failure is associated with faulty coronal seal. The fault in the coronal seal may be due to varied reasons like infection of the prepared canals, fracture of restorations between appointments, doctor induced perforations and patient defiance. This review revolves around the root canal and its microflora and its cleaning and shaping protocols along with the comparative evaluation of coronal seal materials for the intended purpose.

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INTRODUCTION

The legacy of patients referred to an endodontist with only mere cotton and a temporary restoration in the access cavity has led to surplus failures over the years resulting in loss of assurance in endodontic treatment for many patients. Studies have proven that, when saliva and bacteria are in contact with gutta-percha and the pulp chamber, it is only a matter of time for the bacteria to reach the root apex and produce undue symptoms. Catastrophe related to coronal leakage for any implicit reason is undesirable. Root canal treatment encompasses the complete sealing of all endodontic orifices and the access cavity. This eradicates the prospect of micro leakage, mid appointment fractures, iatrogenic perforations, indifferent patients, and contamination of the biomechanically prepared and disinfected pulp canals due to improper isolation techniques. For decades, deficient obturation of the root canal was extensively considered as the source of recurrent endodontic infection. Nevertheless, lately the focus has shifted on the deficient post endodontic restoration after endodontic treatment and the influence of this on the prognosis. (Pierre Machtou, 2006) A successful endodontic therapy requires an integral coronal seal along with a good apical seal. Coronal microleakage must be deliberated as an impending etiological factor for failure of root canal therapy. The significance of the coronal seal must be highlighted during and after obturation to the patients. (Shetty *et al*., 2015) Literature search have shown that inadequate coronal restoration results in higher failures. (Lazarski *et al*., 2001; Friedman *et al*., 2003; Lynch *et al*., 2004; Mindola *et al*., 2006)

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Microbiology

Gram positive facultative anaerobic Staphylococcus bacteria predominate in the apically sealed teeth with coronal leakage and persistent apical periodontitis, followed by the groups Streptococcus and Enterococcus. (Adib *et al*., 2004) Coronal leakage delivers continuous basis of microorganisms and nutrients progressing to peri-radicular inflammation which may be the major source of failure in endodontic therapy. (Leonard *et al*., 1996)

Major Goal of RCT (ENDODONTICS: Colleagues for Excellence, 2002)

The major goals of root canal treatment are to

i. Remove irritants from the root canal system
ii. Fill or obturate the cleaned and shaped system
iii. Prevent future recontamination of the sealed root canals

Recontamination by oral micro flora and their by-products can occur in previously filled canals too. The causes are:

i. Deferral in the coronal restoration of a tooth after root canal treatment
ii. Faulty coronal temporary restoration placed instantly following RCT
iii. Fracture of the tooth with exposed canals prior to final restoration
iv. Lack of marginal integrity in the final restoration irrespective of the type or design of the cavity
v. Recurrent caries at the restoration interface

A chief apprehension for all the practitioners is the rate at which the entire root canal system is contaminated, demanding retreatment of the canal preceding the new restoration.

Obturation

NiTi Rotary instrumentation has revealed fewer microleakage than hand shaped canals regardless of the obturating material. (vonFraunhofer *et al*., 2000) The canal walls machined with NiTi rotary instruments delivers shapes which can be obturated easily. The adaptation of the obturated material to the machined dentinal walls is inversely proportional to the leakage along the margins. Selection of a sealer plays a vital role in the prevention of microleakage and to allow a bond to the core material. For more than a century Zinc oxide eugenol sealers have been the back bone of endodontic treatment. By the end of the second day an exposed ZOE sealer demonstrated complete coronal leakage. Research revealed that none of the ZOE based sealers which were verified could yield a fluid-tight seal even till the fourth day. (Tewari and Tewari, 2002) Amongst the obturating material Resilon suggestively showed lower leakage when compared to gutta-percha. The monoblock delivered by the Resilon system was related to lower apical periodontitis, which could be attributed to its greater resistance to coronal microleakage. (Chivian, 2004)

MATERIALS AND METHODS

Bacterial leakage results in a matter of time irrespective of how well a canal is sealed when the coronal portion of the tooth is improperly sealed. Oral cavity gaining access to the canals through fractured teeth, microleakage, or a lost temporary restoration is encountered clinically. Hence there is a potential for oral fluids and bacterial contamination of the root canals which exists owing to the dissolution of the coronal seal. (Shetty *et al*., 2015) A critically destroyed tooth must be first restored coronally prior to the initiation of endodontic therapy. Canal Projector system can be used to provide isolation of individual canals by encasing them with a resin buildup. This employs usage of rubber dam and improvises the characteristics of the materials being applied. Nevertheless endodontic obturation materials do not prevent coronal microleakage for an indeterminate period of time. (Pisano *et al*., 1998) On exposure to saliva, teeth obturated with gutta-percha and sealer, in the absence of a temporary restoration, presented with leakage ranging from 70% to 85% of the root length within 56 days. (Madison *et al*., 1987) Glass ionomer revealed poor sealing ability when used as a barrier to avert coronal microleakage. The performance of a GIC's sealing ability is also affected by the presence of smear layer with an added possibility of shrinkage on setting. Beckham *et al* observed a gap between GIC and dentinal walls after placement of the material in access opening. This was possibly because of shrinkage of the material on setting leading to microleakage. (Beckham *et al*., 1993) Coronal microleakage was evaluated in endodontically treated multirooted teeth using varied materials like Silver amalgam, Zinc oxide eugenol, and GIC, latter one demonstrated mediocre sealing ability compared to others. (Madison *et al*., 1987) The higher coronal leakage portrayed by GIC is probably endorsed to scarce condensation and trapped air bubbles and/or improper adaptation of cement within the cavity of root canal orifices. (Shetty *et al*., 2015) An essential Double seal could be achieved with an intra-orifice barrier. LCGIC has proven to be better than MTA as an intra-orifice barrier. (Parolia *et al*., 2008) Ketac Molar portrays physical properties comparable to GIC; shrinkage, gap formation, air entrapment, lack of positive pack condensability are inevitable. (Shetty *et al*., 2015) Amalgam's sealability property could be related to it being condensed in irregular areas and the proper adaptation with cavity walls. Self-sealing ability of amalgam with its corrosion products will further enhance the marginal seal. (Madison *et al*., 1987) A bonded amalgam restoration created comparatively lower leakage than non-bonded amalgam. (Howdle *et al*., 2002) Composite hybrids bid improved sealing ability probably due to the employed etching and bonding system. The etchant dissolves the smear layer and smear plugs with demineralization of intertubular dentin, while the bonding agent wets the collagen network and forms hybrid layer. As the filler loading surges it turns the composite less vulnerable to polymerization shrinkage. Composite hybrid displayed minimal quantity of microleakage when related to Amalgam, GIC and Ketac Molar. (Shetty *et al*., 2015) The Sandwich technique (GIC base with overlying Composite) permitted considerably lower coronal leakage in comparison to GIC alone; perhaps because the composite resin inhibits the salivary dissolution and disintegration of the glass ionomer over a long period of time. (Kleitches *et al*., 1995)

The regularly employed temporary restorative materials like IRM or Cavit used between appointments showed higher coronal leakage when compared to GIC. (Barthel *et al*., 2001) Generally failures of temporary restorations can be attributed to insufficient thickness of material, incorrect placement of the material and failure to evaluate the occlusion after placement. (ENDODONTICS: Colleagues for Excellence, 2002) Frequently applied temporary restorative materials are Cavit, TERM and IRM. Following the placement of cotton pellet in the pulp chamber, temporary filling materials should be judiciously placed in the access cavities with no gaps or voids. A minimum of four millimeters of material thickness offers an acceptable seal. Undue delay in replacing the temporary restoration summons coronal leakage and impending failure. (ENDODONTICS: Colleagues for Excellence, 2002) To curtail the probability of perforation when re-entering the tooth to place either a post or to retreat endodontically, assignment of distinct coloured resin over each orifice would be valuable, followed by casing the entire pulpal floor with a tooth coloured flowable resin.

DISCUSSION

According to the researchers the success of the endodontic treatment can be hampered by bacteria from the oral environment, their cellular components, their soluble derivative products or saliva which could enter through defective coronal restorations alongside the boundary of the obturated canals.

Saunders and Saunders first presented that coronal leakage is a vital reason of catastrophe in root canal treatment. (Mc Robert, 1997; Chailertvanitkul and Saunders, 1997) Balto *et al* found that an adequately restored tooth featured twice as low failure rate to cases without an adequate coronal restoration. (Shetty *et al*., 2015) In 1995 Ray and Trope showed apical pathology is inversely proportional to a good coronal restoration compared to the ones inappropriately restored. The authors inference confirmed that the quality of the coronal restoration is highly significant than the superiority of the endodontic treatment for periapical health. (Ray and Trope, 1995) In 1993, Khayat *et al* exposed 30 single rooted teeth to human saliva, extracted and sealed by lateral and vertical condensation with Roth sealer, and assessed for infiltration of saliva with a dye. Regardless of the technique used for obturation all the canals were contaminated within the period of 30 days. (Khayat *et al*., 1993) In 1995, Trope *et al* calculated the diffusion of endotoxins coronally on extracted teeth which were sealed but not restored. The endotoxins extended to the apical foramen within 20 days, rapidly than the bacteria that yield them.[24] Carman and Wallace filled the pulp chambers with several materials and inferred that a coronal barrier of gutta-percha and sealer exhibited considerably higher leakage than teeth filled with amalgam, composite resin, GIC or intermediate restorative material. (Wells *et al*., 2002) Fox and Gutteridgee valuated 10 sealed teeth with posts and core for coronal percolation on three groups. The endorsement was unambiguous: to avoid reinfection of the root canal system, it is desirable to instantly restore the tooth with a pre-manufactured post and a composite, than to place a provisional restoration and a post or an inlay-core with post. (Fox and Gutteridge, 1997) Inadequate post endodontic restoration reportedly resulted in 59.4% of failure in endodontically treated teeth. (Vire, 1991) Leakage of temporary restorative material or fracture of the permanent restoration may lead to loss of coronal seal. (Parolia *et al*., 2008) Bachicha *et al* (1998) equated the seal of two restorative systems: steel post and carbon fibre post, using several sealers. The dentin adhesive cements (C&B Metabond and Panavia-21) showed less leakage than the non-adhesive cements (Zn phosphate and glass ionomer). (Bachicha *et al*., 1998) The Washington study projected inadequate obturation of the canal as the principal etiology of endodontic failure along with 20 other varied factors (Stabholz *et al*., 1994). The intracanal bacteria are accepted as general contributory agent in the progress of apical pathology. (Kakehashi *et al*., 1965; Möller *et al*., 1981) Teeth with amalgam, composite resin, glass ionomer or intermediate restorative material coronal barrier presented lesser failure rate when compared to teeth without coronal barrier. (Carman and Wallace, 1994) Soluti (2000) settled that retreatment is intensely indicated when the obturated canal was subjected to the oral environment for at least five months. (Soluti, 2000)

Though IRM possesses high compressive strength, Cavit is deliberated as superior to it in averting bacterial penetration. Cavit is usually measured to have outstanding sealing ability because of its linear hygroscopic expansion. (Lai *et al*., 2007) In a study conducted over Nepalese population if was confirmed that a fractured/dislodged coronal restoration was the third common etiology of failure of non-surgical root canal treatment commonly distressing the mandibular teeth when compared to maxillary teeth. (Gautam *et al*., 2012) Gillen *et al* reported that an effective root canal therapy and a post endodontic restoration improve the odds of healing apical periodontitis. Although clinical outcome may vary with combinations of adequate root filling- inadequate coronal restoration and inadequate root filling- adequate coronal restoration. (Gillen *et al*., 2011) Safavi at al suggested that a perfect post endodontic restoration should be performed for higher success. (Safavi *et al*., 1987) A permanent restoration portrayed better results than teeth with provisional restorations.

CONCLUSION

Obturation is a barricade to the dismissal of bacterial irritants and must be augmented as soon as possible by coronal restoration. This will enhance the consequence of the endodontic treatment. An obturated root canal is not an ample barrier to leakage; highlighting Coronal Seal is of extreme significance for an effective endodontic treatment result. Present-day research must be focused to accomplish an efficacious monobloc obturation hence forward generating a continuum with the coronal restoration.

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