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COMPARISON OF SHEAR BOND STRENGTH BETWEEN CUSTOM MADE MULTISTRAND BONDED RETAINERS WITH THAT OF CUSTOM MADE CASTED FIXED RETAINER IN DIASTEMA CASES

Dental Science

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ABSTRACT

AIM: To compare the shear bond strength between custom twisted 3 stranded ligature wire (0.36mm thick) retainer and custom casted bonded retainer.

MATERIALS AND METHODS: Study involved 80 extracted anatomically similar maxillary central incisors for various reasons and divided into 2 groups, group-1 bonded with custom made 3 stranded twisted ligature wire, Group-2 bonded with custom casted retainer and stored in distilled water for 24 hours and shear bond strength is tested using instron universal testing machine.

RESULTS: Group -2 with custom casted retainer showed more mean SBS than Group-1 with multistrand custom made retainer. The maximum SBS for Group-1 was 132.73N and with the minimum of 97.33N and in Group-2 the maximum SBS were 264.52N and with the minimum of 147.12N and comparison was statistically significant.p>0.005

CONCLUSION : In the present study both the groups showed resistance more than the required amount of force still Group-2 with custom casted retainer showed mean SBS of 172.74N which is significantly higher than the Group-1 and it is very much advisable to use it as permanent retainer for midline diastema cases.

KEYWORDS

Midline Diastema, Custom Casted Fixed Retainer, Permanent Retainer,shear Bond Strength.

INTRODUCTION:

Oppenheim in 1934 stated: 'Retention is the most difficult problem in orthodontia, in fact, it is the problem[1]. Retention is as well the most important part in orthodontic treatment plan. The relapse of the maxillary midline diastema after orthodontic space closure might be as great as 50%.[2] Retention of the closed diastema space after orthodontic treatment and incisor alignment are foreseen by the patients, which can be obtained by use of fixed permanent retainers[3].Bonded permanent retainers came to practice in late 1970s as a method of permanent retention about 81% of orthodontists use bonded permanent retainers however permanent retention has been given mostly in mandibular arch[4].Very less research has been carried out in bonded maxillary retainers and only 5% of orthodontists use bonded retainers in maxillary arch[5]. The fixed maxillary retainer is a reliable method of achieving permanent retention in the maxilla without relying on long-term compliance[6]In spite of using bonded retainers unwanted movement of the bonded teeth are reported that is because most of the clinicians use slightly adapted flexible wire and sometimes not adapted at all to the tooth surface that impairs the bond strength of the bonded retainer. Use of twisted flexible wires are been used which affects the passivity of the retainer and so use of a round rigid wire has been advocated in the upper jaw[7,8].whereas flexible wires reduce the stress concentration within the bonding composite, thereby minimizing bond failures.[6]Another cause for bond failure in bonded retainers is occlusal heavy loads/ interference and relative heavy force over a wire of small surface area. Hence by use of a material which provides good adaptability with increased bonded surface area can increase the SBS of the bonded retainer thereby avoiding relapse and enhancing the retention in bonded retainers used for patients with diastema.

Hence, a good choice of wire for fixed retention must be flexible enough to allow physiologic tooth movement while exerting minimal forces on the teeth. It should also maintain the teeth in their intended position and be well retained on the teeth without the loss of dimensional stability.

Previous studies have analyzed and compared Shear Bond Strength (SBS) of various retainers, a custom casted bonded retainer were neither used nor evaluated so this study was designed to compare the SBS between custom twisted 3 stranded ligature wire (0.36mm thick) retainer and custom casted bonded retainer.

MATERIALS AND METHOD:

The study involved 80 freshly extracted maxillary central incisors which were structurally intact and caries free. Then the collected samples were cleaned and disinfected with 0.5% chloramine and polished with pumice for 10 secs after which the tooth is thoroughly washed to avoid any chemical reaction with the adhesive.Then anatomically similar maxillary central incisors from the sample were mounted with approximal contact in a standardized form filled with self-cure acrylic resin and the teeth were positioned in such a way that incisal plane was parallel to the resin base. (Fig-1)

Fig-1

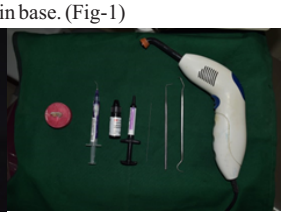


Fig-2

Then the samples were randomly divided into 2 groups with 20 pairs of mounted maxillary central incisors in each group. Samples in both the group were etched with same acid etchant 37% phosphoric acid (D-Tech), bonding agent (transbond XT primer) and same adhesive (transbond XT).(Fig-2)

Group 1 samples were etched and bonding agent applied with usual protocol and custom twisted 3 stranded ligature wire (0.36mm thick) retainer is bonded using transbond XT adhesive and light cured with LEDition Ivoclar Vivadent light cure unit,(fig-3)

Group 2 samples were taken an impression and replicas were made to fabricate the custom made retainer by casting and same protocol was followed to bond the retainer as in group 1.(Fig-4)

Fig-3

Fig-4

Samples from both groups were stored under distilled water for 24 hours before testing. The debonding was done with the universal testing machine (Instron 5965)at a crosshead speed of 1mm/min. The load was given onto the occluso apical axis of the tooth to simulate occlusal load and the shearing rod was placed between the teeth onto the interdental segment. The bond strength measured as the maximum force in Newton (N) to cause debonding wire removal from the composite pad on at least one of the incisor pairs in each specimen. The reading displayed on the electronic console attached to the Instron unit was recorded

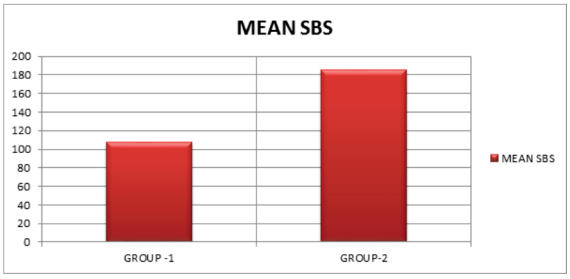
STATISTICALANALYSIS

Data collected was statistically analyzed for Mean and SD and Un-paired t test / student t test was carried out to compare the mean SBS between the two groups using SPSS version 25.and p value less than 0.005 was considered significant.

RESULTS

GROUP	Mean SBS	Maxiimum SBS	Miinimum SBS	Significance p
GROUP-1	107.47N	132.73N	97.33N	>0.005
GROUP-2	185.64N	264.52N	147.12N	

Group -2 with custom casted retainer showed more mean SBS than Group-1 with multistrand custom made retainer. The maximum SBS for Group-1 was 132.73N and with the minimum of 97.33N and in Group-2 the maximum SBS were 264.52N and with the minimum of 147.12N and comparison was statistically significant.p>0.005



DISCUSSION

In an active orthodontic treatment achieving stability extends into the retentive phase. Moving the teeth to establish proper occlusion within the limits of normal muscle balance helps in achieving stability during active orthodontic treatment.[9] whereas in retention phase, stability is achieved by reorganization of the gingival and periodontal fibers to the new position of the teeth. Both these mechanisms help to prevent relapse.[10]

Whenever this stability is lost it leads to loss of function or loss of esthetics or both which is been achieved after active treatment. Apart from gingival and periodontal reorganization, the type of treatment along with growth changes that happen after treatment can additionally contribute to relapse. For these reasons, any existing orthodontic control over tooth position and occlusal relationships must be slowly withdrawn to reduce the chances of relapse.[11-13]During active orthodontic treatment the periodontal ligament undergoes changes that do not revert back to its normal architecture as long as teeth are rigidly splinted to one another. Therefore, as soon as teeth movement is completed, each tooth must be allowed to respond on its own to masticatory forces. It takes about 3–4 months to reorganize and would also allow for any mobility of teeth that was present during appliance removal to wane off. The gingival fibers and supracrestal fibers reorganize at an extremely slow pace and hence produce enough forces to cause relapse which are the main reasons for diastema relapse. These forces may remain active even beyond 1 year of removal of orthodontic appliance and warrants the role of prolonged retention[11] and so retention has to be a lifelong plan, especially with regard to rotations, midline diastemas, and openbites, Therefore, many orthodontists opt for permanent retention in most of their patients.[14]The effectiveness of these bonded retainers remains until they remain intact/bonded to the tooth surface and withstands occlusal forces, deformation or causing any undue force to the teeth.The present study was done to compare the SBS between custom twisted 3 stranded ligature wire (0.36mm thick) retainer and custom casted bonded retainer. Although previous studies have analaysed and compared SBS of various retainers, a custom casted bonded retainer were neither used nor evaluated. Multistranded wires were chosen for the present study since they can allow for physiological movement of the teeth and their braided surface enhances the retention.[15]The choice of etchant, primer, adhesive, length of retainer wire and the steps in bonding were all the same in the three groups so as to the minimize chances of errors. The same operator performed all these procedures, and hence standardization was achieved in this regard. The comparison of custom casted retainer was done with the 3 stranded wire which showed maximum SBS of other materials as compared by Samson, et al.In this study bond strength was tested using an in vitro model designed such that a vertical force could be simulated at the interdental wire between two maxillary incisors[16] where as other studies investigation protocol was different where the force was applied to the adhesive pad of a wire/bond interface by Radlanski and Zain[17]Faltermeier et al. found that the SBS of two- and three-component adhesives significantly exceed that of one bottle systems. Thus in our study we only used three-component systems.[18]Zachrisson[19] and Oesterle[20] et al. enlarged the surfaces of both ends of two wires measuring 0.030 inch and 0.032 inch by sandblasting to increase the adhesion between metal and composite. Whereas in our study we increased the surface area by increasing the area of retainer and increasing the adhesion by tiny pores mesh like casted retainers which provides additional adhesion to the retainer and the results showed increased SBS without mechanically damaging the intact healthy enamel surface.The custom made casted retainer is very acceptable as the impression of the patient to be given can be taken before debonding and can be custom casted which have superior adaptation to the anatomical pattern of the palatal surface of the incisors and increases adhesion there by increasing the retention.The limitations of the study were inability to mimic in vivo conditions such as saliva, physiologic movement of teeth, functional forces of tongue, and mastication as well as the presence of plaque and calculus can affect the outcome of the study.

CONCLUSION

Reynolds determined that materials for acceptable clinical use in orthodontic treatment should be able to resist forces of 6–8 N[21]. Waters noticed that the normal range of oral forces is 3–18 N.[22] In our study both the groups showed resistance more than the required amount of force still Group-2 with custom casted retainer showed mean SBS of 172.74N which is significantly higher than the Group-1 and it is very much advisable to use it as permanent retainer for midline diastema cases while not as flexible as multistrand wires that causes undue forces on the tooth and not much rigid so it allows physiologic tooth movement within limits with better adaptation and mesh pattern.

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