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Analysis of amalgam restorations done in class 1 cavities in a private dental college - A retrospective study

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ABSTRACT

Amalgam is a very special type of alloy in which mercury is one of the components. It is a material of choice for dental restorations. There are various intriguing facts about dental amalgam that stand out from other materials—the dimensional changes of dental amalgam cause it to undergo initial contraction, expansion and delayed contraction. However, the usage is becoming lesser as the implementation of the dental composite material was introduced. Amalgam is usually indicated when aesthetics is of no concern and where occlusal contact is high. Mercury toxicity is the property which is considered negative as there have been debates and discussions of the hazards mercury can bring to health. There have been advancements in the dental amalgam to help improve its usage among restorative materials. Data collection was done in a university setting. One thousand cases were reviewed from the time period of June 2019 to March 2020. Excel tabulation and SPSS version 22 was used for data analysis. Chi-square test was used for the analysis of the data. There was no statistical significance between the variables that included types of base and the tooth number. (P-value>0.05). Zinc phosphate was the most commonly used base material in relation to lower molars, (p-value<0.05) which was statistically significant. The maximum number of amalgam capsules used were one capsule which showed high significance.

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INTRODUCTION

Dental amalgam is an alloy made by mixing mercury with a silver tin alloy (Malhotra and Asgar, 1978). Dental amalgam alloy is a silver-tin alloy to which varying amounts of copper and small amounts of zinc have been added (Roeters *et al.*, 2004). According to Skinner's, amalgam is a special type of alloy in which one of its constituents is mercury (Opdam *et al.*, 2007). In dentistry, it is traditionally used to fill cavities, particularly posterior teeth. There are various intriguing facts about dental amalgam that stand out from other materials. The dimensional changes of dental amalgam cause it to undergo ini-

tial contraction, expansion and delayed contraction. Amalgam has high compressive strength and low tensile strength which can be affected by temperature, condensation, porosity, corrosion etc (Dickson *et al.*, 1968). Amalgam undergoes creep which is a time-dependent plastic deformity of crystalline material under the influence of static and dynamic stress (Bakhurji *et al.*, 2017). Tarnish and corrosion occurs to dental amalgam due to the effects of the oral environment. Mercury toxicity is the property which is considered negative as there have been debates and discussions of the hazards mercury can bring to health (Stone, 2002).

Indications of dental amalgam include cuspal restorations (Hanson, 1982). It can be used as a permanent filling material in Class I, Class II, Class V and Class VI dental caries (Hanson, 1982). Teeth with questionable prognosis and die preparations are also indications of dental amalgam (Carrotte, 2001). Contraindications include small class I and class II cavities, excessive loss of tooth structure and most importantly, aesthetics (de Oyague *et al.*, 2012). The advantages of dental amalgam include ease of use, high compressive strength, excellent wear resistance, favourable long term clinical results, economic value, and it's the self-sealing ability (Petersen, 2017). The disadvantages of dental amalgam include lack of aesthetics, less conservative, non-insulating, corrosion and galvanism, lack of tooth-structure reinforcement, and the difficulty in restoring proper tooth anatomy (Tkahashi, 1971; Parolia *et al.*, 2011; Vandana A Pant *et al.*, 2012).

There have been advancements in the dental amalgam to help improve its usage among restorative materials. Bonding systems are used to bond the amalgam restoration with the tooth to increase its longevity (de Oyague *et al.*, 2012). The examples of bonding systems include ALL BOND, Amalgam bond Plus and Panavia (Parolia *et al.*, 2011). Previously, Saveetha Dental College had conducted and published many articles including in vitro studies (Ramanathan and Solete, 2015; Ramesh *et al.*, 2018), in vivo studies (Janani *et al.*, 2020), surveys (Jose *et al.*, 2020; Manohar and Sharma, 2018) randomised controlled trials (Ramamoorthi *et al.*, 2015), systematic reviews (Rajakeerthi and Nivedhitha, 2019; Teja and Ramesh, 2020), and case studies (Hussainy, 2018; Nasim and Nandakumar, 2018). This retrospective study was conducted for the purpose of evaluating the number of amalgam restorations done along with the types of base and amount of amalgam used in a class I cavity among patients visiting Saveetha Dental College.

MATERIALS AND METHODS

This study was based on a university setting where only a certain population is covered. Data collection was done from June 2019 to March 2020. Case sheets of the patients were reviewed and cross-verified by another examiner to avoid missing data. The sample size of this was 1000 patients, where only 897 patients had class 1 amalgam restorations. The ethical approval of this study was received by the ethical board of the institution. (ethical approval number: SDC/SIHEC/2020/DIASDATA/0619-0320). Three people were involved in this study (guide, reviewer and researcher).

Excel tabulation was done consisting of age, gender, tooth number, number of amalgam capsules used and types of base. SPSS Version 22 was used to import the data and analyse. The statistical test used was the Chi-square test for evaluating the association. Independent variables included age, gender and tooth number. Dependent variables included the procedures that were done.

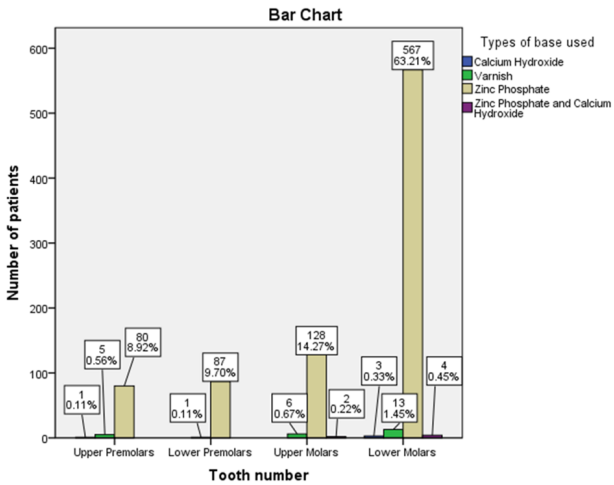

Figure 1: This graph represents the association between tooth number and types of base

RESULTS AND DISCUSSION

Out of the 1000 patients, 897 patients had class I amalgam restoration done. Four hundred ninety-four patients were males and 403 were females. Five hundred eighty-seven patients had class I restorations done in the lower molars and 567 of them had zinc phosphate as the base material. There was no significant association between tooth number and the types of bases used (p-value>0.05 - Chi-square test). One amalgam capsule was used to restore lower molars in 561 patients. There was statistical significance between tooth number and number of amalgam capsules used (p-value<0.05 - Chi-square test).

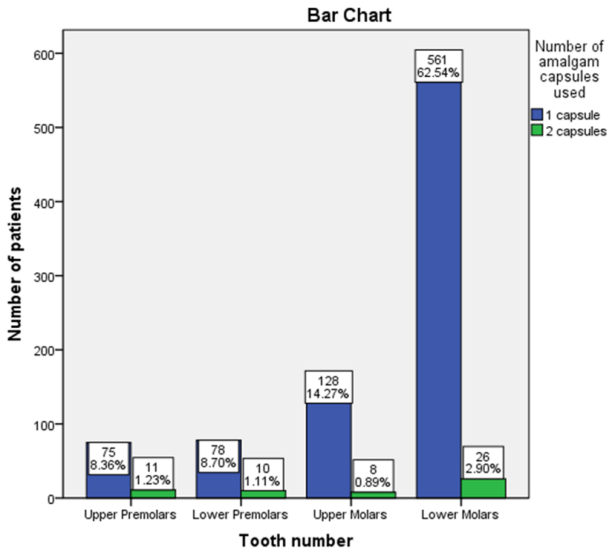

Figure 2: This graph represents the association between tooth number and the number of amalgam capsules

This study assessed the amalgam restorations in class 1 cavities based on the number of amalgam capsules used and the types of base. In this study, we have observed that there is a significant association between the types of base and the number of amalgam capsules used. The tooth number was categorized into upper premolar, upper molar, lower premolar and lower molar. The four most common types of base used are zinc phosphate, calcium hydroxide, varnish and zinc phosphate + calcium hydroxide. Figure 1 shows the association between tooth number and types of base used where blue represents calcium hydroxide, green represents varnish, yellow represents zinc phosphate, and purple represents zinc phosphate and calcium hydroxide. The X-axis represents tooth number and Y-axis represents a number of patients. Chi-square test was done for the association and found to be statistically not significant (p value=0.318)(Chi-Square Value=10.409). However, Zinc phosphate was the most commonly used base in the lower molars (63.21%), followed by upper molars(14.27%), Lower premolars (9.7%) and least in upper premolars (8.92%). In this study, 897 patients had class 1 amalgam restorations. Eight hundred sixty-two patients, out of the total, had zinc phosphate as the base. The usage of zinc phosphate as a base is indicated for cavities of moderate depth (Myatt, 1938; Hajian *et al.*, 2008). It is used as a pulp protecting agent and acts to prevent post-operative sensitivity (Fleming, 2001).

Zinc phosphate is considered a high strength base that is chemically compatible with both the dental-pulpal tissues and restoration (Bruce and Stevens, 1989). It provides thermal protection for the pulp and mechanical support for the restoration (Darvell, 1984; Bruce and Stevens, 1989). It is usually advised as a base for amalgam cavities of moderate depth to induce healthy reparative reactions (Prosser *et al.*, 1981). The maximum usage of zinc phosphate as the base in class 1 amalgam restorations is mostly due to the depth of the cavities being moderate (Cartz *et al.*, 1972). A shallow cavity would require a different pulp protecting material (Peyton and Holmes, 1936). The varnish is natural gum, also known as a synthetic resin which is dissolved in the organic solvent (Edwards, 1978). It reduces leakage around the margins and prevents the microleakage of amalgam into dentin (Nasser, 2011). Twenty-five patients had varnish as their pulp protecting agent which is most likely due to the shallow nature of the cavity.

Six patients had zinc phosphate + calcium hydroxide and four patients had only calcium hydroxide. Calcium hydroxide acts as an aid in the formation of reparative dentin (McComb, 1983). It has low compressive strength and great solubility (Mickenautsch *et al.*, 2010). It is advised for cavities that are deep (Mickenautsch *et al.*, 2010; Zamanian, 2013). Figure 2 shows the cross-tabulation between tooth number and the number of amalgam capsules used where blue represents one amalgam capsule and the green represents two amalgam capsules. The X-axis represents tooth number and Y-axis represents the number of patients. Chi-square test was done for the association and found to be statistically significant (P-value=0.04) (Chi-Square Value=13.781). Hence proving that one amalgam capsule was most commonly used in relation to lower molars(62.61%), followed by upper molars(14.17%), lower premolars (8.71%) and least in upper premolars (8.37%). One amalgam capsule was used in 842 patients while two amalgam capsules were used in 55 patients. The amalgam capsules have two side compartments. One side contains 1 part liquid mercury and the other is 1 part alloy mixture (Phillips, 1944). The capsule is placed in an amalgamator (Darvell, 1980). It breaks the membrane between two compartments and mixes the content at a set time. One amalgam capsule can be used to fill a moderately deep cavity (Scheller-Sheridan, 2013b). 2 amalgam capsules are used to fill a deep cavity (Scheller-Sheridan, 2013a).

Statistical analysis showed that there was a significant association between amalgam capsules and types of base, however insignificant in lieu with the tooth number. There are studies that are similar in literature. According to Bakhurji et al., a dental amalgam restoration is only as good as the choice of base material used and the depth of the cavity. The

limitations of this study were the small sample size and retrospective nature. This study cannot be generalised to a larger population due to specific data requirements. Future research should be conducted in a larger sample size and also in prospective study design to evaluate the clinical performance of amalgam restorations, particularly postoperative sensitivity and longevity of restorations.

CONCLUSION

Within the limits of the study, it can be concluded that zinc phosphate was the most commonly used base for class 1 amalgam restorations and one amalgam capsule was used for restoring the majority of the class 1 cavities requiring amalgam restorations among patients visiting Saveetha Dental College.

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Conflict of Interest

The authors declare that they have no conflict of interest for this study.

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