

Original Article

In Vitro Comparative Analysis of Fracture Strength Recovery of Teeth Restored with two Different Techniques: Direct Build up and Reattachment of a Segment

Sameer Makkar, Anurag Aggarwal, Kanika Aggarwal, Navjot S Mann, Ruchi Sharma, Shinam Pasricha, Department of Conservative dentistry and Endodontics, National Dental College, Gulabgarh Road, Dera bassi, Mohali

Corresponding Author:

Kanika Aggarwal
Department of Conservative
Dentistry and Endodontics,
National Dental College,
Gulabgarh Road, Dera bassi,
Mohali.

Received: 08-12-2013

Revised: 18-01-2014

Accepted: 22-01-2014

Abstract

Dentist frequently encounters dento-alveolar fractures of anterior teeth especially among individuals under age of 18 years. According to severity of fracture these are restored by various techniques like reattachment (provided fragment available), composite build up, laminates or composite veneers to rehabilitate both aesthetic and functional needs.

Aim: To evaluate and compare the fracture resistance recovery of reattached tooth fragment and direct composite build up.

Materials and Methods: Intact maxillary anterior teeth were subjected to crown fracture by applying compressive forces on buccal aspect of clinical crown using universal testing machine. Fractured teeth were equally distributed into 2 groups based on restoring method 1) reattachment through dentinal groove 2) direct build up. Restored samples were re-fractured under similar standard conditions and force was recorded and expressed as percentage of intact tooth.

Results: Fracture resistance recovery was better with direct composite build up than the reattached fragment under the limitations of this study.

Key words: In vitro, analysis, fracture strength, recovery

This article may be cited as: Makkar S, Aggarwal A, Aggarwal K, Mann NS, Sharma R, Pasricha S. In Vitro Comparative Analysis of Fracture Strength Recovery of Teeth Restored with two Different Techniques: Direct Build up and Reattachment of a Segment. J Adv Med Dent Scie 2014;2(1):5-9.

Introduction

Dentoalveolar traumas are commonly caused due to falls, fights, accidents etc in children and adolescents.^{1,2} Fractures because of trauma usually occurs in maxillary anterior teeth³ and these fractures subsequently lead to aesthetic, functional and phonetic problems which represent a big challenge for the dentist. In the past methods such as resin crowns, stainless steel crowns and pin retained

inlays have been used with varying degree of success.⁴ Over the years more recent aesthetic techniques such as porcelain laminate, veneers, all ceramic crowns, reattachments, direct composite build up have largely replaced the older techniques. In today's era of evidence based, minimally invasive dentistry, reattachment of fractured crown fragment (when available) has become an important

treatment option as it has many advantages like it is conservative procedure, maintains Groove and overcontour technique.^{5,6} therefore this study was conducted to evaluate the fracture strength recovery of restoring incisal part by using two different restoring methods (internal dentinal groove and direct composite build up)

Materials and Method

In this study 40 human maxillary anteriors free from debris and calculus with no structural defects were collected. The teeth were stored in 0.9% saline solution at room temperature until further use. The labial surface of each tooth was divided into transverse and longitudinal third using vernier calliper and marker (Figure 2). All of the samples were individually mounted in cylindrical PVC pipes filled with autopolymerising resin. Each tooth was mounted such that its cemento-enamel junction lay just inside the acrylic, while maintaining its long axis perpendicular to the floor (Figure 1).

The crown of each incisor was then fractured using universal testing machine by following procedure. A point was marked on labial surface of crown at junction of mesial and incisal third to standardize the point of application of the force. Further a small round depression was drilled with 0.5mm round carbide bur at this point. The samples were mounted on the table of universal testing machine (Figure 3). Following this, a compressive force was applied at the predetermined point running at the speed of 1 mm /minute. Load was applied from labial to lingual direction and the fractured segment were collected and stored. The force required to fracture each tooth crown was recorded individually in kilogram force (kgf). All the 40 incisors showed Ellis class 2 fracture pattern (crown fracture involving enamel and dentin without pulpal exposure).



Figure 1: Sample mounted in PVC pipes filled with autopolymerising resins.



Figure 2: Labial surface of tooth divided into transverse and longitudinal thirds

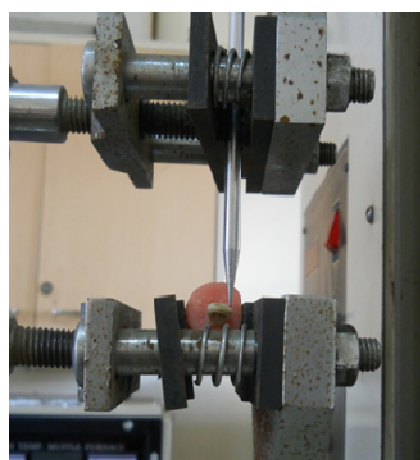


Figure 3: Sample mounted in universal testing machine.

Subsequently fractured teeth were randomly divided into 2 groups (n=20).

Group 1- teeth restored using internal dentinal groove

Group 2- teeth restored using direct composite build up

The two groups differed in restoring techniques. Groups were as follows:

Group 1- Internal Dentinal Groove Technique:

Prior to reattachment of fractured segment, an internal dentinal groove (figure 4 and 5) (1mm deep and 1 mm wide) was prepared within dentin (in bulkiest portion) of both remaining tooth and fragment by means of carbide bur mounted on a high speed air rotor handpiece. The fractured surfaces of both the fragment and the remaining tooth were etched using 37% phosphoric acid for 15 sec followed by rinsing and drying.

Bonding agent (prime and bond) was applied to both etched surfaces, following which aesthetic restorative material was applied and cured. Bonding agent was not cured prior to application of restorative material so as to prevent misfit of the fragment

Group 2-Direct Composite Build Up Technique

In this technique 45 degree bevel was prepared on remaining tooth (fig 6) along margin of fracture line. The etching and priming technique was similar to that described in internal dentinal groove technique. Remaining tooth structure was then restored using restorative nano composite using incremental technique.

Following reattachment/restoration, the crowns were refractured under similar conditions. The force required for re fracture was recorded and expressed as a percentage of fracture strength of intact tooth.

Statistical Analysis

The data acquired was entered into computer and statistical analysis was carried out using SPSS version. The groups were compared with each other using Anova test. A value of $P < 0.05$ was considered to be a statistically significant.



Figure 4: Preparation of internal dentinal groove of the remaining tooth



Figure 5: Preparation of internal dentinal groove of the fragment.



Figure 6: Preparation of 45 degree bevel on the remaining tooth



Figure 7: Restoration of the remaining tooth with composite.

Results

Strength Recovery Percentage Calculated From Mean Fracture Strength of Intact and Restored Samples

The results obtained showed that the-

- Mean force required for fracturing intact samples in both group 1 and 2 on an average is 32.24 kgf and after reattachment/restoration is 24.02 and 29.21 kgf giving a recovery percentage of 82.76±2.37% and 88.31±8.48% respectively.
- Initially prior to inducing fracture the groups were compared with each other for fracture strength and no statistically significant difference could be found ($p>0.05$).
- On the other hand after inducing fracture of restored samples, there was a statistically significant difference in mean recovery in both groups ($p<0.05$).

Discussion

In this study, sound and restored teeth were subjected to a fracturing load, allowing measuring the fracture resistance recovery of each tooth before reattachment procedures, which enables each fragment bonded or restoration done to have its own control. Comparing direct build up and reattachment procedure, direct build up maintains a precise fit because the fracture strength recovery of direct composite build up was better and higher than reattached samples.

In spite of these results, it is well known that restoration of fractured teeth by using the original fragment is advantageous to resin composite restoration. Review of literature has demonstrated that incisal edge reattachment is a valuable clinical tool due to some of its advantages,^{7, 8,9,10} like excellent aesthetics, colour matching, conservatism, preservation of incisal translucency, maintaining original tooth contours. But its fracture resistance recovery is less. This can be attributed to the fact that fragment was kept in saline

Table 1: Mean fracture strength of intact and restored samples along with mean strength recovery percentage.

Groups	Mean±SD (Intact Samples)	Mean±SD (Restored Samples)	Mean Recovery%±SD
Group 1	31.44±3.35	24.02±2.8	82.76±2.37
Group 2	33.89±4.96	29.21±4.4	88.31±8.48

and dry environment because of which there was moisture loss (CAPP et al 2010)¹³ intact sound dentin which is stored in dry environment for 24 hours retain only about 25% of total moisture.¹⁴ It seems that partial loss of dentin moisture and its shrinkage results in reduction of composite surface contact with dentin. Besides over acid etching due to loss of moisture in fractured part of dentin, it results in unfavourable effects on bonding conditions. This also shows the important role of moisture in bonding mechanism. Successful reattachment of a fractured fragment depends on the time of restoring the fractured part after trauma (which may vary from a few hours to a few days) and the patient's awareness; the fractured part may variably lose its moisture. The restoration time can affect bond strength of these restorations because dentin moisture is essential for achieving high bond strength of composite resins with dentin.¹⁵ In the absence of any difference related to bond strength, perhaps the choice of technique could be important in relation to clinical factors. The most favourable situation for using dentinal groove technique exists when there is minimal disruption of enamel at the labial fracture site and the segment fit together with no discernible defects (Reis et al).¹¹ This facilitate an accurate apposition of the fragment. However if fractured fragments are not retrievable direct build up is the preferred method and Fracture resistance recovery of direct build up is better than reattachment under limitations of this study.

Conclusion

The method of restoration seems to have an important influence on the outcome of fracture recovery strength. And this study shows that greater strength recovery was obtained with direct composite build up procedure and it should be preferred method of treatment of fractured tooth fragment under limitations of this study.

References

1. Andersean JO, Ravn JJ. Epidemiology of traumatic dental injuries to primary & permanent teeth in Danish population sample. *Int J Oral Surgery* 1972;12:35-9.
2. Andersean FM, Andersean JO. *Crown fractures textbook and color atlas of traumatic injuries to the teeth*. Copenhagen, Denmark: Mosby 1994, 219-256.
3. Rismond-Richard F, Allanche C. Dental injuries among school children aged from 6 to 15. *Endo Dental Traumatology* 1994;11:186-188.
4. Andersean JO. Adhesive dentistry applied to treatment of traumatic dental injuries-*Operative Dentistry* 2001, 26 328-335.
5. Reis A et al. Reattachment of fractured teeth review of literature regarding techniques and materials: *Operative Dentistry* 2004 29,226-233.
6. Oz IA, Hytac MC, Toroglu MS. Multidisciplinary approach to the rehabilitation of crown root fracture with original fragment for immediate aesthetic: A case report with 4 year follow up: *Dent Traumatology* 2006, 22, 48-52.
7. Chosack A, Edelman E. Rehabilitation of fractured incisor using patient natural crown-Case report: *J Dent Child* 1964, 71-19-21.
8. Diangelis Aj, Jungbluth Ma. Restoration of an amputated crown by acid etch technique-*Quintessence Int* 1987, 18- 829-833.
9. Diangelis AJ, Jungbluth MA. Reattaching fractured tooth segment: An aesthetic alternative. *J Am Dent Association* 1992, 123, 58-63.
10. Baratreli LN, Mointerio S. Tooth fracture reattachment- Case report. *Quint Int* 1990; 21:261-70.
11. Reis A, Kraul A, Francci C. Reattachment of anterior fracture teeth: fracture strength using different materials-*Operative Dentistry* 2002;27:621-7.
12. Farik B, Munksgaard EC, Andersen JO. Impact strength of teeth restored by fragment bonding- *Endod Dent Traumatology* 2000, 16 151-153.
13. Capp CL, Roada MI, Tamaki R. Reattachment of rehydrated dental fragment using two techniques. *Dental Traumatology* 2009; 25:95-9.
14. Arends J, Ruben J. Effect of air drying on demineralised and on sound coronal human dentin: a study on density. *Caries Research* 1995; 29:14-9.
15. Farik B, Munksgaard EC, Suh BI. Adhesive bonding of fracture anterior teeth: Effect of wet technique & rewetting agent. *American J Dental* 1998;11:251-3.

Source of support: Nil

Conflict of interest: None declared