Clinical and radiographical evaluation of intraradicular posts

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Summary

Objective. **The purpose of this study was to investigate the clinical and radiographic success of teeth restored with posts.**

Material and method. **Periapical radiographs of 101 teeth with posts taken from 75 patients were examined. Posts were evaluated in terms of their position, remaining amount of gutta-percha, lengths and diameters, quality of root filling and periapical health. Furthermore, clinical examinations were performed regarding the overlying restorations. Statistical analysis was made to determine the influence of various factors on failure such as root fractures, marginal gap formation, post displacement, root perforation and the presence of a periapical lesion.**

Results. 40.6% of the examined teeth exhibited some kind of failure with an almost equal distribution between custom-cast and prefabricated posts respectively. Parameters such as post type, age of posts, centralization of the post, amount of root filling and the post/root length ratio, post diameters, the lengths of endodontic filling and the type of overlying restorations were not found to exert a significant influence on the failure of post systems ($p>0.05$). On the other hand, a statistically significant relationship was determined between the marginal integrity of the overlying restorations and periapical lesions.

Conclusion. **The results of this study suggest that the marginal integrity of the overlying restorations was determined as a significant influencing factor in the overall success of post systems in endodontically treated teeth. Long-term comparative follow-up studies are needed to make more reliable judgments.**

Key words: **posts, failure, radiographical evaluation of posts, clinical evaluation of posts.**

Introduction

Restoration of endodontically treated teeth with minimal tooth structure remaining is a challenging procedure. In most cases, these teeth require crowns as definitive restorations. Providing the retention of the crown is one of the major factors to be taken into consideration by the practitioner. The primary purpose of a post is to retain a core that will provide adequate support for the definitive crown or prosthesis in a tooth with extensive loss of coronal tooth structure [1]. Even though posts offer significant benefits when the practitioners are faced with the task of rehabilitating a severely damaged tooth with an endodontic treatment, posts may pose some risks as well. Among the major principles that are required for a successful post and core restoration are the correct preparation of the post space, selection of a reliable post system of sufficient length, insertion of the post parallel to the long axis of the root canal, selection of the proper luting agents, sufficient amount of remaining root canal fill-

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ing as well as an acceptable root canal treatment [2,3]. Furthermore, it has been suggested by some authors that the success of the overlying restoration is of equal importance [4-6].

A number of studies [7-11] have reported on the success of several post systems. Turner [7] reported a 12% absolute rate after a 5-year retrospective study on teeth having posts and cores. Weine et al. [8] investigated 138 posts in service for ten or more years and reported a 7% failure rate. Three studies [9-11] reported a failure rate of 9%. Different types of failure rates were reported in different studies. After a detailed literature review, Goodacre and Kan [3] reported loss of retention and tooth fracture as two most common causes of failure.

Objective

The purpose of the present study was to investigate the clinical and radiographic success of teeth restored with posts belonging to a patient population who visited a university clinic for an initial examination.

Materials and methods

This study was undertaken among patients who attended Yeditepe University Faculty of Dentistry for an initial examination. 75 patients were selected whose panoramic x-rays revealed the presence of intraradicular posts. Following this procedure, the periapical radiographs of 101 teeth with posts were taken from the selected patients using the paralleling technique at 65 kV and 8mA for a detailed evaluation. While examining the periapical radiographs, a clinical examination of the teeth was performed on teeth having posts and cores. Success and failure were assessed by periapical radiographic examinations using approximately 5X magnification. Following dental anamnesis and clinical and radiographic evaluation, the types and ages of posts, their positions, remaining amount of gutta-percha, length and diameter of posts and the quality of root filling, the periapical status of teeth and the type and quality of overlying restorations were recorded. While evaluating the types of posts, radiographic appearance was taken as the determining criteria. The coronal status of the teeth restored with posts, length of root filling and periapical status were assessed by the same criteria used by Hommez *et al.* [4].

During the evaluation, the following parameters were adopted:

Radiographic coronal status:

1.Intact restoration without signs of leakage (acceptable).
2.Restoration with open margin (unacceptable).
3. Restoration with recurrent decay (unacceptable).

Clinical coronal status:

1.Good margin (acceptable).
2.Catching of the explorer, no visible crevice (acceptable).
3.Crevice limited to the enamel (acceptable).
4.Crevice penetrating the dentine (unacceptable).
5.Fracture of restoration (unacceptable)
6.Detached restoration (unacceptable).
7. Lost restoration (unacceptable).

Length of root filling:

1.Root filling terminating 0-2 mm from the radiographic apex (acceptable).
2.Root filling terminating >2 mm from the radiographic apex (unacceptable).
3. Root filling extending beyond the radiographic apex (unacceptable).

Periapical status:

1.Normal: Good periapical condition.
2.Widening of the periodontal ligament not exceeding two times the width of the lateral periodontal ligament.
3. Periapical radiolucency in connection with the apical part of the root,

exceeding at least two times the width of the lateral periodontal ligament.

The restorations were considered successful if the posts were of adequate length and there was no deviation or displacement in posts and crowns, there was sufficient remaining root canal filling material, the periapical tissues were healthy without any signs of pathosis and the overlying restorations were functioning well and had successful marginal integrity by clinical examination.

The parameters to define failure were those used by Mannocci *et al.* [12]. The types of failure were categorized as root fracture, post fracture, post displacement, clinical and radiographic evidence of a marginal gap between tooth and restoration, or clinical evidence of secondary caries contiguous with the margins of the restorations. Post displacement was defined as a separation of the post-core and crown from tooth structure.

Radiographic evidence of a marginal gap between tooth and restoration was defined as a visible opening between tooth structure and restoration. Prior to evaluation, a consensus was obtained among the observers regarding different parameters using the criteria determined by Hommez *et al.* [4]. Clinical evidence of a marginal gap formation between the tooth and restoration was recorded in case it was visible. The patient was recorded as having a marginal gap in case one of these situations existed. Correlation of the age, type and length of posts, the marginal integrity of the overlying restorations and length of endodontic filling with the failure of the restorations were statistically examined.

Results

A total of 101 endodontically treated teeth with posts belonging to 75 patients (27 males and 48 females) were investigated in the present study. *Table 1* shows the distribution of the types of teeth examined. Maxillary lateral incisors were the types of teeth most frequently restored with posts. 55.4% of the posts were detected as custom-cast, whereas 44.6% were prefabricated. 40.6% of the examined teeth exhibited some kind of failure. Among the 41 teeth with failures, the percentages of custom-cast and prefabricated posts were almost equal with values of 51.2% and 48.8% respectively. *Table 2* shows the types of failures associated with the investigated teeth. No detectable failure was observed in 59.4% of the examined teeth, whereas the remaining teeth exhibited failures such as root fractures, marginal gap formation and the presence of a periapical lesion. When the

Table 1. The distribution of the types of teeth with post restorations

Teeth	n	%
11	5	5.0
12	12	11.9
13	6	5.9
14	4	4.0
15	9	8.9
17	1	1.0
21	4	4.0
22	10	9.9
23	7	6.9
24	4	4.0
25	7	6.9
26	1	1.0
27	1	1.0
31	1	1.0
34	3	3.0
35	6	5.9
36	1	1.0
37	4	4.0
42	1	1.0
43	1	1.0
44	4	4.0
45	5	5.0
46	3	3.0
48	1	1.0
Total	101	100.0

Table 2. The types of failures associated with the investigated teeth

Types of posts	No failure	Root fracture	Widening of the periodontal ligament	Apical lesion
Cast	35	1	8	12
Prefabricated	25	2	6	12
Total	60	3	14	24

x^2: 1.10 p=0.777

Table 3. The relationship between the age of posts and the occurrence of failures

Age of post (year)	No failure		Failure		Total	
1	9	15.0%	4	9.8%	13	12.9%
2	13	21.7%	5	12.2%	18	17.8%
3	4	6.7%	2	4.9%	6	5.9%
4	3	5.0%	3	7.3%	6	5.9%
5	5	8.3%	4	9.8%	9	8.9%
6	1	1.7%	1	2.4%	2	2.0%
7	3	5.0%	0	0.0%	3	3.0%
8	4	6.7%	1	2.4%	5	5.0%
9	2	3.3%	0	0.0%	2	2.0%
10	8	13.3%	11	26.8%	19	18.8%
11	-	0.0%	2	4.9%	2	2.0%
12	5	8.3%	5	12.2%	10	9.9%
15	1	1.7%	3	7.3%	4	4.0%
20	2	3.3%	0	0.0%	2	2.0%
Total	60	100.0%	41	100.0%	101	100.0%

x^2:15.50 p=0.217

types of failure were examined in terms of their relation with the types of posts, no statistically significant correlation was determined (p>0.05). There was no specific type of failure related with a certain post system. *Table 3* shows the relationship between the age of posts and the occurrence of failures. No statistically significant correlation was found between the ages of posts and failures (p>0.05).

When the centralization of posts was evaluated in two dimensions as viewed from the radiographs, it was determined that 81.2% were situated parallel with the tooth's long axis, whereas 18.8% disclosed a deviation from the main axis. The amount of root canal filling material was within acceptable limits, ending 0-2 mm from the root apices in 15.8% of the cases. On the other hand, 5.9% of the examined teeth displayed a short remaining root canal filling and 78.2% had remaining fillings longer than acceptable. When the teeth were examined with respect to post/root length ratio, it was concluded that the majority (93.1%) did not fulfill the generally accepted 2/3 post/root length ratio [2]. Statistical evaluation showed no significant relationship between the post/root length ratio and failures (p>0.05). A statistical correlation was also searched between the diameters of posts and failure rates. However, statistical analysis did not show any significant correlations between these two parameters, as well (p>0.05).

When the length of endodontic filling was assessed, only 37.6% exhibited an acceptable root filling length.

Table 4 shows the relationship between the types of overlying restorations and the presence of failures. No statistically significant relationship was determined between these two parameters (p>0.05).

The relationship of the marginal integrity with the presence of periapical lesions was statistically evaluated**.** A significant correlation was determined between these two parameters (p<0.05). Teeth that possessed a failure in terms of their marginal integrity were more prone to developing apical lesions. Furthermore, 79.2% of 48 teeth with

Table 4. The relationship between the types of overlying restorations and the presence of failures

Type of overlying restoration	No failure		Failure	
Bridge or crown	48	80.0%	37	90.2%
Filling	5	8.3%	1	2.4%
Lost single crown or filling	2	3.3%	3	7.3%
Removable denture abutment with Crown	1	1.7%	0	0.0%
Lost bridge abutment	4	6.7%	0	0.0%

x^2: 5.92 p=0.204

disrupted marginal integrities were found to develop secondary caries.

Discussion

The patient population examined in the present study consisted of those individuals who were initially examined at the Oral Diagnosis and Radiology Department. Even though an attempt was made to make a random selection between the patients, some bias may exist as those individuals may have visited the clinic for dental problems, which may lead to an overemphasis of complications. Furthermore, this study was not based on a recall performed on the same population; therefore there is no possibility to make a comparison between pre- and post- radiographic images.

Different failure rates have been reported by some authors [7-11, 13]. These values range from 7% to 12%. The relatively higher failure rate observed in the present investigation may be due to the high incidence of apical lesions, which may not be directly correlated with posts.

Basrani and Matthews [14] compared failure rates with different restoration types and concluded that there was no significant difference in failure frequencies among teeth that had endodontic treatment and restoration with adhesive techniques and composite, or endodontic treatment and restoration with adhesive techniques and composite with final restoration with full-coverage metal-ceramic crown. Goodacre *et al.* [15] described the 3 most common complications associated with posts and cores as post loosening, root fracture and caries. On the other hand, in a study that made a three-year comparison of survival of endodontically treated teeth restored with either full cast coverage or with direct composite restoration, Manocci *et al.* [12] reported the failure modes observed at 2 and 3 years as displacement of posts and clinical and/or radiographic evidence of marginal gap between tooth and restoration. In the present investigation, presence of a periapical lesion was determined as the most frequently encountered type of failure followed by marginal gap formation and root fracture. In spite of these findings, it is impossible to draw a direct correlation between the presence of posts and periapical lesions as periapical lesions may develop due to the inadequacy of root canal treatments and may not be directly related with the presence of posts.

The type of posts may also influence the nature and frequency of failures expected. The teeth included in the present investigation were either restored with custom-cast or prefabricated post systems; however it was

difficult to differentiate the type of prefabricated post system used except for some cases that exhibited the presence of a threaded post system by their radiographic images. Furthermore, the utilization of reinforced fiber post systems have not been widely implemented in the population investigated and it is not an invalid assumption to consider the majority of the prefabricated posts investigated as metallic. The relatively higher radiopacity of metallic posts compared to fiber ones was also a contributing factor in differentiating metallic and fiber posts.

A ratio of at least 2/3 is a universally accepted standard when post/root length ratios are concerned [2]. An interesting result obtained in the present study was the unacceptable root/post length ratios in the majority of the cases. This finding suggests that there may be lacking attention among clinicians regarding the basic rules to be followed during the processing of post systems. The fact that no correlation was determined between the root/post length ratios and failure does not undermine the importance of this parameter as unfavorable results may be expected in the long term. Furthermore, the amount of remaining gutta-percha is of equal importance.

The importance of a good coronal seal following endodontic treatment has been indicated by some authors. Ray and Trope [5] suggested that the quality of a coronal restoration is significantly more important than the technical quality of endodontic treatment. Hommez *et al.* [4] stressed on the importance of a good coronal restoration, as well as of a good root filling and concluded that both were determining factors in the periapical status of endodontically treated teeth. There are also some authors who suggested that the technical quality of endodontic treatment is significantly more important than that of the coronal restoration [16]. Iqbal *et al.* [17] further emphasized the significance of occlusal contacts on periapical health. In the present study, only 10 of the cases exhibited signs of traumatic occlusal relationships, 5 of which belonged to the failure group. Heling *et al.* [6] following a detailed literature review, concluded that poor coronal restorations, as well as inadequate root canal obturation, may allow bacteria or endotoxins to penetrate the root canal and initiate periapical inflammation and drew attention to the significance of the prompt placement of coronal restorations. They further offered some clinical recommendations such as post space preparation and cementation under rubber-dam isolation, the preparation of the post space with a heated plugger, a minimum of 3 mm remaining root canal filling, the irrigation and dressing during root canal treatment and the placement of leak-proof restorations in the shortest time possible after root canal treatment. These results bring us to another limited aspect of the present investigation, which are the clinical procedures undertaken during the processing of post systems.

The radiographic images and the clinical findings are the only available data that can be utilized in the present study and there is no information regarding the clinical steps taken during the processing of posts and crowns.

The present investigation reveals a general overview of a number of teeth restored with intraradicular posts. It is an undeniable fact that the success of a restorative procedure cannot be related to a single factor but it is the endodontic-restorative continuum that determines the long-term outcome of the treatment. Follow-up studies involving a higher number of teeth performed with different post systems may yield more valid and comparable results.

Conclusion

The marginal integrity of the overlying restorations was determined as a significant influencing factor in the success of post systems. Long-term follow-ups are definitely required to make more valid comparisons.

References

1. Schwartz RS, Robbins JW. Post placement and Restoration of Endodontically Treated teeth: A literature review. *J Endod*, 2004; **30**: 289-301.
2. Shillinburg HT, Hobo S, Whittsett LD, Jacobi R, Brackett SE. Preparations for extensively damaged teeth. In: Fundamentals of fixed prosthodontics, 3rd ed., Quintessence Publishing Co, Inc, 1997, pp: 181-209.
3. Goodacre CJ, Kan JYK. Restoration of endodontically treated teeth. In: Ingle JI, Bakland LK. Endodontics. BC Decker Inc., Canada, 2002; pp 913-950.
4. Hommez GMG, Coppens CRM, de Moor JG. Periapical health related to the quality of coronal restorations and root fillings. *Int Endod J*, 2002; **35**: 680-689.
5. Ray HA, Trope M. Periapical status of endodontically treated teeth in relation to the technical quality of the root filling and the coronal restoration. *Int Endod J*, 1995; **28**: 12-18.
6. Heling I, Gorfil C, Slutzky H, Kopolovic K, Zalkind M, Slutzky-Goldberg I. Endodontic failure cause by inadequate restorative procedures: Review and treatment recommendations. *J Prosthet Dent*, 2002; **87**: 674-678.
7. Turner CH. The utilization of roots to carry post-retained crowns. *J Oral Rehabil*, 1982; **9**: 193-202.
8. Weine FS, Wax AH, Wenckus CS. Retrospective study of tapered, smooth post systems in place for ten years or more. *J Endod*, 1991; **17**: 293-297.
9. Sorensen JA, Martinoff JF. Clinically significant factors in dowel design. *J Prosthet Dent*, 1984; **52**: 28-35.
10. Bergman B, Lundquist P, Sjögren U, Sundquist G. Restorative and endodontic results after treatment with cast posts and cores. *J Prosthet Dent*, 1989; **61**: 10-15.
11. Torbjörner A, Karlsson S, Ödman PA. Survival rate and failure characteristics for two post designs. *J Prosthet Dent*, 1995; **73**: 439-444.
12. Mannocci F, Bertelli E, Sherrif M, Watson TF, Pitt Ford TR. Three-year clinical comparison of survival of endodontically treated teeth restored with either with full-cast coverage or with direct composite restoration. *J Prosthet Dent*, 2002; **88**: 297-301.
13. Hatzikyriakos AH, Reisis GI, Tsingos N. A 3-year postoperative clinical evaluation of posts and cores beneath existing crowns. *J Prosthet Dent* 1992; **67**: 454-458
14. Basrani B, Matthews D. Survival rates similar with full cast crowns and direct composite restorations. *J Prosthet Dent*, 2002; **88**: 297-301.
15. Goodacre CJ, Bernal G, Rungcharassaeng K, Kan JY. Clinical complications in fixed prosthodontics. *J Prosthet Dent*, 2003; **90**: 31-41.
16. Tronstad L, Asbjornsen K, Doving L, Pedersen I, Eriksene HM. Influence of coronal restorations on the periapical health of endodontically treated teeth. *Endod Dent Traumatol*, 2000; **16**: 218-221.
17. Iqbal MK, Johansson AA, Akeel, RF, Bergenholz A, Omar R. A retrospective analysis of factoras associated with the periapical status of restored, endodontically treated teeth. *Int J Prosthodont*, 2003; **16**: 31-38.

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