

FORCES ACTING ON CLASS-5 RESTORATIONS

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Abstract

The main aim of the review is to discuss the forces acting on the class 5 restoration. A thorough literature search was performed using the database like Pubmed, google scholar, BioRxiv, MESH, Cochrane database using the keywords 'forces', 'class 5' and 'restoration' with no date and year restrictions. The language is restricted to English. 8 articles with similar data were found which were analysed and have been included in this study. Effect of brushing in class 5 restoration leads to poor esthetics and the person loses the confidence to smile. Vigorous and improper brushing damages the class 5 restoration. Class 5 cavities involve caries affecting the gingival one-third of facial or lingual surfaces of anterior or posterior teeth. Class 5 has only one surface and there is no direct force acting on it, so it is free of mechanical problems. Tooth can withstand force because of resiliency of dentin. Several studies have demonstrated that the use of an adhesive matrix decreases cuspal flexure compared with occlusal amalgam restoration. The depth of an occlusal restoration particularly is more critical than the width. Some instances also showed that the peak stresses were greater than the known bond strengths of composite to dentine.

Keywords: Brushing simulation; forces; class 5; glass Ionomer cement; composite resin; Abrasion; non carious cervical lesion; Dental amalgam.

Introduction

Class 5 cavities involve Caries affecting the gingival one-third of facial or lingual surfaces of anterior or posterior teeth[1]. Class 5 has only one surface and there is no direct force acting on it, so it is free of mechanical problems[2]. The primary cause of class 5 cavity is prolonged exposure to dental hard tissues to corrosive chemicals such as highly acidic drinks. Studies have suggested that any material with a critical pH of < 5.5 could demineralize the tooth's hard tissues.

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The forces acting on teeth will make them move within their periodontal tissues which may vary in magnitude, duration, frequency and direction[3]. In order to know the success rate of the treatment done i.e restoration placed inside a oral cavity physico-mechanics of the forces acting on it has been understood, by restoring the tooth form, we ultimately aim at maintaining the integrity and continuity of dental arch which is very important as far as mastication is concerned. Therefore the prepared cavity should be able to withstand all stresses acting on tooth structure without leading to failure of restoration[4]. Both resistance and retention form is very important incase of a successful restoration[5].

Effect of brushing in class 5 restoration leads to poor esthetics and the person loses the confidence to smile[6]. Correlating tooth cleaning efficiency, a new robot brushing simulation technique has been found for clinical plaque removal and also to check the efficiency of restoration done[7]. Bearable force is applied only if the restoration is able to withstand the forces. The main damage caused mainly due to vigorous brushing is tooth enamel damage, It cannot be reverted. Vigorous brushing can also lead to receding of gums. Our gums cannot regenerate unlike other tissues so this will lead to a vast damage and pain. Class 5 restoration is usually done in the gingival one third of the facial or lingual surface of anteriors or posterior teeth. There are other effects of brushing on class-5 restorations such as microleakage where there will be passage of bacteria, fluids, molecules or ions between a cavity wall and the restorative material applied to it[8].

Cervical abrasions are injury to hard tissues located in the neck of the tooth. This cannot be cured by the dentist but they can fill the groove with restoration materials like Glass Ionomer cement, Dental amalgam, Dental porcelain or ceramics, Composite resin, gold etc. Tooth coloured restoration materials are preferred widely in case of anterior teeth for aesthetics.

Normal biting forces are caused by jaw movements and elevator muscles of mastication. The main force caused by hard substances leads to forces in dental structures that have a moment to force ratio required for translation. In case of proximal restorations of an anterior tooth i.e. class 5 restorations they have physico mechanical forces and stress acting on them[1].

MATERIALS AND METHODS:

A thorough literature search was performed using the database like Pubmed, google scholar, BioRxiv, MESH, Cochran database using the keywords ‘forces’, ‘class 5’ and ‘restoration’ with no date and year restrictions. The language is restricted to English. 8 articles with similar data have been found which were analysed and have been included in this study.

Class 5 cavity restoration:

Class 5 cavities involve Caries affecting the gingival one-third of facial or lingual surfaces of anterior or posterior teeth[9]. The primary cause of class 5 cavity is prolonged exposure to dental hard tissues to corrosive chemicals such as highly acidic drinks. Studies have suggested that any material with a critical pH of < 5.5 could demineralize the tooth's hard tissues.

A filling helps in prevention of further decay and allows the tooth to function normally[10]. The class-5 restoration is done using dental amalgam in case of non esthetic option but when it comes to esthetic zone options like adhesive composite resin, conventional and resin modified glass ionomers, flowable composite resins and compomers are used[11].

Forces acting on class 5 restorations:

It was thought earlier that the only forces dislodging the restoration of class V were the pulling forces of sticky foods, although little consideration was given to the biomechanics of the formation of the dents[12].

Gable was the first person to consider the possibility of occlusal forces affecting restorations of class V. In addition, direct measurements were made of the changes in the diameter of the occlusal-gingival preparations of class V[13].

Displacement of cavity margins and cuspal flexure was considered responsible for the extrusion of amalgam and changes in the cavity's cervico-occlusal width, and the extent of the deformation was related to the amount of tooth tissue that was lost[14]. It was seen that forces applied to a tooth's occlusal surface could cause stresses in a restoration remote from the point of force application.

In 1991, Heymann proposed a retention theory of tooth flexure to explain those findings. They suggested that two mechanisms are working to cause failure. One is the lateral excursive movements that result in lateral cuspal movements that generate tensile stresses along the tooth restoration interface and the other are heavy forces in central occlusion that cause vertical deformation of the tooth leading to compressive and shear stresses at the interface of tooth restoration. In vitro, cuspal flexure was also shown to increase with the rise in the extent of coronal preparation. If the theory of tooth flexure is correct, then the presence of an occlusal restoration may have a deleterious effect on class V restoration retention[15]. In fact, it has been demonstrated that the use of an adhesive matrix decreases cuspal flexure compared with occlusal amalgam restoration. The depth of an occlusal restoration particularly is more critical than the width[16].

Class 5 has only one surface and there is no direct force acting on it, so it is free of mechanical problems. But, when the mandible is moving in the lateral excursion form, the lingual slopes of both buccal and lingual cusps of maxillary teeth will lead to the buccal slopes of the buccal and lingual cusps of mandibular teeth. Assuming that we have a facial class 5 restoration in the lower molar tooth. As the tooth is firmly attached with bone, the tooth structure of the crown will be able to move from position 1 to position 2, leading to a V-Shape opening at the margin along with a facial component of force during the restoration facially[17].

Even though the above mentioned opening and forces are very minimal and there is no displacement in the restoration completely, repetition of this more than thousand times a day leads to marginal failure and which in turn leads to the facial protrusion of the restoration material. This can happen in lingual restoration of lower teeth and also in facial or lingual surface of upper teeth. To reduce these effects of displacing forces, the requirement of grooved occlusal and gingival walls are essential for all class 5 cavity preparation for amalgam, in addition to definite surrounding walls, line angles and point angles[18].

The forces may be direct biting forces due to mastication and jaw movements. For any proximal restoration in anterior teeth there are two possible displacing forces[19]. The first one is horizontal displacing or rotating the restoration in linguo proximo lateral direction. The second is a vertical force displacing or rotating the restoration proximal and having a fulcrum at the gingival margin of the preparations.

Effect of forces acting on class V dental amalgam restoration:

In an article published by G Vasudeva[20], the failure of Class V restorations is a clinical situation which is often due to inadequate moisture control[21]. The effects of occlusal forces and cuspal movement may also have an effect. It was then found that the occlusal restoration increased the cuspal movement, which then increased the shear forces around the buccal Class V cavity. This effect was more pronounced when amalgam was used as the occlusal restorative material[22]. Amalgam is strong in compression and weak in case of tension and shear. So, the prepared class-5 cavity should be made as such the dental amalgam is able to withstand the forces and manipulation should be done in such a way that the restoration can receive compression forces and minimum tension and shear forces[23].

Effect of forces acting on class V composite restoration:

In an article published by J S Rees[24], he discussed that the partial failure around the tooth-composite interface of a class V restoration is common due to effects of polymerization shrinkage. It showed that the partial failure resulted in an increase of peak tensile and shear forces compared to a tooth with fully intact cavity wall interface. Some instances also showed that the peak stresses were greater than the known bond strengths of composite to dentine[25].

Flowable composite materials are most commonly used in Class III, Class IV and Class V restorations. The bonding force and the shrinkage force act concurrently on the tooth/restoration interface during bonding and polymerization of resin composites which creates stress in the interface of the tooth / restoration and causes tooth deformation of class 5 restorations[26].

Effect of brushing on class-5 restoration:

Overbrushing can lead to sensitivity teeth and receding gums. Vigorous brushing forces lead to chipping of the restoration material from the cavity and can wear down the enamel on the teeth[27].

Improper brushing leads to microleakage where there will be passage of bacteria, fluids, molecules or ions between a cavity wall and the restorative material applies to it. Many technicians have been devised to test the cavity-sealing properties of restoration both in vital and in vivo[28]. Microleakage is the major problem in clinical dentistry which is an undetectable passage of bacteria, fluids or molecules. Smear layer and microleakage unfortunately cannot perfectly adapt to amalgam or any other restorative to the walls. Such leakage will result in the discolouration or staining of the restoration, produce tooth sensitivity, aid in the recurrence of caries and finally may lead to failure of the restoration [29]. The other effect of brushing on restoration is a pathological condition like dental cervical abrasion injury which is wear of the hard tissues of the tooth located in the neck of the tooth, produced by constant frictional mechanical processes[30]. Dentists cannot cure damage done by tooth brush abrasion but they can fill their groove with porcelain filling. This filling will patch up the pocket and keep bacteria and food debris from entering it. Non carious cervical lesions are also due to brushing where it is characterised by a loss of hard dental tissue near the cemento enamel junction[31]. Commonly, their shape is like a wedge with apex pointing inwards and at times they appear like regular depressions resembling a dome or a cup[32]. To reduce enamel damage we will have to wait at least for an hour after meal before u brush your teeth[33].

CONCLUSION:

Vigorous and improper brushing damages the class 5 restoration. Tooth can withstand any kind of force because of resiliency of dentin. It can be concluded that lower modulus composites can flex with the tooth structure decreasing the bond failure and that the stresses are much lesser when there is absence of occlusal restoration. Occlusal composite restorations reinforce the tooth structure and reduce the cuspal flexure as compared to silver amalgam.

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AUTHOR CONTRIBUTIONS:

P.A.Vasishta:

- 1) Execution of the work
- 2) Data collection
- 3) Drafting of manuscript.

Jayalakshmi S

- 1) Concept and design of the study
- 2) Validation of the data collection

3) Revision and proof-reading of the review

Vinay sivaswamy:

1) Validation of the data collection

2) Revision and proof-reading of the review

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