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Analysis of endodontic success using a Periapical Index in teeth with different types of intraradicular posts

Análise do sucesso endodôntico por meio do Índice Periapical em dentes com diferentes tipos de pinos intrarradiculares

Análisis del éxito de la endodoncia mediante Índice Periapical en dientes con diferentes tipos de postes intraradiculares

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Abstract
This randomized clinical trial evaluated the influence of the type of intraradicular posts (glass fiber post or cast metal post) in the success of endodontic treatment in teeth that received single metal-ceramic restoration. The sample consisted of adult patients, who presented for the first time seeking routine dental care at the dental school over a period of 5 years. Seventy-six out of ninety-six teeth that received endodontic treatment and intraradicular post were analyzed, randomly distributed in two groups – glass fiber post (n=38), and cast metal post (n=38). The quality of the endodontic treatment was radiographically evaluated, and the apical status was assessed using the periapical index (PAI). Statistical Analyses were performed to a significance level of 5%. Descriptive analyses were used to characterize the teeth and survival curves were created using the Kaplan–Meier method. The success rate of endodontic treatment was 90.8% (n=69) including glass fiber post and cast post. When appropriate endodontic treatment was performed is possible to conclude that the success of endodontic treated teeth that received posts was not related to the post type.
Keywords: Root canal therapy; Periapical tissue; Post and core technique.

Resumo
Este ensaio clínico randomizado avaliou a influência do tipo de pino intrarradicular (pino de fibra de vidro ou pino de metálico-fundido) no sucesso do tratamento endodôntico em dentes que receberam restauração metalocerâmica. A amostra foi composta por pacientes adultos, que se apresentaram pela primeira vez em busca de atendimento odontológico de rotina na faculdade de odontologia durante um período de 5 anos. Foram analisados setenta e seis dos noventa e seis dentes que receberam tratamento endodôntico e pino intrarradicular, aleatoriamente distribuídos em dois grupos - pino de fibra de vidro (n = 38) e pino metálico-fundido (n = 38). A qualidade do tratamento endodôntico foi avaliada radiograficamente e o estado apical foi avaliado pelo índice periapical (PAI). As análises estatísticas foram realizadas a um nível de significância de 5%. Análises descritivas foram utilizadas para caracterizar os dentes e as curvas de sobrevivência foram criadas usando o método de Kaplan-Meier. A taxa de sucesso do tratamento endodôntico foi de 90,8% (n = 69) incluindo pino de fibra de vidro e pino metálico-fundido. Concluindo, quando foi realizado o tratamento endodôntico adequado, o sucesso da terapia endodôntica não teve relação com tipo de pino intraradicular.
Palavras-chave: Tratamento do canal radicular; Tecido periapical; Técnica para retentor intrarradicular.

Resumen
Este ensayo clínico aleatorizado evaluó la influencia del tipo de postes intrarradiculares (postes de fibra de vidrio o postes de metal fundido) en el éxito del tratamiento de endodoncia en los dientes que recibieron restauración de metal-cerámica simple. La muestra estuvo conformada por pacientes adultos, quienes acudieron por primera vez buscando atención odontológica de rutina en la facultad de odontología durante un período de 5 años. Se analizaron setenta y seis de los noventa y seis dientes que recibieron tratamiento endodóntico y poste intrarradicular, que consistieron en dos grupos: poste de fibra de vidrio (n = 38) y poste de yeso (n = 38). La calidad del tratamiento endodóntico se evaluó radiográficamente y el estado apical se evaluó mediante el índice periapical (PAI). Los análisis estadísticos se realizaron a un nivel de significancia del 5%. Se utilizaron análisis descriptivos para caracterizar los dientes y se crearon curvas de supervivencia mediante el método de Kaplan-Meier. La tasa de éxito del tratamiento endodóntico fue del 90,8% (n = 69), incluidos los postes de fibra de vidrio y los postes de yeso. Cuando se realizó el tratamiento de endodoncia adecuado, es posible concluir que el éxito de los dientes tratados con endodoncia que recibieron postes no estuvo relacionado con el tipo de postes.
Palabras clave: Tratamiento del conducto radicular; Tejido periapical; Técnica de perno muñón.

1. Introduction

Intraradicular posts are required to promote retention of the coronal restorative material to the radicular portion in cases without preservation of the crown structure (Soares et al, 2012). The influence of the intraradicular post in the quality of the final restoration is also an important factor in the success of the endodontic therapy since the marginal coronal leakage can lead to reinfection of the apical region (Ayna et al, 2010).

The assessment of endodontic treatment quality requires clinical as well as radiographic follow-ups at regular intervals. Radiographic evaluation of the periapical status in teeth submitted to endodontic therapy is an important measure of follow-up that might help to define the need for future retreatment. An intact periodontal ligament space in the apical region and absence of clinical symptoms are indications of apical healing. Therefore, it is important to evaluate previous endodontic procedures and their effect on treatment outcome (Gencoglu et al, 2010).

Variations in radiographic interpretations of endodontically treated teeth may lead to different treatment plans. General dentists recommend retreatment based on two main criteria: a) planned prosthodontic treatment, and b) presence of periapical radiolucency characterizing endodontic failure. During retreatment decisions, it is important to consider the complexity of the radiographic interpretation process (Morgental et al, 2012). Changes in periapical tissues after endodontic treatment are usually detected on radiographs. To establish the success rate in root canal–treated teeth, radiographic assessment, and interpretation may be graded using a PAI score. The PAI scoring system allows standardization of the different categories and further comparisons between radiographs. Its reliability has been established by previous investigations (Orstavik, 1988).

The purpose of this study was to evaluate the influence of the type of intraradicular posts (glass fiber post or cast metal post) in the success of endodontic treatment of teeth that received single metal-ceramic restoration.

2. Methodology

This prospective, parallel-group randomized controlled trial (RCT) was registered at ClinicalTrials.gov (NCT01461239). The study was approved by the local research and ethics committee (protocol 122/2009) and followed the CONSORT recommendations. Participants' oral health was assessed, and they provided written informed consent before enrollment in the study. The sample consisted of adult patients who presented for the first time seeking routine dental care at the Dental School, Federal University of Pelotas, Rio Grande do Sul, Brazil over a period of 5 years. Participants' oral health was assessed, and they provided written informed consent before enrollment in the study. Inclusion criteria were: good oral health (no caries or periodontal disease), presence of one or more anterior or posterior teeth requiring endodontic treatment and intraradicular retention, single metal-ceramic crown, and adequate endodontic filling. Exclusion criteria were: the absence of

intraradicular posts (fiber post or cast post type), dental root fracture, dental extraction, waiver by the patient, and inadequate endodontic filling (root fillings with more than 2 mm short of the radiographic apex or grossly overfilled and root fillings with voids, inadequate density, unfilled canals, and/or poor condensation) (Tronstad et al, 2000). All periapical radiographs were taken using the parallelism technique and processed at the same radiology center under standard conditions.

Clinical Procedures

Undergraduate and graduate students enrolled in the Department of Operative Dentistry at the Federal University of Pelotas performed all root canal treatments under the supervision of experienced instructors. Treatment procedures adhered to the following standardized protocol: a preoperative periapical radiograph of the tooth was captured, the tooth was anesthetized with lidocaine hydrochloride and epinephrine at 1:100,000 (Alphacaine; DFL, Brazil), and isolated with a rubber dam. All materials were used according to the manufacturers' instructions. Straight-line access was prepared with a high-speed, water-cooled Diamond bur (Intensiv, Grancia, Switzerland). After preliminary scouting of canals with size 10 K-files (Dentsply Sirona, Ballaigues, Switzerland), working length was confirmed radiographically. Canals were instrumented using the crown down technique and irrigation with 2.5% NaOCl solution (Ponce de Leon Del Bello et al, 2003). Teeth were filled using the lateral condensation technique and Grossman cement (Endo- Fill; Dentsply Maillefer, Petrópolis, Brazil) and gutta-percha cones (Dentsply Maillefer). Then, 2/3 of the fillings were removed from the root canal with #5 Gates Glidden burs (Dentsply Maillefer).

The cementation procedures were as previously described by Sarkis-Onofre et al. (2014). A randomization sequence was generated with a computerized random number generator. For treatment randomization, a person not involved in the study wrote post types (glass fiber and cast metal) on slips of paper and inserted them into plain brown envelopes. For participants randomly assigned to receive glass fiber posts. Before glass fiber post cementation, root canals were prepared with the reamer from the fiber post system. Glass fiber posts (White Post DC; FGM, Joinville, Brazil) were cleaned with ethanol and pretreated with silane (ProSil; FGM). Cast metal posts were previously done directly in acrylic resin (Duralay II Lab Pattern Resin; Polidental, Cotia, Brazil). Briefly, resin cement was used to lute all posts, according to the manufacturer's instructions. All teeth received single metal-ceramic restorations. The teeth included had a ferrule height of 0–0.5 mm. Undergraduate and graduate students who had attended 12h of lectures and training in restorative dentistry performed the procedures. Participants were recalled for clinical and radiographic examinations once a year up to a 4-year follow-up period.

Periapical Status

Apical status was assessed using the periapical index (PAI) proposed by Orstavik et al. (1986) which scores the apical area of the radiographic images as follows: 1.normal periapical structures; 2.small changes in the bone structure; 3.changes in bone structure with some mineral loss; 4.periodontitis with a well-defined radiolucent area; 5.severe periodontitis with exacerbating features**.**

A score of PAI 1 and 2 was defined as a healthy periapical region. All other PAI scores (3, 4, and 5) were evaluated as apical periodontitis.

Two observers in the present study participated in the calibration training for the PAI system, which involved scoring 50 radiographic images of teeth with different periapical statuses. For each tooth, a 'true periapical status' was established by consensus between the two examiners. The strength of the inter-observer agreement was determined by the calculation of kappa value (kappa=0.87) (Cohen, 1960). Afterwards, all the radiographs were independently examined by both examiners that were blinded to the type of intraradicular posts by inserting a plain brown paper on the image of the post by a third person not involved in the analysis. In case of disagreements and difficult borderline cases, a consensus decision was reached by

discussing these cases and a joint evaluation was established to reach an agreement. Intra-examiner reproducibility was evaluated by repeated scoring of the same 50 radiographs at 2 weeks after the first examination. The intra-observer agreement on PAI scores for the 2 observers (OSS and RCJ) produced kappa values of 0.83 and 0.84, respectively.

Statistical analyses

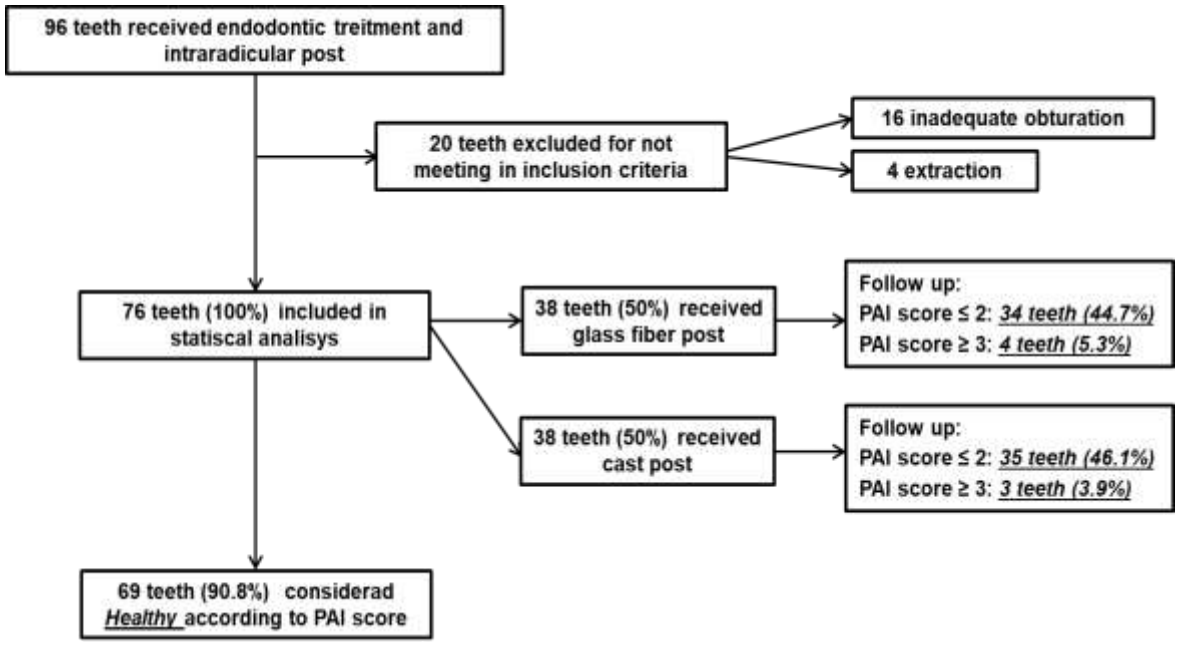
Statistical analyses were performed using SigmaStat software (version 3.5; Systat, Richmond, CA, USA). Descriptive analyses were used to characterize the teeth included in the study and the reasons for failure. Survival curves were created using the Kaplan–Meier method.

3. Results

Figure 1 shows the flowchart of the study. A total of 76 out of 96 teeth that received endodontic treatment and intraradicular post were analyzed. Twenty teeth were excluded because they had an inadequate endodontic filling or were extracted. Figure 2 is the Kaplan-Meier curves survival estimates that showed the time of failure of each group. Table 1 shows the characteristics of gender, tooth location, tooth type, preoperative and postoperative PAI score according to the type intraradicular post.

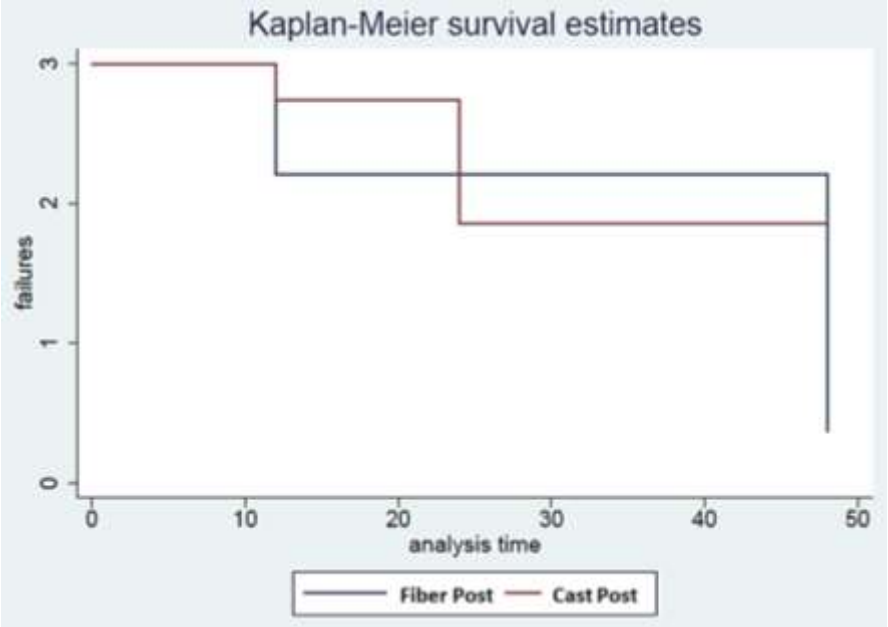
The success rate of endodontic treatment was 90.8% (n=69) including glass fiber post and cast post. All teeth included in this study were clinically examined. None of the evaluated teeth showed periodontal problems, and no patient reported endodontic-related pain.

Figure 1 - Flowchart of phases.



Fonte: Autores.

Figure 2 – Kaplan-Meier survival curves for glass fiber and cast metal posts. Analysis time in months of failure moment.



Fonte: Autores.

Table 1 – Descriptive data of gender, tooth location, tooth type, PAI score preoperative, and postoperative according to the type intraradicular post.

	Cast Post	Fiber post
Gender		
• Male	05	08
• Female	33	30
Tooth location		
• Maxila	29	34
• Mandible	09	04
Tooth type		
• Single-rooted	22	19
• Premolar	13	14
• Molar	03	05
Preoperative		
• PAI score ≤ 2	25	28
• PAI score ≥ 3	13	10
Postoperative		
• PAI score ≤ 2	35	34
• PAI score ≥ 3	03	04

Fonte: Autores.

4. Discussion

The focus of this study was teeth with large coronal destruction that received endodontic treatment and intraradicular retainer with either glass fiber or cast metal posts. All procedures were performed according to pre-established protocols that were carefully followed. Differences in failure rates between the 2 groups were nonexistent. All teeth evaluated in this study

received final single metal-ceramic restorations. The use of the same final restoration for all teeth creates a standardization of the sample.

Adequate coronal restorations help to prevent reinfection and reestablish occlusal function, which may influence bone healing and remodeling after endodontic therapy. An endodontic treatment that was initially considered successful may fail with time due to a defective restoration (Tronstad et al, 2000). All analyzed teeth possessed appropriate coronal restorations, and a minimum recall time of 12 months was chosen to allow sufficient time for radiographic and clinical signs and symptoms of failure to become apparent (Orstavik, 1996; Orstavik 2004).

Parasi et al. (2015) evaluated the long-term success rate of teeth restored with quartz fiber posts and fixed dental prostheses obtained a success rate of 85.86% of the restorations in a mean period of 5.88 ±1.37 years. Sterzenbach et al. (2012) compared the survival rates of endodontically treated teeth restored with pre-fabricated glass fiber–reinforced epoxy resin or titanium posts using a self-adhesive luting material. These authors showed a low endodontic failure rate and concluded that post endodontic restorations achieve a high long-term survival rate irrespective of the post material and its rigidity.

Oliveira et al. (2021) showed that due to better distribution of forces, fractures in fiberglass posts are smaller, but both types of posts present good results when performed correctly. Furthermore, fiberglass posts are more practical, conservative, economical and aesthetic, when compared to the cast metal core (Carvalho et al. 2020).

Morgental et al. (2012) investigated the effect of root canal filling quality and periapical status on retreatment decisions based on radiographic interpretations. They concluded that the visualization of the root of the unedited radiograph affected the interpretation of the periapical status, and the quality of fillings influenced the decision to endodontic retreatment. In our study, the radiographs were observed unedited. Cases of inadequate root fillings were excluded and cases with an adequated root canal filling with disease or onset of disease or maintenance of the disease by PAI score were considered as failure.

In this study, we observed a success rate of 90.8%. Clinical studies showed that initial non-surgical endodontic procedures have mean success rates ranging from 73.5% to 92.3% (Ng et al, 2011; Azim et al, 2016; Lee et al, 2012). A retrospective study that evaluated extensive tooth-supported fixed dental prostheses after 10 years observed that the endodontically treated teeth examined showed 11.7% of periapical lesions (Alsterstål-Englund et al, 2021).

To establish the success rate in root canal–treated teeth, radiographic assessment, and interpretation may be graded using a PAI score. PAI scoring system allows standardization of the different categories and further comparisons between radiographs. Its reliability has been established by previous investigations (Orstavik, 1988). Radiographic analysis as evaluation criteria of success or failure of endodontic treatment is dependent on subjective interpretation and can differ among observers. The intra-observer values on PAI scores for the two examiners produced kappa values of 0.83 and 0.84, indicating high agreement. Most studies that evaluate endodontic treatment only by radiographic exam, observe the conditions of canal fillings, apical limit, and density of obturation material, trying to relate the presence or absence of periapical pathology (García-Guerrero et al, 2020).

Authors such as Fernández et al. (2013), Moreno et al. (2013) and Song et al. (2014) associated the quality of the restoration, a postoperative factor, with the success of the initial endodontic treatment.

5. Conclusion

The complexity of the anatomy of the tooth and difficulties found during treatment might influence periapical healing. The minimum precautions taken during the endodontic therapy, post cementation until the final restoration, will be responsible for sealing the root canal with the intraoral cavity. When appropriate endodontic treatment was performed, it is possible to conclude that the success of endodontic treated teeth that received posts was not related to the post type. Further studies can be

done to assess the greater longevity of rehabilitation in endodontically treated teeth that received intraradicular posts allied to different trademarks.

References

Alsterstål-Englund, H., Moberg, L. E., Petersson, J., & Smedberg, J. I. (2021). A retrospective clinical evaluation of extensive tooth-supported fixed dental prostheses after 10 years. *The Journal of prosthetic dentistry*, *125*(1), 65-72. https://doi.org/10.1016/j.prosdent.2019.10.009

Ayna, B., Ayna, E., & Çelenk, S. (2010). Endodontic and prosthetic treatment of teeth with periapical lesions in a 16-year-old-girl. *Journal of Applied Oral Science*, *18*(2), 201-206. https://www.scielo.br/scielo.php?pid=S1678-77572010000200016&script=sci_abstract&tlng=es

Azim, A. A., Griggs, J. A., & Huang, G. J. (2016). The Tennessee study: factors affecting treatment outcome and healing time following nonsurgical root canal treatment. *International endodontic journal*, *49*(1), 6-16. https://doi.org/10.1111/iej.12429 https://doi.org/10.1111/iej.12429

Carvalho, G. A. O., de Souza, J. R., Câmara, J. V. F., Ribeiro, A. D. O. P., & Pierote, J. J. A. (2020). Reconstrução de dentes com retentores intrarradiculares: uma revisão da literatura. *Research, Society and Development*, *9*(7), e850974941-e850974941. https://doi.org/10.33448/rsd-v9i7.4941

Cohen, J. (1960). A coefficient of agreement for nominal scales. *Educational and psychological measurement*, *20*(1), 37-46. https://doi.org/10.1177/001316446002000104

Fernández, R., Cadavid, D., Zapata, S. M., Álvarez, L. G., & Restrepo, F. A. (2013). Impact of three radiographic methods in the outcome of nonsurgical endodontic treatment: a five-year follow-up. *Journal of endodontics*, *39*(9), 1097-1103. https://doi.org/10.1016/j.joen.2013.04.002

García-Guerrero, C., Delgado-Rodríguez, C. E., Molano-González, N., Pineda-Velandia, G. A., Marín-Zuluaga, D. J., Leal-Fernandez, M. C., & Gutmann, J. L. (2020). Predicting the outcome of initial non-surgical endodontic procedures by periapical status and quality of root canal filling: a cohort study. *Odontology*, *108*(4), 697-703. https://doi.org/10.1007/s10266-020-00494-z

Gencoglu, N., Pekiner, F. N., Gumru, B., & Helvacioglu, D. (2010). Periapical status and quality of root fillings and coronal restorations in an adult Turkish subpopulation. *European journal of dentistry*, *4*(1), 17. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2798785/

Lee, A. H. C., Cheung, G. S. P., & Wong, M. C. M. (2012). Long-term outcome of primary non-surgical root canal treatment. *Clinical oral investigations*, *16*(6), 1607-1617. https://doi.org/10.1007/s00784-011-0664-2

Moreno, J. O., Alves, F. R., Gonçalves, L. S., Martinez, A. M., Rôças, I. N., & Siqueira Jr, J. F. (2013). Periradicular status and quality of root canal fillings and coronal restorations in an urban Colombian population. *Journal of endodontics*, *39*(5), 600-604. https://doi.org/10.1016/j.joen.2012.12.020

Morgental, R. D., Santos, R. B. D., Rösing, C. K., Chanin, T. D. A., & Figueiredo, J. A. P. D. (2012). Interference of partial visual analysis of root filling quality and apical status on retreatment decisions. *Journal of Applied Oral Science*, *20*(2), 206-211. https://doi.org/10.1590/S1678-77572012000200014

Ng, Y. L., Mann, V., & Gulabivala, K. (2011). A prospective study of the factors affecting outcomes of nonsurgical root canal treatment: part 1: periapical health. *International endodontic journal*, *44*(7), 583-609. https://doi.org/10.1111/j.1365-2591.2011.01872.x

Oliveira, L. K. B. F., da Silva, S. R. C., de Moura, V. S., da Cruz Andrade, A. M., de Menezes Torres, L. M., da Silva, M. D. A. F.,... & de Gusmão Gonçalves, E. (2021). Análise comparativa entre pino de fibra de vidro e núcleo metálico fundido: uma revisão integrativa. *Research, Society and Development*, *10*(5), e51610515236-e51610515236. https://doi.org/10.33448/rsd-v10i5.15236

ØRSTAVIK, D. (1988). Reliability of the periapical index scoring system. *European Journal of Oral Sciences*, *96*(2), 108-111. https://doi.org/10.1111/j.1600-0722.1988.tb01415.x

Ørstavik, D., Kerekes, K., & Eriksen, H. M. (1986). The periapical index: a scoring system for radiographic assessment of apical periodontitis. *Dental Traumatology*, *2*(1), 20-34. https://doi.org/10.1111/j.1600-9657.1986.tb00119.x

Ørstavik, D. (1996). Time-course and risk analyses of the development and healing of chronic apical periodontitis in man. *International endodontic journal*, *29*(3), 150-155. https://doi.org/10.1111/j.1365-2591.1996.tb01361.x

Ørstavik, D., Qvist, V., & Stoltze, K. (2004). A multivariate analysis of the outcome of endodontic treatment. *European journal of oral sciences*, *112*(3), 224-230. https://doi.org/10.1111/j.1600-0722.2004.00122.x

Parisi, C., Valandro, L. F., Ciocca, L., Gatto, M. R., & Baldissara, P. (2015). Clinical outcomes and success rates of quartz fiber post restorations: a retrospective study. *The Journal of prosthetic dentistry*, *114*(3), 367-372. https://doi.org/10.1016/j.prosdent.2015.03.011

Del Bello, T. P. D. L., Wang, N., & Roane, J. B. (2003). Crown-down tip design and shaping. *Journal of endodontics*, *29*(8), 513-518. https://doi.org/10.1097/00004770-200308000-00006

Sarkis-Onofre, R., de Castilho Jacinto, R., Boscato, N., Cenci, M. S., & Pereira-Cenci, T. (2014). Cast metal vs. glass fibre posts: a randomized controlled trial with up to 3 years of follow up. *Journal of dentistry*, *42*(5), 582-587. https://doi.org/10.1016/j.jdent.2014.02.003

Soares, C. J., Valdivia, A. D. C. M., Silva, G. R. D., Santana, F. R., & Menezes, M. D. S. (2012). Longitudinal clinical evaluation of post systems: a literature review. *Brazilian dental journal*, *23*(2), 135-740. https://doi.org/10.1590/S0103-64402012000200008

Song, M., Park, M., Lee, C. Y., & Kim, E. (2014). Periapical status related to the quality of coronal restorations and root fillings in a Korean population. *Journal of endodontics*, *40*(2), 182-186. https://doi.org/10.1016/j.joen.2013.10.017

Sterzenbach, G., Franke, A., & Naumann, M. (2012). Rigid versus flexible dentine-like endodontic posts—clinical testing of a biomechanical concept: seven-year results of a randomized controlled clinical pilot trial on endodontically treated abutment teeth with severe hard tissue loss. *Journal of Endodontics*, *38*(12), 1557-1563. https://doi.org/10.1016/j.joen.2012.08.015

Tronstad, L., Asbjørnsen, K., Døving, L., Pedersen, I., & Eriksen, H. M. (2000). Influence of coronal restorations on the periapical health of endodontically treated teeth. *Dental Traumatology*, *16*(5), 218-221. https://doi.org/10.1034/j.1600-9657.2000.016005218.x