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Analysis of Fracture Resistance of Endodontically Treated Teeth with Different Restorative Materials: An In Vitro Study

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ABSTRACT

Background: Endodontic teeth are more prone to get fractured. There are numerous restorative materials that possess different fracture resistance. The present study was conducted to compare the fracture resistance of endodontically treated teeth restored with Glass Ionomer Cement (GIC), amalgam and composite cements.

Materials & Methods: The present study was conducted on 40 freshly extracted mandibular premolars. All teeth were divided into 4 groups of 10 teeth each. Group I teeth were restored with silver amalgam. Group II teeth were restored with GIC. Group III teeth were restored with composite and group IV teeth were control in which no alteration was performed. Testing machine applied force on teeth to detect fracture resistance.

Results: The mean fracture resistance was maximum in group IV (1050.2 N) followed by group III (956.2 N), group I (836.4 N) and group II (766.4 N). The difference was statistically significant (P< 0.05). The mean difference of fracture resistance was significant when all groups were compared (P< 0.05) except in group I and group II (P> 0.05).

Conclusion- Post restoration of endodontically treated teeth is essential to strengthen the teeth. Composite resin possesses highest fractures resistance as compared to GIC and silver amalgam.

Keywords: Amalgam, Composite, fracture resistance, restoration.

INTRODUCTION

The management of infected teeth having periapical lesions is endodontic treatment. With the endodontic therapy, the life of the tooth increases and the patient maintains its natural teeth. The only drawback is the strength of the tooth which decreases significantly as pulp is completely removed and filled with root canal filling material. There is considerable loss of tooth structure such as dentin during filing with files and reamers. Restoring tooth following endodontic therapy is an essential and important step to maintain strength.[1]

There are numerous restorative materials available to restore the teeth. Some authors suggest that filling the tooth after endodontic therapy is sufficient in maintaining function, and anatomy of the tooth. Even esthetics are preserved with restoration of the root canal treated tooth. Fracture is a common phenomenon in root canal treated teeth. However, placing crown over tooth is one of the protective measures to minimize the fracture.[2]

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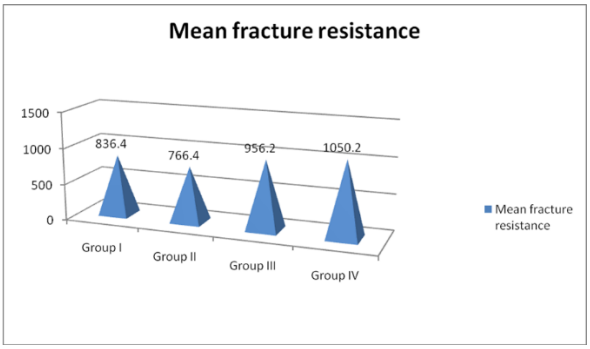
Table I Distribution of teeth.

Groups	Group I	Group II	Group III	Group IV	P value
Materials	Silver amalgam	GIC	Composite	Control	1
Number	10	10	10	10	

Table II Multiple comparison between all groups using Tukey HSD.

Groups	Comparison	Mean differences (N)	P value
Group I	Group II	70	0.4
	Group III	119.8	0.001
	Group IV	214	0.00
Group II	Group III	189.8	0.01
	Group IV	283.8	0.00
Group III	Group IV	94	0.01



Graph I: Mean fracture resistance in all groups.

The successful endodontic therapy is judged by factors such as how long tooth remains in the oral cavity, its ability to perform all functions such as chewing, biting etc., and resistance against fracture. Different restorative materials such as glass ionomer cement, silver amalgam, miracle mix etc. are commonly employed. Glass ionomer cement is widely used in anterior teeth whereas amalgam in preferred material in posterior tooth but for its placement considerable tooth reduction is necessary to establish mechanical retention which in turns further weakens the tooth. Silver amalgam may be used in posterior teeth but it requires extensive tooth preparation. Recently, composite resins have been considered to be material of choice due to various reasons such as color similarity with the tooth.[3] The present study was conducted to compare the fracture resistance of endodontic treated tooth restored with GIC, amalgam and composite cements.

MATERIALS & METHODS

The present study was conducted on 40 freshly extracted mandibular premolars with similar morphology. All teeth were extracted as desired for orthodontic treatment. Teeth with fracture, carious lesions, and attrition were excluded from the study. Following extraction, all teeth were stored in the milk. Ethical clearance was obtained from the institutional ethical committee before starting the study.

Armamentarium and materials used to restore amalgam, GIC and composite materials. All teeth were divided into 4 groups of 10 teeth each. Group I teeth were restored with silver amalgam. Group II teeth were restored with GIC. Group III teeth were restored with composite and group IV teeth were controls in which no alteration was performed.

In all teeth except group IV, access was achieved using straight burs and working length was taken. Bio- mechanical preparation was done using files and reamers. All canals were prepared till 45 size using K files. Lateral condensation technique was followed for obturation. Gutta percha was used for the obturations. All teeth were mounted on dental plaster blocks. After doing biomechanical

preparation and obturation of the canals with gutta percha, teeth were filled with different restorative materials such as silver amalgam, GIC and composite.

In order to assess the fracture resistance of all teeth in different groups, a testing machine was used which applied vertical load along long axis of teeth. The amount of force required to fracture was recorded in all teeth. Results thus obtained were subjected to statistical analysis using chi- square test and using statistical IBM SPSS software version 20. P value less than 0.05 was considered significant.

RESULTS

Table I shows that in group I, teeth were restored with silver amalgam. In group II, teeth were restored with GIC. In group III, teeth were restored with composite and in group IV, teeth were controls. The difference was non- significant (P- 1). Graph I shows that the mean fracture resistance was maximum in group IV (1050.2 N) . In other groups, maximum fracture resistance was seen in group III (956.2 N) followed by group I (836.4 N) and group II (766.4 N). The difference was significant (P< 0.05). Table II shows that the mean difference was 70 N when group I was compared with group II, 119.8 N when group I was compared with group III and 214 N when group I was compared with group IV. The difference was significant (P< 0.05) except in group I and II (P- 0.4). It was 189.8 N and 283.8 N when group II was compared with group III and group IV respectively. The difference was significant (P< 0.05). It was statistically significant when group III was compared with group IV (P- 0.01).

DISCUSSION

Endodontic therapy is required in cases with pulpal involvement and if there is any periapical pathology. It demands straight lined access cavity preparation followed by biomechanical preparation and filling the canals with different restorative materials and most commonly used is gutta percha or any other root canal obturating material. The success of any endodontic treated teeth depends upon many factors such as type of obturating material used, type of irrigating solution employed for the procedure, maintenance of apical seal and type of restorative material used for coronal restoration.[4]

In this study we compared the fracture resistance of different restorative materials such as silver amalgam, GIC and composite. The ability of any restorative material to tolerate the fracture depends upon how much is the strength of the cement and how it bears the masticatory or compressive forces. Excessive removal of radicular, coronal dentin and axial walls leads the teeth to fracture. It has been observed that with the endodontic treatment, the strength is affected which makes the tooth brittle and prone to get fractured. The successful endodontic tooth should be able to withstand all type of forces it encounters.[5]

Researchers have studied the effect of occlusal forces on the survival rate of endodontic treated teeth. Dalpino et al[6] in their study of fracture resistance of teeth directly and indirectly restored with composite resin and indirectly restored with ceramic materials found that cavity preparation, access cavity, filling, removal of pulp with reamers, files and canal preparation with different number of files makes the tooth weak as the considerable amount of tooth structure gets lost in successive steps. P. Ausiello[7] conducted a study to measure the fracture resistance of endodontically-treated premolars adhesively restored and found that sound teeth are more fractured resistance as compared to endodontically restored teeth.

In this study, mandibular premolars were selected. The age group was almost similar in all teeth and were extracted for orthodontic purpose. We observed that the mean fracture resistance was maximum in sound teeth. This can be explained by the facts that sound teeth without caries, any fracture etc. possesses sound enamel which is the hardest component of the teeth. Enamel is responsible for maintaining the strength of the tooth.[8]

In restored teeth as in case of group I, II, group III, maximum fracture resistance was seen in teeth restored with composite (956.2 N). Composite is commonly and widely used restorative material in recent times. It has gained popularity in the past few years owing to its color similarity, its strength and micro- mechanical bonding to tooth structure.[9] The availability of different shades makes it suitable

in different patients. Moreover, with this restorative material, the need to prepare extensive tooth cavities is eliminated as this can be filled and cured in small cavity also. It is considered more conservative in nature. In case of slight loss of material, the same can be restored and there is no need to replace the whole material which is mostly demanded in silver amalgam restoration.[10]

We found that in group I (Silver amalgam), the mean fracture resistance was 836.4 N which was less as compared to group III & group IV. Silver amalgam has been widely used in case of extensive carious lesions. It is prepared by mixing silver powder with mercury. The danger of mercury poisoning is still there, if proper trituration is not done. Mercury is bacteriostatic in nature. The occurrence of secondary caries is less as compared to composite resins.[11]

In group II (GIC), the mean fracture resistance was 766.4 N which was lowest among all restorative materials. The only benefit of GIC is the steady fluoride release over the time which is the important component of GIC. The color similarity makes it suitable for anterior teeth or teeth with less carious lesions. Chutinan et al[12] compared six direct core materials and found that composite exhibits micro- mechanical bonding to tooth, thus possessing better fracture resistance. Moosavi, et al[13] conducted a study of fracture resistance of premolars restored by various types and placement techniques of resin composites found that composite exhibits higher fracture resistance than other restorative materials. Lia Mondelly[14] found 1514 N fracture resistance in unprepared tooth 605 N in MOD premolar cavity. Shivanna and Gopeshetti[15] observed 524 N fracture resistance in premolars restored with composite.

We compared all restorative materials with each other and found significant differences except silver amalgam with GIC. Joshi et al[16] found 841 N fracture resistance with composite resin in premolars. Ashika et al[17] compared the fracture resistance of endodontically treated teeth with composite and GIC in extracted teeth and found composite to be better than GIC. Wendt et al[18] found composite to be the preferred restorative material than silver amalgam due to its easy handling. The operator clinical experience, presence of moisture during restoration and antagonist teeth and type of teeth also determines the fracture tendency.

CONCLUSION

Composite resin was comparatively better in terms of fracture resistance. Composite exhibited higher fracture resistance than silver amalgam which had higher fracture resistance than GIC. Factors such as antagonist tooth, type of tooth, moisture in oral cavity while cavity preparation etc. determines the fracture resistance.

CONFLICTS OF INTEREST

The authors declare they have no potential conflict of interests regarding this article.

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