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Original Research

Comparative evaluation of fracture resistance of simulated human immature teeth reinforced with anatomic post and MTA or Biodentine as apical barrier

Kirti Mangalam¹, Khushbu², Shaily Sharma³, Priyanka Verma⁴, Hamdan⁵

¹BDS, Sarjug Dental College & Hospital Darbhanga, Bihar, India;

^{2,3}BDS final year student, Manav Rachna Dental College, Faridabad, Haryana, India;

⁴BDS, Final year, Geetanjali Dental College and Research Institute Udaipur, Rajasthan, India;

⁵BDS, Himachal Institute of Dental Science, Shimla University, Himachal Pradesh, India;

ABSTRACT:

Background: The present study was conducted to compare the resistance to fracture of simulated human immature teeth treated with anatomic post and MTA or biodentine as apical barrier. **Materials & Methods:** The present study was conducted on 40 permanent mandibular incisors. The 40 teeth were then randomly divided into two groups (n = 20) according to the apical barrier used for apexification. All samples were incubated for two weeks at 37°C before subjecting to fracture testing using the Universal Testing Machine. A compressive load was applied at 135° to the long axis of the tooth. **Results:** Group I—apical barrier using biodentine and Group II—apical barrier using MTA (MTA Plus). Each group was further divided into four subgroups: Group I (n = 20), subgroup A (n = 5)—apical barrier using Biodentine with no obturation, subgroup B (n = 5)—apical barrier using biodentine, subgroup C (n = 5) apical barrier using biodentine and the same biodentine as complete obturation material. Subgroup D (n = 5)—apical barrier using biodentine with prefabricated glass fiber post as reinforcement. Group II (n = 20) The subgroups (n = 5 each) were same as Group I, but Biodentine was replaced by MTA as apical barrier as well as canal reinforcement material (subgroups IIA, IIB, IIC, IID). Fracture resistance in group I was maximum as compared to group II. Everstick showed value of 1472.3 MPa in group I and 1294.5 MPa in group II. Control showed 642.4 in group I and 610.5 MPa in group II. Inter- group comparison was significant (P < 0.05). **Conclusion:** Authors found that everStick post is a viable option for reinforcement of teeth with immature root apex. **Key words:** Bio dentine, EverStick post, Root apex.

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Corresponding author: Dr. Kirti Mangalam, BDS, Sarjug Dental College & Hospital Darbhanga, Bihar, India

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INTRODUCTION

Trauma to the anterior teeth is the most frequent cause for pulpal necrosis and cessation of root development. Because of open apices and weak dentinal walls, the management of such cases is both an endodontic and restorative challenge which predispose such teeth to root fractures at the cervical dentin.¹

An optimal treatment protocol for immature permanent teeth with necrotic pulp is to regenerate functional pulp tissue and facilitate continuation of root development and apical closure.² Although it has potential for clinical success, it may not be successful

in every case. It requires strict adherence to treatment protocol and takes longer time for completion of treatment, and possible failure may make further treatment difficult.³

Apexification is one of the best treatment modality in such cases. Apexification with long-term calcium hydroxide is reported to have a success rate of 79–96%.⁴ However, the unpredictable time for apical barrier formation, increased brittleness of the tooth, and susceptibility to root fractures are its major disadvantages. To surmount these disadvantages, various bioceramic materials with superior properties

such as osteogenic potential, sealing ability, and antibacterial property have been used for single visit apexification.⁵ MTA is considered to be the gold standard material as an artificial apical barrier inducer in immature and incompletely developed teeth. Various studies have reported that complete obturation of immature teeth with MTA can enhance their resistance to horizontal as well as vertical root fractures. Glass fiber posts which exhibit a modulus of elasticity similar to that of the dentin has been investigated extensively.⁶ The present study was conducted to compare the resistance to fracture of simulated human immature teeth treated with anatomic post and MTA or Biodentine as apical barrier.

MATERIALS & METHODS

The present study comprised of 40 permanent mandibular incisors. The study was approved from institutional ethical committee.

The root canals were prepared as per standardized protocol. The 40 teeth were then randomly divided

into two groups (n = 20) according to the apical barrier used for apexification: Group I—apical barrier using Biodentine and Group II—apical barrier using MTA (MTA Plus). Each group was further divided into four subgroups: Group I (n = 20), subgroup A (n = 5)—apical barrier using Biodentine with no obturation, subgroup B (n = 5)—apical barrier using Biodentine, subgroup C (n= 5) apical barrier using Biodentine and the same Biodentine as complete obturation material. Subgroup D (n = 5)—apical barrier using Biodentine with prefabricated glass fiber post as reinforcement. Group II (n = 40) The subgroups (n = 5 each) were same as Group I, but Biodentine was replaced by MTA as apical barrier as well as canal reinforcement material (subgroups IIA, IIB, IIC, IID). All samples were incubated for two weeks at 37°C before subjecting to fracture testing using the Universal Testing Machine. A compressive load was applied at 135° to the long axis of the tooth. Results were tabulated and subjected to statistical analysis. P value less than 0.05 was considered significant.

RESULTS

Table I Distribution of teeth

Groups	Group I	Group II
Material	Apical barrier using biodentine	Apical barrier using MTA
Sub group A	No obturation	No obturation
Sub group B	Biodentine+ Everstick post	MTA+ Everstick post
Sub group C	Complete obturation with biodentine	Complete obturation with MTA
Sub group D	Biodentine + prefabricated glass fibre post	MTA + prefabricated glass fibre post

Table I shows distribution of samples in group I and II and subgroups A, B, C and D based on materials used.

Graph I MTA and Biodentine apical barrier with various obturation techniques

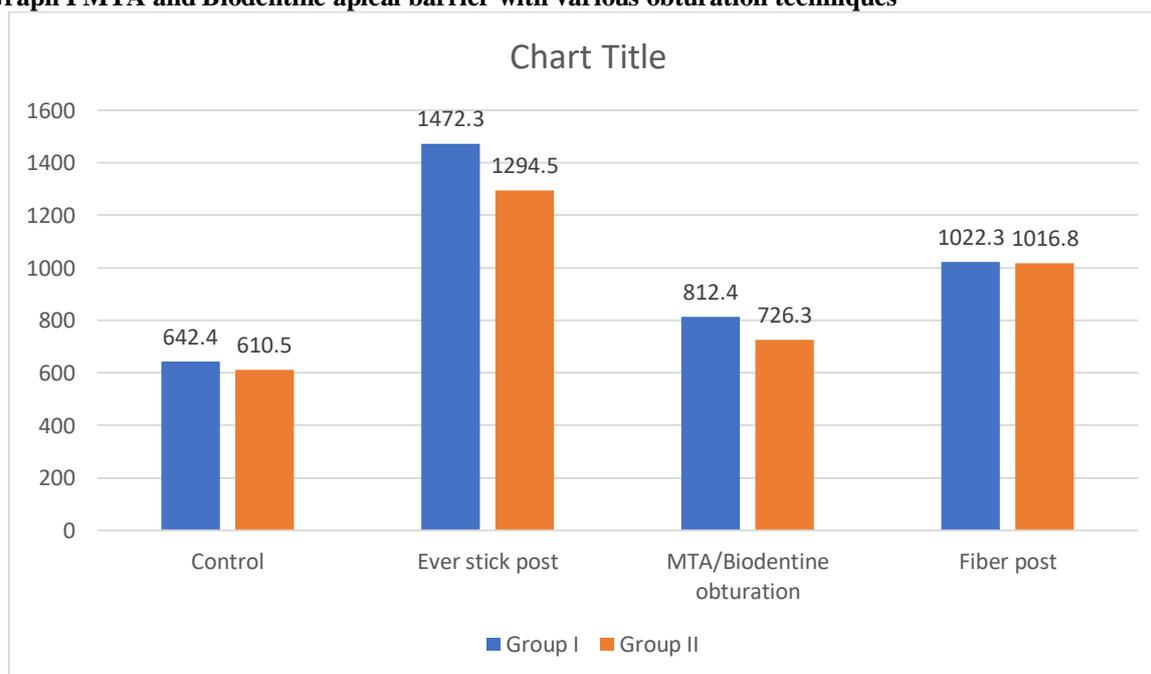


Table II Fracture resistance of the simulated human immature teeth treated with MTA and Biodentine apical barrier with various obturation techniques

Group	Group I	Group II	P value
Control	642.4	610.5	0.04
Ever stick post	1472.3	1294.5	0.01
MTA/Biodentine obturation	812.4	726.3	0.02
Fiber post	1022.3	1016.8	0.05

Table II, graph I shows that fracture resistance in group I was maximum as compared to group II. Everstick showed value of 1472.3 MPa in group I and 1294.5 MPa in group II. Control showed 642.4 in group I and 610.5 MPa in group II. Inter- group comparison was significant ($P < 0.05$).

DISCUSSION

Mineral trioxide aggregate (MTA), a powder aggregate containing mineral oxides, has been recently recommended for apexification. Properties like high pH, antimicrobial action, biocompatibility, low cytotoxicity, good sealing ability, and ability to set in the presence of blood and moisture are all advantages offered by MTA.⁷ Various materials have been verified for increasing the fracture resistance of endodontically treated teeth.⁸ Even though glass fibre post (GFP) looks promising, a 10-year evaluation study for GFP supported endodontic restorations has reported a high annual failure rate. Recently a few reported cases that used dentin as a post have shown successful outcomes.⁹ Cervical third root fractures have an occurrence rate of about 28–77%, the highest percentage of fractures occurring in immature teeth. There has been a paradigm shift in the way necrotic immature permanent teeth are being treated.¹⁰ The present study was conducted to compare the resistance to fracture of simulated human immature teeth treated with anatomic post and MTA or Biodentine as apical barrier.

In this study following groups were made. Group I—apical barrier using Biodentine and group II—apical barrier using MTA (MTA Plus). Each group was further divided into four subgroups: Group I (n = 20), subgroup A (n = 5)—apical barrier using Biodentine with no obturation, subgroup B (n = 5)—apical barrier using bio dentine, subgroup C (n = 5) apical barrier using Biodentine and the same Bio dentine as complete obturation material. Subgroup D (n = 5)—apical barrier using biodentine with prefabricated glass fiber post as reinforcement. Similarly group II was subgrouped with MTA material. Dholakia et al¹¹ included eighty extracted maxillary central incisors which were divided into two groups (n = 40 each) as group I—apical barrier using Biodentine and group II—apical barrier using MTA. Statistical analysis was done using one-way ANOVA test and post hoc Bonferroni test. In the above tests, p value less than 0.05 ($p < 0.05$) was taken to be statistically significant. A novel anatomic post, everstick post is a viable option for reinforcement of teeth with immature root apex and thin dentinal walls after apexification.

We observed that fracture resistance in group I was maximum as compared to group II. There was

maximum fracture resistance in group reinforced with everstick posts compared to other reinforcement materials. Control showed minimum fracture resistance as compared to other materials in both groups. Everstick showed value of 1472.3 MPa in group I and 1294.5 MPa in group II. Control showed 642.4 in group I and 610.5 MPa in group II. Nikhil et al¹² compared the fracture resistance of simulated immature teeth restored with gutta-percha, glass fiber posts (GFP), experimental dentine posts (DP) or Intracanal composite Resin (ICR). Fifty maxillary canines were decoronated, standardized and enlarged until, number 5 Peeso reamers were allowed to simulate immature teeth. After placement of 5 mm of MTA, the canals were divided into 5 groups and filled as follows: Group 1: AH Plus + gutta-percha, lateral compaction; Group 2: GFP luted with PARACORE dual cure resin; Group 3: DP luted with PARACORE dual cure resin; Group 4: PARACORE dual cure resin. A standardized core was built in all groups except in Group 5. Each of the specimens was tested for fracture resistance by universal testing machine. The mean fracture resistance were 817 ± 27.753 , 1164.6 ± 21.624 , 994.4 ± 96.8747 , 873.8 ± 105.446 and 493.7 ± 6.945 newtons for Groups 1, 2, 3, 4, and 5 respectively. Independent “t” test revealed statistically significant discrepancies, in the fracture resistance among the 4 groups except Group 1 and Group 4.

The limitation of the study is small sample size.

CONCLUSION

Authors found that everStick post is a viable option for reinforcement of teeth with immature root apex.

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