Review Article

"Ferrule Comes First. Post Is Second!" Fake News and Alternative Facts? A Systematic Review

Michael Naumann, DMD,[*] Marc Schmitter, DMD,[†] Roland Frankenberger, DMD,[‡] and Gabriel Krastl, DMD[§]

Abstract

Introduction: Both the role of an endodontic post and the ferrule effect have been discussed for decades. The clinical impact of endodontic posts compared with post-free restoration with or without ferrule support was not systematically reviewed so far. It was assumed that the effect of an endodontic post compared with a post-free restoration can be evaluated only when at the same time a ferrule or no-ferrule situation was clinically compared. **Methods:** The specific PICO question was as follows: Patient: adults with sufficient endodontic treatment needing a core or post; Intervention: post-endodontic treatment using posts with or without ferrule; Comparison: post-endodontic treatment without posts with or without ferrule; Outcomes: failure rates of post/core complexes with or without ferrule support. A Medline search was performed via PubMed in June 2017 using relevant electronic databases. Additionally, hand search was performed. Only prospective clinical studies in humans comparing the success/survival of teeth restored with or without posts over a minimum time of observation of 5 years were included. **Results:** In total, 7 randomized controlled trials and 1 prospective clinical trial met inclusion criteria. Cochrane rating showed high risk of bias in 5 studies. Two of 3 studies support the ferrule-effect concept. Seven of 8 show no post effect. Clinical evidence regarding the influence of tooth location on its survival is scarce. **Conclusion:** Ferrule effect and maintaining cavity walls are the predominant factors with regard to tooth and restoration survival of endodontically treated teeth. Most studies do not confirm a positive effect of post placement. *(J Endod 2017;■:1–8)*

Key Words

Buildup, clinical trial, core, dowel, endodontically treated teeth, no-post, post-and-core, post-free, post-retained, screw

Significance

Ferrule effect and maintaining cavity walls are predominant factors with regard to tooth and restoration survival of endodontically treated teeth. Considerable clinical evidence to the influence of the tooth type on the survival of endodontically treated teeth is scarce. Most studies do not confirm a positive effect of post placement for indirect restoration.

In contrast to vital teeth, the complication rate of restorations on endodontically treated teeth (ETT) is considerably increased, maybe finally resulting in tooth loss. Therefore, ETTs are often judged as "less valuable" as abutments for prosthodontic restorations when it comes to reliability and cost-effectiveness compared with vital teeth (1) or implants (2). Systematically reviewed (SR) data over 3 to 25 years showed that survival rates of restorations after endodontic treatment ranged between approximately 81% and 100% (3).

Over the past decades, much research focused on the question of which post-and-core technique/material should be used to increase ETT and restoration survival (4). A wide range of post materials with different mechanical properties, such as cast gold (5), stainless steel (6, 7), titanium (8), zirconia (9), or less rigid materials, such as fiber posts (10) was applied. A recent survey reported that a great variety of options is presently used, also including no post placement depending on the final restoration planned (11). However, unequivocal guidelines do not exist.

The aim of the present SR was to look for for high-level clinical evidence comparing post *versus* no-post placement in ferruled and unferruled teeth to distinguish between post and ferrule effect and to exclude the blurring impact of the latter. The null hypothesis was that post placement is superior to post-free restorations (post effect) irrespective of the presence of a ferrule (ie, ferrule effect) for restoration and/or tooth survival.

Material and Methods

PICO Question

The specific PICO question was as follows:

P (patient): adults with sufficient endodontic treatment needing a dentin core buildup procedure

I (intervention): post-endodontic treatment using posts with or without ferrule support

C (comparison): post-endodontic treatment without posts with or without ferrule support

O (outcomes): tooth and/or restoration survival

From the *Department of Prosthodontics, Geriatric Dentistry, and Craniomandibular Disorders, Charité–Universitätsmedizin Berlin, Berlin, Germany; †Departments of Prosthodontics and §Conservative Dentistry and Periodontology, University Hospital of Würzburg, Würzburg, Germany; and ‡Department of Operative Dentistry and Endodontology, University of Marburg, Marburg, Germany

Address requests for reprints to Michael Naumann, Prof Dr med dent, DMD, Department of Prosthodontics, Geriatric Dentistry, and Craniomandibular Disorders, Charité–Universitätsmedizin Berlin, Aßmannshauser Str 4-6, Berlin 14197, Germany. E-mail address: naumann@naumann-kiessling.de

0099-2399/$ - see front matter

https://doi.org/10.1016/j.joen.2017.09.020

The resulting question was the following:

Is the insertion of a post or a post-free restoration the most successful treatment option in patients requiring restoration of an endodontically treated tooth, irrespective of the presence of a ferrule?

Search Process and Selection of Studies

Three of the authors (M.N., M.S., G.K.) performed a Medline (via PubMed) search in March 2017 using the terms ("post" OR "posts" OR "dowel" OR "dowels" OR "screw" OR "screws" OR "core" OR "post-retained" OR "no-post" OR "post-free" OR "endocrown" OR "buildup" OR "buildups" OR "build-up" OR "build-ups") to identify studies comparing the success/survival of dental restorations using posts or no posts. In this database, the authors used limits to narrow the search with the options "clinical trial" and "dental journals." Furthermore, the following electronic databases have been assessed using the search terms "posts" and "core": Opengrey, BBO, LILAC, and IBECS. All references cited in the identified articles also were checked to identify other potentially relevant articles. Finally, the personal databases of the authors were included in the search.

Inclusion/Exclusion Criteria

The present review included *in vivo* studies in humans comparing the success or survival of teeth restored using posts-and-cores and teeth restored using cores without posts. Retrospective clinical studies, *in vitro* and finite-element studies, and studies assessing the survival or success of either posts or cores have been excluded. Only studies including statements of the remaining coronal tooth structure and studies comparing post placement or post-free restorations with or without ferrule support were considered (Table 1).

Appraisal of the Studies Selected

After selection of the literature, its quality was assessed using standardized checklists:

1. The critical appraisal skills program (CASP)
2. Cochrane checklist (version 5.1.0)

Statistical Analysis

Quality of methodology was assessed by 3 referees. Two of the 3 referees had to agree to set the quality level on the selected degree. The agreement was assessed using the intraclass correlation coefficient, which was calculated using SPSS (V 23.0.0.2) (IBM SPSS Statistics, IBM Corporation, Chicago, IL).

Results

In Medline, 2595 articles were found. After screening the titles and the abstracts of the identified studies, 8 studies were included in the full-text analysis. In LILAC, IBECS, OpenGrey, and BBO, no further relevant references could be found (Fig. 1). In total, 8 studies were included, among them 7 randomized controlled trials (RCTs) and 1 prospective clinical trial (Table 1).

Main Findings from Selected Studies

Randomized Controlled Trials. Creugers et al (12, 13) published 5-year data on post-and-core restorations with or without covering crowns conducted between January 1988 and June 1991. Observations after 17 years were published by Fokkinga and coworkers (6, 7). Studies were conducted at Nijmegen University clinic and in 17 general practices around Nijmegen.

The first article including 5-year observations reported 249 patients with ETT requiring 1 covering crown. Three types of restorations were included in that trial: (1) cast post-and-core, (2) direct metal post and resin composite core restoration, and (3) post-free all-resin composite core restoration. Teeth were divided in 2 expected dentin heights after crown preparation with (#1 called trial S, substantial dentin height, 201 teeth) > 75% of circumferential dentin height, and thickness was 1 mm or more above gingival level (ie, a ferrule of 1 to 2 mm was achievable), and (#2, trial M, minimal dentin height, 118 teeth) < 75% as described in (Fig. 2) (6, 7, 12, 13). Thus, in the latter, no appropriate ferrule was achieved.

Effect of Ferrule. After 5 years of observation, restorations with ferrule in subgroup S survived significantly better (98% ± 2%) than in subgroup M without ferrule (93% ± 3%) ($P = .04$). However, after 17 years, comparison of survival probability between the ferrule subgroup (trial S, S = 0.84) and no-ferrule subgroup (trial M, S = 0.71) differed significantly only for prefabricated post with resin composite cores and crowns ($P = .03$).

Effect of Post. After 17 years, 28% (computed by authors: $n = 89$ teeth) of all restorations were available. Type of post-and-core had no significant influence in both trials ($P > .05$). Survival rate at restoration level varied from 71% to 80%, and at tooth level from 83% to 92%.

Effect of Post (Effect of Ferrule Not Applicable). A second subsequent article of this working group (12) reports 5-year observations of direct restorations in patients ($n = 87$) not able or willing to receive a single crown in the same setting as described previously. After random allocation in this trial, 99 direct restorations were performed with ($n = 53$) or without ($n = 46$) prefabricated posts. After 5 years of observation, all post-free restorations survived (survival 98% ± 2%). No significant difference between groups was found ($P > .05$).

Overall estimated survival rate after 17 years of restoration was 53% (±14%), and for the teeth 79% (±11%). Post placement had no influence ($P > .05$) on survival probability. Caries was the predominant reason for absolute failure.

Effect of Post (Effect of Ferrule Not Applicable). Mannocci et al (14) compared the 5-year clinical performance of 219 endodontically treated premolars with Class II cavities restored with either amalgam ($n = 109$) compacted in the coronal third of the root canal to increase retention or direct resin composite restorations ($n = 110$). At 5 years, 9 of 100 amalgam and 10 of 97 resin composite restorations failed (no significant difference, $P = .81$).

Ferrari et al (15) reported 6-year data (15, 18) of 345 patients divided into 6 groups of 60 premolars each (maximum 2 teeth per patient). Four groups were divided according to the remaining cavity walls (1 to 4). Additionally, in another group (group 5), the coronal tooth structure provided adequate ferrule, whereas in group 6 no ferrule was present. Within each group, teeth were randomly divided into 3 subgroups. Subgroup A did not receive a post, in subgroup B prefabricated fiber-reinforced composite posts were inserted, and in subgroup C customized fiber-reinforced composite posts were used.

Effect of Post. The overall survival rate was 94.1% (lost to follow-up 12.3%), 99.1% for prefabricated posts, 97.2% for customized posts, and 85.9% for no posts. The 6-year recall did not exhibit interactions between the type of restoration and the amount of remaining coronal dentin (ie, cavity walls) ($P > .05$).

Cloet et al (16) reported results of 143 patients in a 5-year recall. All subjects received all-ceramic crowns after root canal treatment in 203 teeth in a university setting (29 operators). The comparison of restorations with and without posts was performed in a second study arm