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Comparison of shear stress acting on the severely worn anterior canine restored with 2 different restorations: An in vitro study

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***Abstract*---**Aim: To compare fracture resistance of severely destructed mandibular canine under oblique loading restored with Richmond crown verses zirconia endocrown. Materials and method: 10 mandibular canine were endodontically treated and divided into 2 group of 5 each both the group were cut 2mm above the cement enamel junction one group received endo crown and second group received cast metal post and core, both the group were subjected shear force on UTM at cross head speed of 1 mm/min the results obtained were calculated in newton's and statistical analysis was carried out. Results: Cast metal post and core (972.4±217.51N) showed better resistance to fracture than Richmond crown group (1180.6±168.87N). statistical analysis done using unpaired t test (P value =0.1818) which was which was statistically insignificant. Conclusion: endocrown showed better resistance to fracture from shear forces than cast metal post and core.

***Keywords*---**shear stress acting, different restorations, anterior canine.

Introduction

Restoration of endodontically treated severely worn anterior teeth poses a great problem in prosthetic dentistry. Such teeth requires additional retention from root canal for crown restoration especially after root canal therapy. In such cases post and core treatment modality has been advised in the literature. The ferrule, or encircling band of cast metal around the coronal surface of the tooth, has been suggested to improve the integrity of the endodontically treated tooth. It is considered to counteract the functional lever forces .To restore a teeth ,ferrule lengths varying from 1 to 2 mm of coronal tooth structure above the crown margin is suggested in the literature (1).

Some cases complicated with deep bite and minimum overjet require special consideration as it becomes very difficult to place a prosthetic crown in such cases. Richmond crown advised in deep-bite cases involving minimum overjet with severely destructed tooth structure can be placed in such situation as it does not require cemental interface between post- core and crown. Richmond crown is a single-piece, post-retained crown with a porcelain facing designed to function as bridge retainer. Richmond crown is not a post and core system but it is customized castable post and crown system as both are single unit and casted together. It is easy to make cast metal restoration with aid of posts for long term retention (2).

Other type of restorations like conventional cast metal post and core with conventional crown have poor prognosis in deep bite cases other restorative option available in the literature is endocrown which can be given in cases with minimal coronal structure available.. Endocrowns can be used to restore damaged, supragingival structure of posterior teeth. These restorations are recommended in case of damaged molars crowns, short and narrow roots, obturated canals or limited interocclusal space. These restorations are mechanically anchored in pulp chambers (3 4 mm element)[and strongly, adhesively bonded with hard dental tissues using resin cements (3).research in terms of its use for anterior tooth restoration is lacking due to limited data available in the literature. The aim of the study was to compare fracture resistance of severely destructed mandibular canine under oblique loading restored with richmond crown verses zirconia endocrown.

Materials and Method

1. 10 mandibular canine extracted due to periodontal conditions were selected, all the extracted tooth were mounted on the self-cure resin block and were endodontically treated by the same operator .selected teeth were divided into two group(A and B) with 5 teeth in each group.
2. All the 10 teeth were sectioned 2 mm above the cementoenamel junction to simulate supragingival margin
3. For Groups A, the gutta percha in the dental canals was partially removed upto 2/3 relative to the length of the root using peeso reamer II and III and the coronal orifice was enlarged using Gates–Glidden III and II drills. Then ferule of 2mm in height and 1 mm width was created around the tooth

4. For group B, only coronal canal was prepared upto the height of 3.5 mm, walls of the canal were made parallel and free of undercut using cylindrical-conical green diamond bur and Diamond flat disc, filling material was filled in the cavity over the gutta percha to recive the restoration the height from cavosurface margin upto the base of restoration was maintained to 3mm to receive the coronal endocrown. The endocrown preparation consisted of a circular supragingival butt margin with a depth of the central retention cavity of 3 mm from the cavosurface margin with round internal line angles.
5. Pulp canal of teeth in the group A were recorded using the pattern resin, petroleum jelly was applied to the tooth and pattern for Richmond crown was fabricated using pinjet and pattern resin, pattern obtained was casted and framework for Richmond crown was fabricated.
6. CAD/CAM was used to fabricate the zirconia crown for teeth in group B, models were scanned and restoration were designed using the in lab software (dentsply Sirona) and were milled, sintered and finally glazed.
7. Fabricated restoration were cemented using the same resin cement in both groups as it has properties like resistance to shear forces.
8. The restorations were subjected to a fracture test by exerting a static load at a crosshead speed of 1 mm/min to the center of the labial surface of the teeth

Fig1: teeth cut 2mm above the CEJ

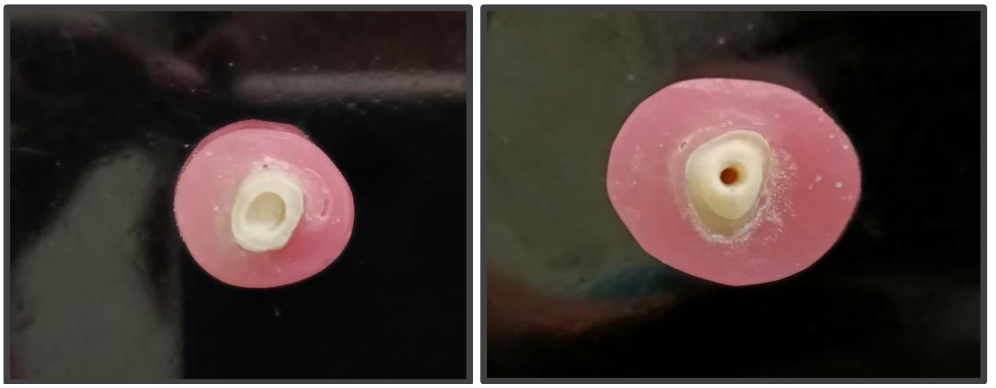

FIG 2&3: tooth prepared to receive endocrown and cast post and core crown respectively

9. Restorations using a universal testing machine (UTM).Acrylic cylindrical base was used to seat the specimen on the platform of the UTM. The load was applied to the same point in all specimens. A laser simulated the future point of impact of the force on the tooth and positioning of all the specimens.
10. Load was applied at an angle of 45 degree to the long axis of the tooth and position was marked for all the specimens, load was maintained and increased gradually until the fracture of the restoration occurs and the load at which fracture occurs was recorded in newton.

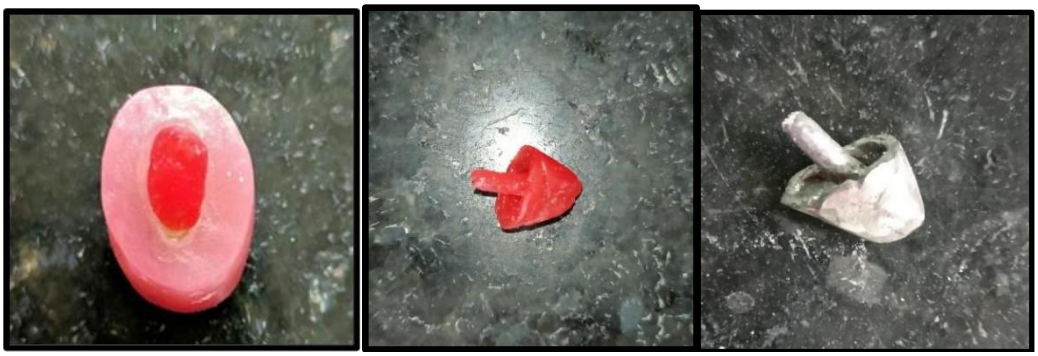

Fig 4,5&6:Pattern fabricated and casting done for Richmond crown framework

Fig 7: zirconia endocrown prepared with the aid of CAD/CAM

11. Load for each group was recorded and which is presented in the table below and were submitted for statistical analysis

FIG :8&9 cemented restorations

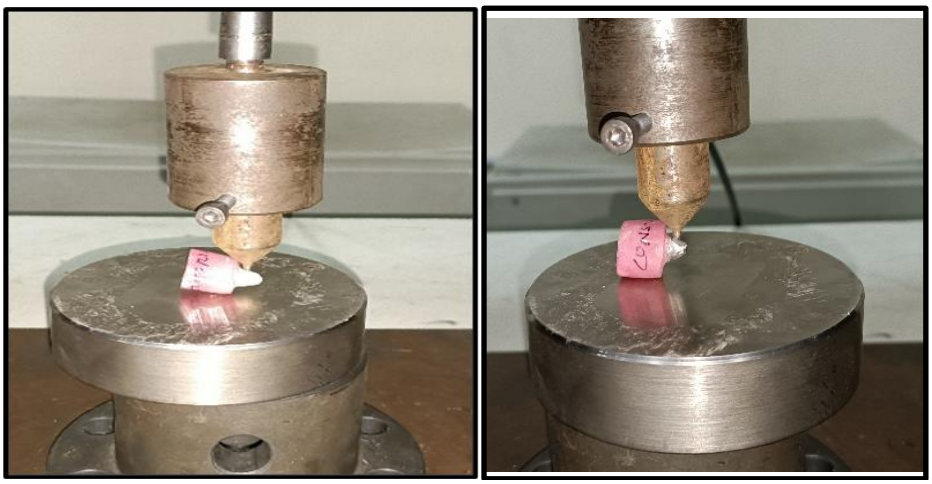

Fig 10& 11 testing done on UTM

Results

The results obtained for each group is given in the Table below

Table 1: load applied on samples in newtons

Sample	Load applied on Richmond crown frame work(newton)	Load applied on endocrown (newtons)
1	1254	1189
2	754	1427
3	1128	1173
4	947	897
5	779	1217

Table 2: comparison of mean and forces applied

Group	No of samples	Mean±SD	SE	MAX. LOAD	MIN. LOAD
Richmond crown	5	972.4±217.51	97.27	1254	754
endocrown	5	1180.6±168.87	75.52	1427	897

The results obtained showed that the shear load applied on the endocrown (972.4±217.51N) showed better resistance to fracture than Richmond crown group (1180.6±168.87NS). Statistical analysis was carried out using unpaired t test and the p value obtained was 0.1818 which was >0.05 so the test was statistically insignificant that is there was no difference in shear stress between the two compared group. However, the difference in mean between two group suggest better resistance of fracture to shear load of endocrown than the Richmond crown

Discussion

A deep overbite is where the vertical overlap of the upper and lower incisors exceeds half of the lower incisal tooth height. Problems associated with the deep overbite can include soft tissue trauma, lack of inter-occlusal space and tooth wear, all of which can present significant challenges for the restorative dentist. While management options very much depend on the nature of the situation and patient's symptoms. Sometimes there is situation in deep bite cases where the anterior tooth is grossly destructed and restoring such tooth becomes a great challenge, in literature various technique and restorative approaches are given to treat such patient but the search for ideal material and approach is still on.

Post and core systems have been widely investigated with the aim of achieving long-term promising prognoses. Despite the various attempts that have been made, vertical root fractures of pulpless teeth are still encountered in everyday clinical practice. Hayashi et al [4] reported that Under the condition of oblique loading, although there was no significant difference in fracture resistance between the cast metallic post-core and fiber post groups, the majority of fractures in the cast metallic post-core group were propagated over the middle portion of the roots and the load applied for fracture of metal post core system was much higher than the glass fiber post.

Assif et al [6] observed that the use of intracanal retainers only promoted retention of the prosthetic crown. As a result of removing a healthy dental structure to enable the placement of rigid elements devoid of mechanical behaviors similar to those of the tooth, the remaining tooth could be weakened. Such situations further get complicated when there is deep bite with no/very less overjet in anterior teeth; as oblique forces are maximum and core reduction should be adequate to provide indicated thickness for ceramic/metal ceramic crown to achieve desirable esthetics. mishra et al[8] Richmond crown is very much indicated in situations with very less incisal clearance to accommodate core+cement+crown thickness.

With the development of adhesive techniques and ceramic materials, the advantage of adhesive restorations is that a macro-retentive design is no longer a prerequisite if there are sufficient tooth surfaces for bonding. The endocrown preparation consists of a circular shoulder margin of 1 mm width and a central retention cavity the size of the pulp chamber that allows construction of the crown and core as a single unit. According to the in vitro study conducted by c Biacchi et al [9] on mandibular molar, endocrown restorations presented greater fracture strength than indirect conventional crowns associated with glass fiber posts and resin composite filling cores. Studies proving the survival of endocrown as an anterior restoration in deep bite cases is lacking where shear forces acting are greatest and height for core build up is compromised ,literature provide enough evidence for use of Richmond crown in such situation but minimally invasive treatment that will involve least of the pulpal canal should be looked for.

Endocrowns are indicated in the regions where teeth have short or atresic clinical crowns. Other advantages of endocarown are that they are esthetic and can resist compressive load to much higher extent than post and core system, according to

review published by Sevimli el al[10] extensive coronal tissue loss, better aesthetics and mechanical performance, low cost and short clinical time are the indications and advantages of endocrowns.

In the given study the comparison of the mean of group showed that the resistance to shear forces by the endocrown(1180.6±168.87) was higher than the Richmond crown group (972.4±217.51).though the results obtained were statistically insignificant but by the comparison of the mean prove the effectiveness of endocrown to tolerate shear force

Conclusion

The conditions were deep bite is present ,Richmond crown are indicated but with the development of adhesive system endowcrowns are gaining popularity ,the study supports this idea and more study is to be conducted to prove its effectiveness for restoration of anterior teeth.

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