

Comparative Evaluation of Effect of Auxillary Grooves on Retention of Complete Cast Crowns in Molar Teeth – An In-Vitro Study

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Abstract

Aim: The aim of this study is to compare and evaluate the effects of auxillary grooves on retention of complete cast crown on molars. **Method:** Thirty mounted teeth were divided randomly into three groups of 10 each and grooves are placed using NOF104R diamond point. In group A, no groove is placed – control, group B, one groove is placed proximally in the centre of mesial surface – Test group. In group C, two groove is placed proximally, each in centre of mesial surface and distal surface - Test group. Castings were prepared luted and retention was checked using a Universal Testing machine Results were subjected to one way ANOVA and Student T Test. **Results:** Auxillary retentive features produces a significant increase in retention of complete cast crowns. Incorporation of two proximal grooves on the mesial and distal side produces the most retention as compared to one groove or conventional tooth preparation **Conclusion:** Retentive features produces a significant increase in retention of complete cast crowns

Key words: auxillary grooves, complete cast crowns, tooth preparations, mandibular molar

Introduction

A full complement of natural dentition plays an important role in mastication, speech and aesthetics. Conditions like dental caries, periodontal problems, congenital abnormalities, neoplasm, trauma affects the dental health causing loss of teeth, which results in loss of function and aesthetics. Restorative materials are used to re-establish form and function of teeth.

Different modalities of tooth replacement are removable dental prosthesis, fixed dental prosthesis, & Implant supported prosthesis, and among them the most

frequently done is fixed dental prosthesis. Complete coverage restoration are the commonly fabricated restoration to regain the morphology, function and contour of the damaged tooth structure caused by caries, trauma and for protection of root canal treated teeth as well as retainers for fixed partial dentures. They are also indicated for establishing occlusal rest and guide planes in removable partial dentures.

Teeth preparation is defined as the mechanical treatment of dental diseases that restores tooth to original form. Tooth preparation must follow certain mechanical, biological and esthetic principles. Retention prevents removal of restoration along the path of insertion or along the tooth preparation. Retention depends on taper, height, surface area and texture of tooth preparation. ^{1,2}

Sometimes we come across tooth with inadequate crown height which results in reduced crown retention causing dislodgment of the crown by masticatory or para-functional forces.

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Clinically a short crown requires crown lengthening, which is a periodontal surgical procedure before crown preparation which adds to the cost and complexity of treatment. Other modalities for inadequate crown height to improve retention are incorporation of grooves, boxes, pins & ledges. The aim of this study is to compare and evaluate the effects of auxiliary grooves on retention of complete cast crown on molars.

Materials and Method

Thirty extracted mandibular first molars, of equal dimensions mesiodistally, buccolingually and cervico-incisally were selected for the study. The roots of teeth were notched for anchorage and mounted vertically in auto polymerizing acrylic resin block 2mm below the cemento-enamel junction. A dental surveyor is used to position the long axis of the tooth. These mounted teeth were divided randomly into three groups of 10 each and grooves are placed using NOF104R diamond point.

In group A, no groove is placed – control group

In group B, one groove is placed proximally in the centre of mesial surface – Test group

In group C, two groove is placed proximally, each in centre of mesial surface and distal surface - Test group.

The groove were placed parallel to the path of insertion and minimum of 3mm long. Groove should be terminated 0.5mm above the chamfer finish line and are parallel to each other with the axial walls converging towards the occlusal surface. Size of groove should be half the diameter of the diamond point with buccal and lingual walls diverging from each other.

Tooth Preparation:

Teeth preparation was done with a high speed airtor handpiece attached to vertical arm of surveyor using a lockable joint. A custom made paralleling device is used to attain parallelism of axial walls and constant taper for each crown preparation. All teeth were then photographed (at an image size of 4:1) for facial and/or lingual aspect as well as mesial and/or distal aspect. A protactor was used to measure the degree of taper. A constant taper of 10 ± 1 degree was obtained for all the preparations. A uniform chamfer finish line of 0.5mm width is established at the cemento-enamel junction. All preparations are refined using SF-102R diamond point. Teeth are prepared to constant

height of 3.5mm as measured at the mid-buccal surface.

IMPRESSION TECHNIQUE:

Impressions of the prepared teeth were made with multiple mix single step technique with polyvinyl siloxane impression material. and cast is poured in type IV die stone following manufacturer's instructions taking care to see mix is free of any defects or air bubbles by mixing with a vacuum mixer.

PREPARATION OF WAX PATTERNS: The dies are painted with three coats of die spacer 1mm short of finish lines. Die lubricant (Isolit) is painted on the master die and excess of lubricant is removed with a gentle stream of air. Wax copings of 1mm is prepared by using blue inlay wax (BEGO), carved with PKT wax instrument simulating a cylinder axially and flat occlusally. A 2mm sprue wax is made as loop and attached to the centre of occlusal surfaces of wax pattern for testing in a universal testing machine. Wax patterns are designated with a code number for convenience of identifying it for corresponding prepared tooth. These wax patterns are sprued and invested with phosphate bonded investment. Burn out is done by lost wax process.

Casting And Finishing:

Test copings are cast using nickel chromium alloys (Wirrolloy Bego, Germany) in electronic centrifugal induction casting machine (Galloni). These castings are retrieved from investments and sprues are cut using high speed grinder (Speed Master). Minor adjustments to seat the casting are done with a small round bur mounted on a laboratory hand piece. Internal surface of the castings are air abraded with 100-150 um Aluminium oxide particles at 40 psi and fit of casting are verified on the preparation. All the casting are cleaned with ultrasonic cleaning unit (USG 4000 Ultrashall, Dentarum) for 15 minutes.

Cementation:

Teeth and crowns are thoroughly cleansed and dried with filtered compressed air before cementation. All these teeth are cemented with Type I glass ionomer cement according to manufacturers recommendation. Each casting is filled with sufficient luting cement to evenly cover the inner surface, seated with digital pressure on the tooth taking care to see that excess cement is flown all around. An explorer is used to carefully remove the excess cement.

To verify the complete seating of casting , micrometer measurements are made before and after cementation. Each casting is seated on tooth without cement and the distance from the bottom margin of the acrylic resin base is measured. Measurement is repeated after cementation and two readings are compared . Tests specimens are stored for 24 hours at 37 degree at 100% relative humidity .

Measurement Of Retention:

Crowns are subjected to vertical dislodgement force until failure on a universal testing machine at a cross head speed of 5mm/ min. Castings are pulled along the apicoronal axis of each tooth using a “J” hook attached to the upper member of the testing machine. Force of dislodgement and debonding are recorded in Megapascals and tabulated . Intergroup comparison was done using ANOVA. Level of significance was set at $p \leq 0.05$

Results

Results are presented in Table 1 and 2

Table 1: Mean and Standard Deviations of the forces required to dislodge each casting from its preparations

| Samples | N | Mean | Standard deviation |
|---------|----|--------|--------------------|
| Group A | 10 | 256.8 | 4.135 |
| Group B | 10 | 34.553 | 7.173 |
| Group C | 10 | 57.67 | 10.58 |

Table 2: Comparison of different groups using least significant difference test

| Group (X) | Group (Y) | Mean difference (X-Y) | p |
|-----------|-----------|-----------------------|-------|
| Group A | Group B | -8.693 | 0.047 |
| Group A | Group C | -31.814 | .001 |
| Group B | Group C | -23.121 | 0.001 |

Discussion

Full cover restorations are required to restore teeth with minimal remaining coronal tooth structure or when fixed partial denture is fabricated. A steadily increasing demand for restorations of edentulous regions with fixed partial dentures has directed attention to the effectiveness of retention of fixed partial denture on abutment teeth. Several factors affect the retention of the crowns. They are geometry of preparation, type of luting agent, occlusal forces acting, position of crown and tenso-frictional resistance offered by the dentin. Loss of retention of a full coverage restoration may be due to poor geometrical preparation of the crown , dissolution of the luting agent and improper occlusal contacts.

This study demonstrated that clinically compromised complete coverage tooth preparation including reduced occluso cervical dimension, increased TOC, and a reduced occluso cervical –to buccolingual dimension ratio offered greater retention with grooves. Thirty freshly extracted mandibular molars are used . These teeth were divided into three groups. Group A had teeth prepared in a conventional manner , group B had teeth prepared with one proximal groove & group C had teeth prepared with two proximal grooves. Tooth occlusal convergence is one of aspect of preparation of complete cast crowns. Retention of crown is determined at various TOC angles by applying a tensile force to cemented crown. Maximum tensile retentive values are recorded at 5 degree TOC. Wilson and Chan in 1994¹ reported maximal retention occurred between 6 to 12 degrees. Occlusal views were used to clinically assess TOC but of limited value, hence during tooth preparation mouth mirror has been recommended so that facial and lingual view of prepared tooth is established as effective means of assessing TOC .

Mandibular teeth are generally prepared with greater TOC compared to maxillary teeth¹, hence axial grooves are routinely incorporated in preparation of mandibular molars for fixed partial dentures . Also FPD abutments are prepared with greater TOC compared to individual crowns.

Woosley and Matisch ⁵ determined that proximal grooves provided complete resistance to faciolingual forces , whereas facial or lingual grooves provided only partial resistance to faciolingual dislodgment . Proximal grooves increase the resistance and retention of restoration. Ayad etal ⁶ in a study found a marked difference between the degree of taper of full crown

preparation of 18-22 degree and that of boxes and grooves in the axial surface of preparations as shorter distance between walls allows dentist to prepare more precisely. Also Woosley and Matich reported that proximal grooves on short 15 degree dies provide complete resistance to faciolingual horizontal displacement.

The results showed highly significant amount of separation force required to dislodge casting between one groove (Group B) and no grooves (Group A) $p \leq 0.047$ and very highly significant forces required to dislodge castings with two grooves $p \leq 0.001$. This suggests incorporation of proximal grooves improves the retention of cast crowns. The increased retention may be attributed to the fact that the lateral walls of the grooves will help in the tensofrictional resistance and will limit the freedom of displacement. This results are in confirmation with previous studies done by Kishimoto et al and, Omar et al^{2,3}

Limitations :

Unidirectional forces were applied for dislodgement of crowns in this study · masticatory forces are multidirectional . In addition only one luting agent that is Type I glass ionomer was under consideration . This study was an invitro study and did not consider the role of saliva which has an influence of the physical properties of the luting agent.

Conclusion

1. Auxiliary retentive features produces a significant increase in retention of complete cast crowns
2. Incorporation of two proximal grooves on the mesial and distal side produces the most retention

as compared to one groove or conventional tooth preparation

Conflict of Interest : Nil

Source of Funding : Self

Ethical Clearance for this study is taken from our college institutional ethical committee. Enclosed certificate of ethical clearance.

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