Medical
Communication

Biosci. Biotech. Res. Comm. 10(2): 19-24 (2017)

BBRC
Bioscience Biotechnology
Research Communications

Reconstructing root treated teeth using post and core – A Systematic Review

O Hedaiat Moradpoor[1], Sahar Raissi[2]* and Erfan Bardideh[3]

[1]*Assistant Professor, Prosthodontics Department- Faculty of Dentistry Kermanshah University of Medical Sciences-Iran*
[2]*Assistant professor, Prosthodontics department- Faculty of Dentistry Kermanshah University of Medical Sciences-Iran*
[3]*Prosthodontics Department- Faculty of Dentistry Kermanshah University of Medical Sciences-Iran*

ABSTRACT

Post and core is the main treatment method for reconstructing for endodontically treated teeth. There are different reasons for clinical failure of post and cores; such as losing retention, post fracture, root fracture and failure from periodontal, endodontical complications and dental caries. Purpose of this study was to evaluate and compare clinical failures in different post and core systems using Network Meta-Analysis.Search strategy was used to search Central,MEDLINE,Scopus and EMBASE data bases and also IADR conference proceedings from the beginning till March of 2016 and then after matching studies with inclusion and exclusion criteria. 6 randomized clinical trials and 4 cohort studies was chosen and then evaluated using Network Meta-Analysis. According to randomized clinical trials, cast metal posts had the lowest failures in every failure aspect (losing retention, post fracture, root fracture and failure from periodontal, endodontical complications and dental caries) (OR<1). According to cohort studies, prefabricated non-metal posts had the lowest clinical failures in every aspect (OR<1). According to sum total of studies, prefabricated non-metal posts had the lowest root fractures and also lowest sum of failures but cast metal posts had the lowest post fractures (OR<1).The failures from periodontal, endodontical complications and dental caries and losing of retention is the same (OR=1). In every single study the prefabricated metal posts had the most clinical failures of all the post types(OR>1).According to randomized trials, cast metal posts and according to cohort studies, prefabricated non-metal posts are the best treatment options and according to every study prefabricated metal posts are the worst treatment options in regards to clinical failure.

KEY WORDS: POST-CORE; META-ANALYSIS; ROOT CANAL TREATED TEETH; CLINICAL FAILURE

ARTICLE INFORMATION:

**Corresponding Author:*
Received 1st April, 2017
Accepted after revision 30th June, 2017
BBRC Print ISSN: 0974-6455
Online ISSN: 2321-4007 CODEN: USA BBRCBA
Thomson Reuters ISI ESC and Crossref Indexed Journal
NAAS Journal Score 2017: 4.31 Cosmos IF : 4.006

Online Contents Available at: http//www.bbrc.in/

INTRODUCTION

Reconstructing root treated teeth is one of the biggest issues in dentistry. Compared to vital teeth, side effect of reconstructing dentures of root treated teeth was higher in the restoration and mostly led to tooth loss. Endodontic treatments are primarily done for the crowns having restoration failure or crown failure because of rot (Abo-Rass 1992). When a large amount of crown is lost because of damage, it is impossible to sufficient anchorage can be achieved by the dentin (Heydecke 2002) Therefore, in cases where the loss of the crown is great, the "core " is needed for the final restoration and post is used for its Anchorage (Bolla 1999) and (Ferrari 2002) and (Belleflamme 2017) .

For more than 250 years, clinicians have searched on the use of in-the- root post to obtain stuck. (Smith 1998). Post and core have a long history of clinical success. For teeth with moderate to severe destruction, they are pretty good, (Terry 2010). Cast post is appropriate especially for small teeth, when posts should be provided many teeth at the same time, and when the angle of core should be different with post (prefabricated post should not be bend, (Shen 2013).

Also: about 40 percent of dentists are expressed on a questionnaire that they use normal prefabricated posts, and metal parallel posts are widely used (Morgano 1994). The use of prefabricated post and direct core s is the selected method for reconstruction of Muller with highly destroyed buildings (Morgano 1993). Prefabricated method has a simpler placement method, less chair time, low cost and the ability to have immediate reconstruction of teeth (Zalkind 2000). Due to their cylindrical shape, they are applicable for being used in channels with circular cross-section (maxillary central incisors) and are less applicable in the channels with Low mesiodistally width and high bucco lingually (Choudhary 2014) and (Soundar 2014) and (Borths 2017) and (Rightmire 2017).

Fiber Posts history dates back to 1989, the posts of carbon fiber composite started to be used for clinical use (Duret 1990). Raw fiber Posts used fiber-graffiti carbon because of their mechanical properties (such as stiffness and high tensile strength, low toxicity and electrical conductivity) (Singh 2015). Zirconia Post was introduced first by Meyenberg claiming that the torsional rigidity (900-1200 MPa) of the posts is comparable with gold or titanium castings and the dimensions of the posts can be in the same size as of gold and casts posts (Meyenberg 1995). Zirconia combined with yttrium was used due to the chemical stability and high mechanical strength, high toughness and Yang factor such as an stainless alloy of steel. Initial resistance and high toughness fracture of zirconia combined with yttrium is due to the phenomenon of transformation toughness (Petercsak 2014). The following factors affect the choice of posts:

Root length 2. Dental Anatomy 3. post width 4.type of canal and post compliance 5. Dentin textures 6.location of tooth in the arch 7.stress 8 Torsional forces 9. Hydrostatic force role 10. Post design 11.compliance of materials together 12. bonding ability 13.core stuck 14.recovery capability 15.beauty (Fernandes 2003). Among the factors affecting the result of the reconstruction, tooth type and force on it because of its location in the bend, proximal contacts and final prosthesis (Crown, FPD, RPD) can be noted. Also, the existence of coronal tooth structure (called a ferrule effect; ivory collar height of 2 mm) is known as the main feature for the success of the reconstruction by post and core (Dua 2016)

MATERIALS AND METHODS

The present study is a systematic review. The population of study is the studies related to databases of Cochrane Central Register of Controlled Trials (CENTRAL) 'MEDLINE' Scopus 'EMBASE. In addition, the list of references and the found studies, and a summary of IADR conferences are from the beginning to the march 2016. Sampling was evaluated by all articles that match survey strategy , then, articles that met inclusion criteria were enrolled. Conduction of this systematic review was based on systematic review guidance of PRISMA . so that: In order to find the studies related to the inclusion criteria, the samples were found according to survey strategy in databases of Cochrane Central Register of Controlled Trials (CENTRAL) 'MEDLINE' Scopus and EMBASE. Translation of Non-English references were also used. The reviewed studies are clinical trial, retrospective and futuristic Survey strategy is as the following:

Tooth nonvital OR endodontically treated tooth OR pulpless OR pulp disease OR root fill teeth OR root filled tooth) and (post and core OR post and core system OR post and core technique OR fiber post OR fiber core OR metal post OR cast metal OR cerapost OR zirconia post OR milled zirconia post and core OR fiber-reinforced post OR carbon-fiber post OR carbon-quartz fiber post OR ceramic post) data obtained by QCochrane test as well as the I2 were set to ensure homogenity .then, by L'Abbéplot chart, both the Fixed-Effects and Random-Effects cases were evaluated, so that if data is heterogeneous, Random-Effects method will be used for their the meta-analysis interpretation.

NetworkMeta-Analysis test was separately done for the "loss of stuck-cohort post-cohort, fracture, root-cohort Fracture, etc. (endodontic failure, caries and periodontics) cohort - mixture (all failures) -cohort" / "losing stuck- RCT, post-RCT Fracture, root-RCT Fracture,

etc. (endodontic failure, caries and periodontics) – RCT, mixed RCT (all failures) as well as" the loss of stuck-studies (RCT + Cohort), Fracture post-studies (RCT + Cohort), Fracture root-studies (RCT + Cohort), etc. (endodontic failure, caries and periodontics) - studies (RCT + Cohort), combined (all failures) - Total studies (RCT + Cohort) " by WINBUGS algorithm for both default Fixed-Effect and Random-Effect with CI = 95% . Moreover, results were obtained in the form of OR (Odds Ratio) and SUCRA number which was used to draw ForrestPlot and LeagueTable diagrams.

RESULTS AND DISCUSSION

In the case of treatment failure due to loss of stuck in cohort studies, the amount of the loss in non-metallic prefabricated posts (Glass fiber) was Less than metal prefabricated OR(95% Cr.I.)=0.25 (0.01 – 1.75) and also less than metal cast (Cast Metal) OR(95% Cr.I.)=0.35 (0.03 – 2.05). In addition, the amount of loss of stuck cast metal posts (CM) is less than Prefabricated metal posts (PM) (PM) OR(95% Cr.I.)=0.72 (0.34 – 1.76).In the case of treatment failure due to loss of stuck in RCT studies, the amount of the loss in non-metallic prefabricated posts (Glass fiber) was Less than metal prefabricated (PM) OR(95% Cr.I.)=0.27 (0.04 – 1.01), but loss of stuck in metallic cast posts is less than that of non-metal prefabricated (GF) OR(95% Cr.I.)=0.84 (0.37 – 1.85) and less than that of metal prefabricated (PM) OR(95% Cr.I.)=0.25 (0.02 – 1.14

In the case of treatment failure due to loss of stuck in (RCT+ cohort) studies, the amount of the loss in non-metallic prefabricated posts (Glass fiber) was Less than metal prefabricated (PM) OR(95% Cr.I.)=0.59 (0.25 – 1.56), but it was equal with cast metal (CM) OR(95% Cr.I.)=1.00 (0.56 – 2.04). In addition, loss of stuck in in cast metal posts is less than that of prefabricated metal posts (PM) OR(95% Cr.I.)=0.62 (0.26 – 1.33)

In the case of treatment failure due post Fracture in cohort studies, the amount of post Fracture in prefabricated non-metallic (GF) posts was less than prefabricated metal (PM) OR (95% Cr.I.) = 0.31 (0.06 - 1.04). In addition, the amount of fracture of metal cast post (CM) is more than that of non-metal prefabricated (GF) OR(95% Cr.I.)=1.58 (0.05 – 13.15). Moreover, the amount of post fracture in cast metal posts is less than metal prefabricated posts (PM) OR(95% Cr.I.)=0.21 (0.02 – 8.10).

In the case of treatment failure due post Fracture in RCT studies, the amount of post Fracture in cast metal posts is less than prefabricated metal (PM) OR(95% Cr.I.)=0.36 (0.12 – 0.93) and also less than non-metal prefabricated posts (GF) OR(95% Cr.I.)=0.46 (0.04 – 5.47). Moreover, the amount of post fracture in prefabricated glass fabric is less than metal prefabricated posts ((PM) OR(95% Cr.I.)=0.82 (0.13 – 7.15).

In the case of treatment failure due post Fracture in (RCT+cohort) studies, the amount of post Fracture in cast metal posts is less than prefabricated metal (PM) OR(95% Cr.I.)=0.31 (0.12 – 0.87), and also less than glass prefabricated posts (GF) OR(95% Cr.I.)=0.42 (0.21 – 1.06) . Moreover, the amount of post fracture in prefabricated glass fabric is a little less than metal prefabricated posts ((PM) OR(95% Cr.I.)=0.73 (0.16 – 2.39).

In case of treatment failure due to the endodontic, Periodontics and decay in cohort studies, the amount of endodontic Periodontics and decay problems in glass pre-fabricated posts is less than metal prefabricated(PM) OR (95% Cr.I.)=0.39 (0.04 – 3.94) and less than cast metal OR (95% Cr.I.)=0.52 (0.07 – 4.61)(CM). In addition, the amount of endodontic, Periodontics and decay problems in cast metal posts is less than metal prefabricated posts (PM) OR (95% Cr.I.)=0.79 (0.39 – 1.79).

In case of treatment failure due to the endodontic, Periodontics and decay in RCT studies, the amount of endodontic Periodontics and decay problems in cast metal posts is less than metal prefabricated(PM) OR(95% Cr.I.)=0.39 (0.05 – 2.32) and also less than glass prefabricated posts OR(95% Cr.I.)=0.58 (0.11 – 2.06). In addition, the amount of endodontic, Periodontics and decay problems in glass prefabricated posts is less than metal prefabricated posts (PM) OR(95% Cr.I.)=0.65 (0.24 – 1.59).

In case of treatment failure due to the endodontic, Periodontics and decay in RCT+Cohort studies, the amount of endodontic Periodontics and decay problems in cast metal posts is less than metal prefabricated(PM) OR(95% Cr.I.)=0.79 (0.37 – 1.58) and also equal with glass prefabricated posts OR(95% Cr.I.)=1.00 (0.47 – 1.95). In addition, the amount of endodontic, Periodontics and decay problems in glass prefabricated posts is less than metal prefabricated posts (PM) OR(95% Cr.I.)= 0.83 (0.33 – 1.65).

In case of treatment failure due to root fracture in cohort studies, the amount of root fracture in glass prefabricated posts (GF) is less than metal prefabricated (PM) OR(95% Cr.I.)=0.31 (0.06 – 1.04), and less than cast metal (CM) OR(95% Cr.I.)=0.34 (0.12 – 0.91). In addition, root fracture in cast metal (GF) posts is less than metal prefabricated posts (PM)OR(95% Cr.I.)=0.84 (0.29 – 2.20).

In case of treatment failure due to root fracture in RCT studies, the amount of root fracture in glass prefabricated posts (GF) is less than metal prefabricated (PM) (PM) OR(95% Cr.I.)=0.46 (0.05 – 2.63), but, root fracture in metal cast posts (CM) is less than glass prefabricated (GF)OR(95% Cr.I.)=0.64 (0.05 – 2.62), and metal prefabricated (PM) OR(95% Cr.I.)=0.28 (0.01 – 2.39).

In case of treatment failure due to root fracture in RCT+cohort studies, the amount of root fracture in glass prefabricated posts (GF) is less than metal prefabricated (PM) OR(95% Cr.I.)=0.36 (0.19 – 0.86) and less than cast metal (CM) OR(95% Cr.I.)=0.56 (0.27 – 1.33). In addition, root fracture in cast metal (CM) posts is less than metal prefabricated posts (PM)OR(95% Cr.I.)=0.62 (0.29 – 1.57).

About all the treatment failures in Cohort studies, glass prefabricated posts (GF) is less than metal prefabricated OR (95% Cr.I.)=0.11 (0.03 – 0.32) (PM), and less than cast metal OR (95% Cr.I.)=0.21 (0.07 – 0.53)(CM). In addition, all treatment failures in cast metal posts (CM) is less than metal prefabricated posts OR (95% Cr.I.)= 0.51 (0.27 – 0.95)(PM).

Moreover, all treatment failures in glass prefabricated posts is less than metal prefabricated OR(95% Cr.I.)=0.36 (0.13 – 0.90)

About all the treatment failures in RCT studies, amount of treatment failure of cast metal posts is less than metal prefabricated (PM) OR(95% Cr.I.)=0.19 (0.06 – 0.62) and glass prefabricated (GF) OR(95% Cr.I.)=0.54 (0.31 – 0.92). In addition, all treatment failure in glass prefabricated posts is less than metal prefabricated posts OR(95% Cr.I.)=0.36 (0.13 – 0.90).

About all the treatment failures in RCT +Cohort studies, amount of treatment failure of cast metal posts is less than metal prefabricated (PM) OR(95% Cr.I.)= 0.45 (0.20 – 0.99) . Treatment failure of glass prefabricated posts is less than metal cast OR (95% Cr.I.)= 0.74 (0.34 – 1.32). In addition, all treatment failure in glass prefabricated posts is less than metal prefabricated posts OR (95% Cr.I.)= 0.33 (0.14 – 0.74).

In RCT studies, cast posts in all aspects of treatment failure (loss of stuck, post fracture, root fracture, endodontic problems, periodontics and dental caries) had a lower failure rate than other posts (PM, GF), they were the best posts for tooth restoration. Metal prefabricated posts had the highest amount of treatment failure in all the aspects, and they are the worst posts for tooth restoration. In Cohort studies, glass prefabricated posts (fiber posts) in all aspects of had a lower failure rate than cast metal. Like RCT, metal prefabricated posts had the highest amount of treatment failure in all the aspects, and they are the worst posts for tooth restoration.

In (RCT+Cohort) studies, root fracture and total failures in fiber posts is less, however, the amount of post fracture in metal cast posts is less. In losing stuck, and failure due to endodontic, Periodontics and decay, the amount of clinical failure of fiber posts and cast metal was equal. Metal prefabricated posts still had the highest amount of treatment failure in all aspects, and they were the worst posts for tooth restoration.

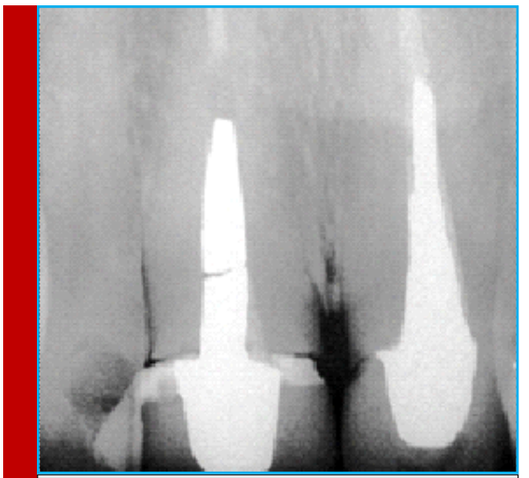

FIGURE 1. Post fracture

FIGURE 2. Root fracture

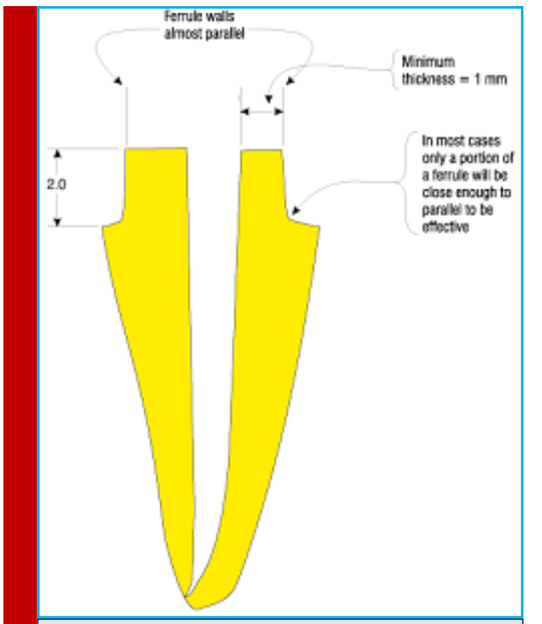

FIGURE 3. Ferrule effect

In the present study, for the first time, various aspects of treatment failure were examined separately in different systems of post (loss of stuck, failure in endodontic, Periodontics and decay, post fracture, and root fracture) in primary studies of Cohort and RCT. In addition, for the first time, Network Metal- analysis was used to examine 2 different treatment methods to reconstruct root treated teeth.

As the result of Network Metal- analysis on the primary studies of RCT, in all levels of treatment failure aspects (loss of stuck, failure in endodontic, Periodontics and decay, post fracture, and root fracture), and in all treatment failures, cast posts had the less failure than other posts (PM.GF), and they were the best posts to restore teeth. The mentioned results aligned with the studies of Figueiredo et al (Figueiredo 2015), and Zhou et al (Zhou 2013), but they are in contrast with the results of Bolla (Bolla 2007).

Of course, in the study of Figueiredo, root fracture rate was considered equal among all cast metal and fiber posts that are in contract with the results of the present study. In addition, in meta-analysis of RCT studies, metal prefabricated posts had the highest rate of treatment failure in all aspects, and they were the worst posts for tooth restoration, which were studied just in the study of Figueiredo, and in comparison with cast metal posts. In the mentioned study, treatment failure rate of them was twice higher than cast metal posts.

In primary studies of Cohort, in all levels of treatment failure aspects and in all treatment failures, glass prefabricated posts (fiber posts) had the less failure than metal posts (whether cast, or prefabricated). The mentioned results aligned with the studies of Bolla et al and Soarez et al. like RCT, metal prefabricated posts had the highest rate of treatment failure in all aspects, and they were the worst posts for tooth restoration. In (RCT+Cohort) studies, root fracture rate is less in fiber posts, but post fracture rate in cast metal posts is less. In addition, in loss of stuck and failure due to endodontic, Periodontics and decay problems, the rate of clinical failure of fiber casts and cast metal was the same, which has not been studied in another survey. In total, treatment failure of fiber posts was less than cast metal. Metal prefabricated posts had still the highest rate of treatment failure in all aspects, and they were the worst posts for tooth restoration.

The study of Figueiredo et al was conducted in 2015, in which, such as the present study, both random and Cohort studies were used. However, due to using Onearm Cohort studies that studies just one post without comparing with other posts, there was not possibility to conduct meta-analysis between Cohort and RCT studies in the mentioned study.

Besides, the results were just in the form of reviewing survival average difference among different posts, and odd ration was not examined among various posts. Of course, this study is the only one that has studied metal prefabricated posts, of course, just with cast metal posts, and has informed their fracture rate to be twice more than that of metal cast posts. Moreover, root fracture rate between cast metal posts and fiber posts were equal that are in contrast with our study results.

Study of Zhou and et al was released in 2013 in Chinese in which about 13 studies were analyzed and the only general failure of treatment was evaluated. Metal posts had a significant lower rate of failure rather than fiber posts that the result of the study is aligned with our RCT meta-analysis, but in contract with our Cohort meta- analysis and total result.

The review study of Soarez et al in 2012 was conducted on just the non-random primary studies I nwhich the studies were reviewed separately, and any meta-analysis was not done on them. Finally, failure rate of metal posts was more than glass posts. The result is aligned with our meta-analysis on Cohort and total studies, but is not aligned with our RCT meta-analysis results.

In study of Bolla et al in 2005, just one study was included in meta-analysis. Finally, the result was that glass posts have less failure rather than metal posts. The result is in contrast with our RCT meta- analysis result that is probably because of few numbers of primary studies in Bolla meta- analysis. As it is observed, meta-analysis results of Cohort studies and random clinical trial are different between fiber post and metal cast in all aspects. In random studies, metal cast post in all aspects in the best post, and in Cohort studies, almost in all aspects, fiber posts are the best. Therefore, to compare the results of Cohort and random clinical studies, there is a great heterogeneity even when using Random-effects. (Heterogeneity (Vague) = 1.11, Heterogeneity (Inform.) = 0.472895% CrI (0.0821 – 0.9902))

As the result, the final result of analysis, according to (Cohort+RCT) studies and in contract with separate meta-analysis of Cohort studies, RCT has a wide range of OR (0.74 (0.34 – 1.32 for Random-Effects) and 0.92 (0.60 – 1.35) for Fixed Effects) which must be noted while considering the results. Moreover, if using Random-effects, the total failure result in (Cohort+RCT) studies has a different result (superiority of fiber posts) rather than using Fixed-Effects (equality of fiber posts and cast metal) that must be noted when exploiting the present study.

CONCLUSION

According to RCT studies, cast metal posts had the lowest and metal prefabricated posts have the highest rate of failure in all aspects. According to Cohort studies, glass prefabricated posts (fiber posts) had the lowest rate of failure in all aspects. Metal prefabricated posts had

the highest rate of failure in all aspects. According to (Cohort+RCT) studies, cast metal posts has the lowest failure rate regarding post fracture, and fiber posts had the lowest root fracture and lowest total failure. Rate of stuck loss and failure due to endodontic, periodontics and dental caries problems, rate of clinical failure of fiber posts and metal cast were equal. Prefabricated metal posts had the highest rate of failure in all aspects.

REFERENCES

Belleflamme, M.M., Geerts, S.O., Louwette, M.M., Grenade, C.F., Vanheusden, A.J. and Mainjot, A.K., 2017. No post-no core approach to restore severely damaged posterior teeth: An up to 10-year retrospective study of documented endocrown cases. Journal of Dentistry.

Bolla, M., Muller-Bolla, M., Borg, C., Lupi-Pegurier, L., Laplanche, O. and Leforestier, E., 2007. Root canal posts for the restoration of root filled teeth. The Cochrane Library.

Borths, M.R. and Seiffert, E.R., 2017. Craniodental and humeral morphology of a new species of Masrasector (Teratodontinae, Hyaenodonta, Placentalia) from the late Eocene of Egypt and locomotor diversity in hyaenodonts. PloS one, 12(4), p.e0173527.

Choudhary, S., Begum, Z., Choudhary, P. and Tripathi, S., 2014. Comparative evaluation of retention of prefabricated and conventional cast post: An in vitro study. Journal of International Society of Preventive & Community Dentistry, 4(2), p.87.

Duret, B., Reynaud, M. and Duret, F., 1990. New concept of coronoradicular reconstruction: the Composipost (1). Le Chirurgien-Dentiste de France, 60(540), pp.131-41.

Dua, N., Kumar, B., Arunagiri, D., Iqbal, M., Pushpa, S. and Hussain, J., 2016. Comparative evaluation of the effect of different crown ferrule designs on the fracture resistance of endodontically treated mandibular premolars restored with fiber posts, composite cores, and crowns: An ex-vivo study. Journal of conservative dentistry: JCD, 19(3), p.264.

Figueiredo, F.E.D., Martins-Filho, P.R.S. and Faria-e-Silva, A.L., 2015. Do metal post–retained restorations result in more root fractures than fiber post–retained restorations? A systematic review and meta-analysis. Journal of endodontics, 41(3), pp.309-316.

Ferrari, M., Grandini, S., Simonetti, M., Monticelli, F. and Goracci, C., 2002. Influence of a microbrush on bonding fiber post into root canals under clinical conditions. Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology, 94(5), pp.627-631.

Fernandes, A.S. and Dessai, G.S., 2001. Factors affecting the fracture resistance of post-core reconstructed teeth: a review. International Journal of Prosthodontics, 14(4).

Fernandes, A.S., Shetty, S. and Coutinho, I., 2003. Factors determining post selection: a literature review. The Journal of prosthetic dentistry, 90(6), pp.556-562.

Goodacre, C.J. and Spolnik, K.J., 1994. The prosthodontic management of endodontically treated teeth: a literature review. Part I. Success and failure data, treatment concepts. Journal of Prosthodontics, 3(4), pp.243-250.

Heydecke, G. and Peters, M.C., 2002. The restoration of endodontically treated, single-rooted teeth with cast or direct posts and cores: a systematic review. The Journal of prosthetic dentistry, 87(4), pp.380-386.

Hongxue, M., Lili, S., Kun, L. and Linwang, S., 2013. Clinical evaluation of residual crowns and roots restored by glass fiber post and core, cast metal post and core or directly. West China Journal of Stomatology, 31(1).

Leprince, J.G., Leloup, G. and Hardy, C.M., 2017. Considerations for the Restoration of Endodontically Treated Molars. In The Guidebook to Molar Endodontics (pp. 169-205). Springer Berlin Heidelberg.

Meyenberg, K.H., LÜTHY, H. and SCHÄRER, P., 1995. Zirconia Posts: A New All-Ceramic Concept for Nonvital Abutment Teeth. Journal of Esthetic and Restorative Dentistry, 7(2), pp.73-80.

Morgano, S.M., Hashem, A.F., Fotoohi, K. and Rose, L., 1994. A nationwide survey of contemporary philosophies and techniques of restoring endodontically treated teeth. The Journal of prosthetic dentistry, 72(3), pp.259-267.

Morgano, S.M. and Milot, P., 1993. Clinical success of cast metal posts and cores. The Journal of prosthetic dentistry, 70(1), pp.11-16.

Pétercsák, A., Radics, T. and Hegedus, C., 2014. Advantages and disadvantages of applying yttrium stabilized zirconium-dioxide post and core restorations. Fogorvosi szemle, 107(1), pp.9-13.

Rightmire, G.P., de León, M.S.P., Lordkipanidze, D., Margvelashvili, A. and Zollikofer, C.P., 2017. Skull 5 from Dmanisi: descriptive anatomy, comparative studies, and evolutionary significance. Journal of Human Evolution, 104, pp.50-79.

Rocha, A.T., Gonçalves, L.M., de Carvalho Vasconcelos, A.J., Maia Filho, E.M., Carvalho, C.N., Tavarez, R.R.D.J., No, R.J.M. and São Luis, R.I., Effect of anatomical customization of the fiber post on the bond strength of a self-adhesive resin cement.

Singh, S.V., Bhat, M., Gupta, S., Sharma, D., Satija, H. and Sharma, S., 2015. Stress distribution of endodontically treated teeth with titanium alloy post and carbon fiber post with different alveolar bone height: A three-dimensional finite element analysis. European journal of dentistry, 9(3), p.428.

Smith, C.T. and Schuman, N., 1998. Prefabricated post-and-core systems: an overview. Compendium of continuing education in dentistry (Jamesburg, NJ: 1995), 19(10), pp.1013-8.

Terry, D.A. and Swift, E.J., 2010. Post and Cores: Past to Present. Dentistry today, 29(1), pp.132-134.

Zalkind, M., Shkury, S., Stern, N. and Heling, I., 2000. Effect of prefabricated metal post-head design on the retention of various core materials. Journal of oral rehabilitation, 27(6), pp.483-487.

Zhou, L. and Wang, Q., 2013. Comparison of fracture resistance between cast posts and fiber posts: a meta-analysis of literature. Journal of endodontics, 39(1), pp.11-15.