



Minimally Invasive Dentistry: Polymer Burs

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Abstract

Dental caries is a multifactorial disease which is very much prevalent in India occurring especially in high economic group and some in middle and lower economic groups of world population. The cause is due to the acquisition of abnormal eating habits by children's, adolescents, younger age groups. One of the conventional ways of treating dental caries is by excavation by using slow and high speed hand pieces. This has become very much true in developing countries like India. The most common instruments used for excavation of dental caries are the use of diamond and carbide burs. There is effective removal of the carious tooth structure through these burs which leads to excess removal of tooth structure and weakening the teeth. Since minimally invasive dentistry came into the practice, many innovative materials have been introduced i.e. Polyimide polymer burs are one of the ways used for excavation of dental caries which helps in removing only the carious part of the tooth and wears of once it reaches and starts cutting sound tooth structure. This article aims to review its applications and discuss its effectiveness based on evidence available through latest published studies.

Keywords: Minimally invasive dentistry; MID; Burs; Polymer burs; Dental caries; Conventional burs

Introduction

Dental caries is a multifactorial disease characterised by the destruction of inorganic and dissolution of organic material from tooth structure [1]. The disease is prevalent in western and developing countries due to acquisition of unhealthy eating habits. Although due to extensive dental research, dental education and awareness programmes the disease prevalence is increasing from 24% to 28% between 1988 and 2004 in the United States. The prevalence of dental decay in deciduous teeth age between 2- 8years is estimated to be 37% in 2011-12 and in permanent teeth between 6-11 years it is estimated to be 21% [2]. A recent review concluded that the prevalence of early childhood caries is 12% to 30 % in their study population [3]. Caries experience among the subjects for permanent teeth was estimated to be 13.8% and for primary teeth 60.1% in South Indian population [4].

In late Nineteenth century G.V. Black introduced a concept for removal of dental caries "Extension for Prevention" [5-7]. This proposes a method of extending the cavity walls till the healthy tooth structure is achieved and infected dentine is removed. Conventionally, this can be done by using diamond and carbide burs using slow and high rotary hand pieces. Since the dentistry has advanced so much in Twenty-first century that the G.V. Blacks "Extension for Prevention" has transformed to "Prevention for Extension". The evolution of concept of minimally invasive dentistry and evidence based dental practice has changed the way currently dentistry is been practiced.

The concept of minimally invasive dentistry practices the science of detecting, diagnosing and intervention at the earliest and treating at the microscopic level [8-11]. This helps to preserve most of the healthy structure of natural teeth and has become the objective of every dentist and if it is not the case, it should be the objective of the dentist in patient's best interest. The newer method for caries removal which follows the principle of minimally invasive dentistry has developed recently since last decades. These include lasers, chemo-mechanical method, air abrasion, air polishing, ultrasonic, ozone method, polymer burs and enzymes [12-21].

Polymer Burs (Polymer Rotary Burs-Smartprep, Ss White)

Smartprep polymer burs are a relatively recent and novel introduction for selective dentine caries removal. In recent years, polymer burs described as "dentin safe," it means that it removes only carious dentine; the bur will be self-limiting when it reaches sound, healthy dentin. Its use has shown to be effective in caries removal. Polymer burs can remove softened dentin but cannot cut

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hard healthy dentin.

Principle

The design of the polymer cutting instrument is based on the differential hardness of the tooth tissues. The knop hardness of enamel is approximately 380-400 and that of dentine is 66-80 [22]. The Knoop Hardness for carious dentine is 30KHN [23]. In order to achieve effective removal of caries from enamel, dentine and to match KHN with sound teeth an instrument made of polymer which has KHN 50 was devised. Since this bur remove only carious part of the tooth, there are less chances that the odontoblasts are exposed which can minimize the pain and sensitivity while preparing the cavity or post-operative procedure. These burs rotate at a speed of 500-800 rpm.

Evidence

Dental materials are introduced in dental market by companies. They come up with an innovative solution to diagnose and treat disease in more effective way. On the contrary, it is obligatory to understand the effectiveness of their products in diagnosing and treating existing dental problems by the clinicians and researchers. A number of studies have been conducted to validate the effectiveness of selective caries removal. A clinical study by Prabhakar et al. [24] tried to determine the efficacy of carious dentine removal by using polyamide burs without removing sound dentin. The author used permanent molars. Bilateral occlusal carious lesions on 40 patients were selected. The procedure of cavity preparation and restoring the prepared teeth is performed by the single operator. The effectiveness of caries removal is assessed by visual, tactile and caries detector method. The results found that there was no significance between polymer burs and carbon steel burs in removing carious dentine and also time taken to remove carious dentine. This study also found that there was no statistical significance on patient's perception about treatment and longevity. The authors concluded that the polyamide burs were effective in removal of carious dentine [24].

In Vitro study by T. Dammaschke et al. [25] tried to compare polymer bur with conventional carbide burs in vitro and found that the polymer burs were ineffective in removal of caries compared to carbide burs. One of the reasons, the author mentioned about his findings is that, dentists had difficulty in handling the small, split sample teeth. Although, in a more clinical type of experiment, both bur systems might show better histological results, but it can be assumed that the relation of caries-free specimens between Smart Prep and bud bur will be similar, because the difference was statistically highly significant. The author used fifty extracted teeth and five different dentists to excavate the carious lesions from the teeth. The dentists were trained before cutting actual samples with smart prep burs. The hardness on probing, dentin coloration and the unique sound of unaffected dentin on probing ("cri dentaire") were the parameters used for following assessing the caries-free status of dentin. The amount of time involved was measured from starting the hand piece until the final probing for dentin hardness. Histological method was used for evaluation of remaining carious dentine [25].

A Similar In vitro study by Meller C et al. [26] tried to compare the effectiveness of polymer and carbide burs in removing dentinal caries. The author used 30 extracted natural teeth and divided into two groups. The time of excavation, working time and hard tissue assessment was done by an experienced restorative clinician. Caries detector was used to determine the remaining carious dentine after

cutting with polyamide and carbide bur. The study found that there was minimal change but was not significant use of polymer burs and carbide burs. The carbide burs was 84.5% caries free and polymer burs was 93.0%. The carbide burs found smaller carious surface staining depth compared to polymer burs. The working time of polymer burs was 5.11mins and 4.99mins for carbide burs. The study concluded that the polymer burs were similarly effective for caries removal compared to carbide burs [26]. Other studies have confirmed that the polymer burs significantly removes less dentine compared to stainless steel burs in a slow speed hand piece at 4,000 rpm. The mean dentine loss was 4.25 mg (range 1.4 - 9 mg) for Smartprep burs and 12.21 mg (range 7.6 - 16.5 mg) for stainless steel burs [27]. The limitation of the diamond burs compared to disposable diamond burs has been well reported [28].

A microbiological study confirmed that the effectiveness of polymer burs in removal of carious dentine has no statistically significant differences in the reductions of the numbers of CFU/ml compared to carbide burs and hence preserves the sound dentine [26-29].

Since these polymer burs are effective in removing dentinal caries, very few dentists have used this instrument. The probable reason is that, dentists are trained in using dental burs for slow speed and high speed burs and some practices hand instrument excavation. The costs of the burs also play a role for choosing polymer burs which in turn impact on the patients. But, a good operator can still practice effectively using these instruments [30].

Bond Strength

The effect on the bond strengths of adhesives to dentine when prepared with the polymer and carbide burs was also determined. There was formation of thick smear layer formed by polymer burs that affected the penetration of the bonding agents. Hence polymer decreased adhesiveness of restorative materials like glass ionomers (GIC) to the tooth structure which are routinely used by the practitioner [31].

Infection Control

Since the multiple use of conventional diamond burs have risk of cross infection, polymer burs based on its working principle can be single use and hence usage of polymer burs minimize the chances of cross infection known in dentistry [32].

Conclusion

Polymer burs were found to be effective in removing carious tooth structure. Hence, minimally invasive dentistry should be employed in day to day practice based on advances in science. A better understanding of chemistry of materials, basic science research in biomimetic and identifying the relationships with the tissues of the body will increase the prognosis of a sealed, adhesive restoration.

Clinical Relevance

Polymide polymer burs were found to be effective compared to carbide burs in removal of carious tooth. It will be challenging for the general dentists and other specialists to imbibe this new concept into the clinical practice. There are number of factors for this; firstly the belief of clinicians in newer techniques and concept itself because they would like to expect to see immediate results rather the results on follow-up basis. Secondly, the cost to the patient and patient co-operation third is the interests of private companies and lastly the

time factor in dental clinics have greater impact on transforming traditional practice to minimally invasive on evidence based. On contrary, training of dentists and specialists will help to make informed clinical decision making and hence a better outcome.

References

- Heymann, Harald O, Edward J Swift, Andre V Ritter. *Sturdevant's art & science of operative dentistry*. Elsevier Health Sciences. 2014.
- Dye BA, Thornton-Evans G, Li X, Lafolla TJ. Dental Caries and Sealant Prevalence in Children and Adolescents in the United States, 2011-2012. US Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics. 2015.
- Dye, Bruce A, Kuei-Ling C Hsu, Joseph Afful. "Prevalence and Measurement of Dental Caries in Young Children." *Pediatr Dent*. 2015; 37: 200-216.
- Poornima P, Disha P, Pai SM, Nagaveni NB, Roshan NM, Neena IE. Dental caries experience among 8-9-year-old school children in a South Indian City: A cross-sectional study. *Journal of Indian Association of Public Health Dentistry*. 2015; 13: 144.
- Hamama, Hamdi H, Cynthia K Yiu, Michael F Burrow. "Caries Management: A Journey between Black's principals and Minimally Invasive Concepts." *Int J Dentistry Oral Sci*. 2015; 2: 120-125.
- Gupta G, Shanbhag N, Puranik MP. Perceptions regarding minimal intervention dentistry among dental interns in India: A cross-sectional survey. *IJCDDR*. 2015.
- Jain K, Bardia A, Geetha S, Goel A. Papacarie: A Chemomechanical Caries Removal Agent. *IJSS*. 2015; 1: 57.
- da Mata C, Cronin M, O'Mahony D, McKenna G, Woods N, Allen PF. Subjective impact of minimally invasive dentistry in the oral health of older patients. *Clinical oral investigations*. 2015; 19: 681-687.
- Banerjee A. The Contemporary Practice of Minimally Invasive Dentistry. *FDJ*. 2015; 6: 78-85.
- Zhang X, Deng X, Wu Y. Remineralizing Nanomaterials for Minimally Invasive Dentistry. In *Nanotechnology in Endodontics*. Springer International Publishing. 2015; 173-193.
- Prado N. Pickard's Guide to Minimally Invasive Operative Dentistry, BR5776. *British Dental Journal*. 2015; 219: 472.
- Valério RA, Borsatto MC, Serra MC, Polizeli SA, Nemezio MA, Galo R, et al. Caries removal in deciduous teeth using an Er: YAG laser: a randomized split-mouth clinical trial. *Clin Oral Investig*. 2015; 1-9.
- Neves AA, Lourenço RA, Alves HD, Lopes RT, Primo LG. Caries-removal effectiveness of a papain-based chemo-mechanical agent: A quantitative micro-CT study. *Scanning*. 2015.
- Hamama HH, Yiu CK, Burrow MF. Effect of chemomechanical caries removal on bonding of resin-modified glass ionomer cement adhesives to caries-affected dentine. *Aust Dent J*. 2015.
- Hamama HH, Yiu CK, Burrow MF, King NM. Systematic Review and Meta-Analysis of Randomized Clinical Trials on Chemomechanical Caries Removal. *Oper Dent*. 2015; 40: E167-E178.
- Ferraz C, Freire AR, Mendonça JS, Fernandes CA, Cardona JC, Yamauti M. Effectiveness of Different Mechanical Methods on Dentin Caries Removal: Micro-CT and Digital Image Evaluation. *Oper Dent*. 2015; 40: 263-270.
- Kaul R, Angrish P, Jain P, Sasan NS. Ozone Therapy-A Paradigm Shift in Dentistry. *IJHSR*. 2015; 5: 410-415.
- Kaul R, Angrish P, Jain P, Sasan NS. Ozone Therapy-A Paradigm Shift in Dentistry. *IJHSR*. 2015; 5: 410-415.
- Olivi G, Olivi M. Restorative Dentistry. In *Lasers in Restorative Dentistry*. Springer Berlin Heidelberg. 2015; 23-36.
- Hamama HH, Yiu CK, Burrow MF, King NM. Systematic Review and Meta-Analysis of Randomized Clinical Trials on Chemomechanical Caries Removal. *Oper Dentistry*. 2015; 40: E167-E178.
- Ricketts D N J, N B Pitts. "Novel operative treatment options." *Monogr Oral Sci*. 2009; 174-187.
- Craig RG, Peyton FA. The microhardness of enamel and dentin. *J Dent Res*. 1958; 37: 661-668.
- Fusayama T, Okuse K, Hosoda H. Relationship between hardness, discoloration, and microbial invasion in carious dentin. *J Dent Res*. 1966; 45: 1033-1046.
- Prabhakar A, Kiran NK. Clinical evaluation of polyamide polymer burs for selective carious dentin removal. *J Contemp Dent Pract*. 2009; 10: 26-34.
- Dammaschke T, Rodenberg TN, Schäfer E, Ott KH. Efficiency of the polymer bur Smart Prep compared with conventional tungsten carbide bur in dentin caries excavation. *Oper Dent*. 2006; 31: 256-260.
- Meller C, Welk A, Zeligowski T, Splieth C. Comparison of dentin caries excavation with polymer and conventional tungsten carbide burs. *Quintessence Int*. 2006; 38: 565-569.
- Banerjee A. Minimal intervention dentistry: part 7. Minimally invasive operative caries management: rationale and techniques. *Br Dent J*. 2013; 214: 107-111.
- Toledano M, Cabello I, Yamauti M, Osorio R. Differential resin-dentin bonds created after caries removal with polymer burs. *Microsc Microanal*. 2012; 18: 497-508.
- Siegel, Sharon C, J A Von Fraunhofer. "Assessing the cutting efficiency of dental diamond burs." *J Am Dent Assoc*. 1996; 127: 763-772.
- Isik EE, Ölmez A, Akca G, Sultan N. A microbiological assessment of polymer and conventional carbide burs in caries removal. *Pediatr Dent*. 2010; 32: 316-323.
- Andrade R, Parsley CK, Parma R. Polymer burs remove less sound dentin and are as effective as carbide burs in caries removal (UT CAT# 2206). *Tex Dent J*. 2012; 129: 672.
- Haley RW, Quade D, Freeman HE, Bennett JV. "Study on the efficacy of nosocomial infection control (SENIC Project): summary of study design". *Am J Epidemiol*. 1980; 111: 472-485.