Restoring the fractured root-canal-treated maxillary lateral incisor: In search of an evidence-based approach

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Objective: To demonstrate the existing difficulties and variability in the application of evidence-based dentistry by comparing the recommendations made by 4 dental experts for the treatment of a fractured tooth. **Method and Materials:** A case presentation was given to 4 specialists, who were asked to independently develop and explain their personal favorite treatment strategy, based on the best available external evidence and their clinical expertise. The entire case was then reviewed by an expert in evidence-based medicine and discussed with the first author. **Results:** Each of the 4 experts relied on different articles in justifying their clinical decisions. The minimal overlap in the literature they cited largely explains the different treatment suggestions: While the endodontist preferred a metal post-and-core and a porcelain-fused-to-metal (PFM) crown, both the operative dentist and the prosthodontist opted for a glass-fiber post/fiber-reinforced resin composite post. The perio-prosthodontist recommended a PFM crown with either a direct or indirect post and core. The citation analysis revealed that little high-quality information is available about what would be the best therapy for horizontal fractures of root-canal-treated anterior teeth. **Conclusions:** This article illustrates that, although it is now common practice in dentistry to base clinical decision making on external evidence from the literature, search strategies and the resulting clinical recommendations still vary greatly. *(Quintessence Int 2007;38:179–191)*

Key words: dental abutments, evidence-based dentistry, fixed partial denture, post-and-core technique, resin cements, root canal therapy, tooth fractures, tooth-root injuries, treatment outcome, treatment planning

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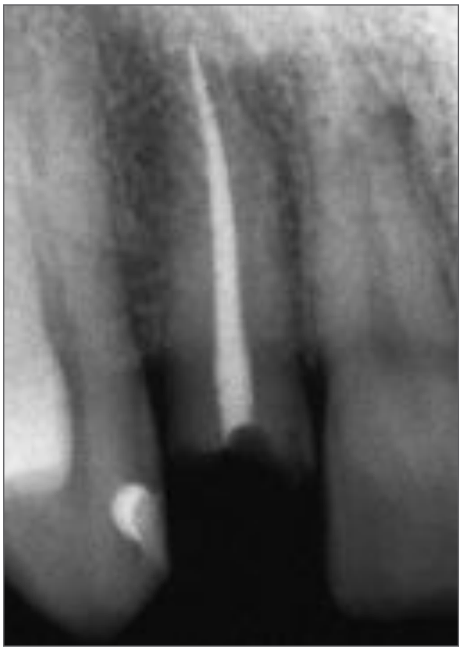
Over recent years, the concept of evidence-based medicine has been gaining increasing recognition in dentistry.[1,2] Nonetheless, the application of evidence-based medicine in daily practice remains a challenge because, for many clinical questions, the quality level of the best available external clinical evidence (ie, research papers from peer-reviewed journals) is low. For example, for a great number of clinical questions, information on level 1, according to the Oxford Centre for Evidence-Based Medicine Levels of Evidence,[3] is simply not available at this point in time.



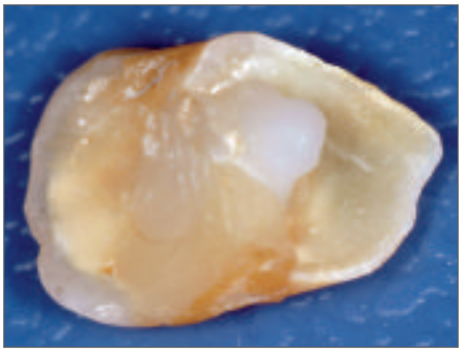


Fig 1 *(left)* Root canal filling of the maxillary right lateral incisor (radiograph from 1975).

Fig 2a *(center)* The fractured natural clinical crown.

Fig 2b *(right)* Intraoral view of the fractured tooth.

Furthermore, even in those cases where high-quality information is accessible, the application of an evidence-based approach does not necessarily mean that different clinicians will offer the same treatment. This is due to the fact that evidence-based medicine requires that the individual clinical expertise of the clinician (internal evidence), as well as the patient's wishes and the external evidence, need to be taken into account. In addition, even if the same databases (external evidence) are available, variations are likely to occur, eg, due to different search strategies.

This article will exemplify the existing difficulties and variability with the application of evidence-based medicine in dentistry by comparing the clinical decisions made independently by 4 dental experts.

THE CASE

In 1976, at the age of 15, the pulp of the first author's maxillary right lateral incisor was exposed during caries excavation. In the same session, a root canal filling was made (Fig 1). The tooth remained symptom-free and in perfect function for about 30 years. Because of slight discoloration, the nonvital tooth was internally bleached with hydrogen peroxide in 1993 and 1998, and the access opening on the palatal aspect was definitively restored with resin composite.

In October 2005, while biting into a bread roll, the clinical crown of the tooth suddenly broke off about 1 mm above the gingival margin (Figs 2a and 2b). Apart from its separation from the root and the preexisting endodontic access cavity, the clinical crown incurred no further damage. Within 2 hours, the first author—now patient—was treated by the last author (N. U. Z.). All procedures described below were performed using a rubber dam.

A re-treatment of the root canal was carried out, and the old root canal filling was replaced. The old filling was removed using K-Files and eucalyptus oil. The canal was cleaned using the balanced-force technique[4] and irrigated with sodium hypochlorite (1%). A small caries lesion on the mesiopalatal side of the tooth was removed. The root canal was obturated with gutta-percha and AH-26 (Dentsply DeTrey) as sealer using the lateral condensation technique (Fig 3). Subsequently, the fractured surface of the salvaged natural clinical crown, including the existing resin composite restoration, was abraded with airborne particles (50 µm aluminum oxide), etched with phosphoric acid (Fig 4), and adhesively luted to the root

Fig 3 *(left)* The new root canal filling.

Fig 4 *(center)* The remaining crown, etched with phosphoric acid.

Fig 5 *(right)* The natural clinical crown immediately before luting.

using a resin composite cement (Panavia TC, Kuraray) (Fig 5). Occlusion and function (vertical overbite, 5 mm) were adjusted to minimize occlusal contacts by the opposing dentition.

Since the patient was uncertain about *(1)* whether further treatment was necessary and *(2)* which procedure would be best both esthetically and in terms of longevity, he decided to approach 4 recognized dental specialists: an endodontist (O. P.), an operative dentist (G. K.), a prosthodontist (G. H.), and a perio-prosthodontist (specialist in reconstructive dentistry, N. U. Z.).

METHOD AND MATERIALS

Each of the 4 clinicians was requested to independently develop and explain his or her personal favorite treatment strategy, based on the best available external evidence and clinical expertise. In conclusion, the entire case was reviewed by a renowned expert in evidence-based medicine (G. A.) and discussed with the first author (who was also the patient).

RESULTS

Treatment choice of the endodontic specialist (O. P.)

The fractured tooth should be built up with a cast post and core and a porcelain-fused-to-metal (PFM) crown.

Search strategy. A spontaneous search was done in PubMed as well as in a personal database containing articles and references relevant to the topic.

Reasons for his choice. Although there is an almost complete loss of the clinical crown, the tooth can be restored in the above-mentioned way with a good prognosis for the following reasons:

1. There is no periapical pathology and periodontal disease.
2. There is enough tooth structure left to create a ferrule 2 mm wide for the final restoration.[5]
3. The root appears to be long enough so that there will not be a compromised crown-root ratio after the restoration.
4. The remaining root structure appears thick enough for insertion of a post and core. Given the conical shape of the root, a tapered post with a remaining apical root canal filling 4 mm long is recommended. In this way, the tooth structure can be saved.[6]

Discussion. Although the modulus of elasticity of flexible posts (eg, quartz-fiber posts) seems to be more suitable to the dentin than a metal post,[7] the long-term survival rate of cast posts and cores is well documented.[8–10] In addition, there are no long-term randomized controlled clinical studies showing the superiority of flexible posts. According to Drummond and Bapna,[11] the fiber posts lose 11% to 24% of their flexural strength with cyclic loading and thermocycling. The treatment would be less expensive than an implant procedure. Additionally, the patient would not need the surgical procedure required with an implant.

Treatment choice of the operative dentist (G. K.)

A tooth-colored, glass-fiber post should be luted with resin cement to improve retention of the attached fragment.

Search strategy. The literature search was done using Medline and the Cochrane Library. Only English and German literature was considered. Furthermore, all available articles on the topics "dental traumatology" and "restoration of endodontically treated teeth" that had been personally collected during the past 6 years were considered.

Reasons for his choice. Since only a minimal adhesive surface for the bonding procedure was available, a detachment of the bonded fragment is quite probable and further treatment might be necessary soon.

Although, according to Andreasen et al,[12] fracture resistance is not related to the fragment size, Spinas[13] reported that reattached fragments affecting more than one third of the crown are less durable. Since the tooth has had root canal treatment, an additional bonding surface can be attained in the root canal.[14,15] To improve retention and resistance against lateral and shearing forces in the anterior region, the use of an adhesively luted post could be an alternative procedure. This is in accordance with generally accepted guidelines for the management of endodontically treated teeth, which consider the insertion of a post inevitable in cases of total absence of coronal dentin.[16,17] Because of their superior biomechanical performance, glass fiber–reinforced composite posts with an elastic modulus similar to that of dentin are preferred.[18] Additionally, they offer better esthetics, are easily retrievable, and they bond to dentin when an appropriate adhesive strategy is used.[16] Most studies agree that their failure mode is more favorable than that with metal posts.[19]

Discussion. Numerous case reports on fragment reattachment have been published, eg, Reis et al,[20] since Chosack and Eidelman[21] first described the procedure in 1964. Recent in vitro studies of fragment reattachment have demonstrated that, irrespective of the bonding procedure, the fracture resistance of sound teeth could not be achieved.[22–24] Fracture strengths between 37% and 60% have been reported with simple reattachment techniques.[20,22,25–30]

However, modifications such as a bevel around the fracture site or an internal groove have been shown to improve fracture strength.[20,24,30] In a multicenter clinical study, a long-term survival analysis of reattached fractured crown segments showed 25% fragment retention after 7.5 years when a dentin bonding system was used.[12] On the other hand, a recent investigation revealed that, after 7 years, all of the reattachments had failed and needed complete replacement.[13]

While much of the literature on reattachment has focused on restoring vital teeth, there is a lack of data supporting the suggested treatment of a root-canal-filled incisor. Only some case reports have described the successful combination of fragment reattachment and root canal posts.[31–33]

Undoubtedly, the conventional approach would be a post-and-core-supported prosthetic restoration. Nonetheless, even if the evidence for the proposed treatment option is very poor, it is a highly noninvasive, esthetic, and cost-effective approach, leaving options open for further, more invasive treatment should this be necessary in the future.

Treatment choice of the prosthodontist (G. H.)

My first-choice treatment in this case may appear, at first glance, somewhat provisional: retain the salvaged "natural" clinical crown as it is and keep it attached to the root. In general, this solution resembles the route already taken during the emergency treatment phase. However, I would suggest one modification at this point because the integrity of the tooth as a whole has been compromised by the horizontal fracture. Hence, the current and any prospective surface available for reattaching the clinical crown to the root is the fracture surface. We must assume that the adhesive and cohesive bond strengths achieved with today's materials are inferior, even under optimal conditions, to the inherent fracture strength of the tooth as a whole, even one with an endodontic access cavity. Furthermore, the available bonding surface (the diameter of the tooth) has been internally reduced by the repeated endodontic procedure.

Therefore, I suggest adding a fiber-reinforced composite endodontic post. This would not be used to reinforce the root but to connect the root to the clinical crown. In this case, I would use an ER Dentinpost (Brasseler) or a DT Light post (VDW). The use of a post would increase the available bonding surface dramatically. In this case, I would prepare the post hole through the original access cavity using a high-speed handpiece and then remove about three-quarters of the length of the root filling with a Peeso reamer, leaving an apical seal of about 4 to 5 mm. The actual shape of the post space would be created with the bur that corresponds with the post to be used.

For cementation of the post, I would use an autopolymerizing resin composite cement, such as Panavia (Kuraray) or RelyX (3M Espe). Pretreatment of the post surface with hydrofluoric acid and a silane should be performed. After etching with phosphoric acid and applying the dentin primer and adhesive, I would cement the post (and potentially the coronal tooth fragment, if it were broken off again). Thereafter, any voids and the access cavity could be closed with a hybrid composite.

Search strategy. "Post and Core Technique"[MeSH] AND (Clinical Trial[ptyp] OR Meta-Analysis[ptyp] OR Randomized Controlled Trial[ptyp]) AND "2001/05/16 09.52"[PDAT] : "2006/05/16 09.52"[PDAT]. *(2)* "Post and Core Technique"[MeSH] AND fiber posts[All Fields] AND "2001/05/16 09.54"[PDAT] : "2006/05/16 09.54"[PDAT]. *(3)* References of the retrieved publications were reviewed, as were a small number of additional references.

Reasons for his choice: A metal post (eg, a titanium post) could potentially be used. Evidence from in vitro studies has shown that a higher resistance to fracture is achieved with metal posts.[34,35] However, most in vitro studies have also demonstrated that the use of metal posts results in unfavorable, mostly catastrophic failure patterns. Deep oblique root fractures have been observed with this type of restoration, and they render any single-rooted tooth nonrestorable.[35] Secondly, in this case we still have the natural clinical crown as the final "restoration," which has retained most of its natural translucency. Therefore, the use of a tooth-colored fiber-reinforced composite post appears to be the treatment of choice to avoid a dark internal discoloration. In the literature, glass- and quartz-fiber posts have been discussed, with slight advantages in fracture resistance for quartz-fiber posts.[36] In most in vitro studies on fiber posts, post fractures have been described as the prevalent mode of failure. This mostly leaves the residual root in a restorable condition.

The adhesive cementation of all posts, including fiber posts, has been suggested. In the present case, the use of an autopolymerizing resin composite cement, such as Panavia or RelyX, is preferable because it increases the retention and fracture load[37,38] and reduces microleakage[39,40] of teeth restored with posts. Pretreatment of the post with either hydrofluoric acid or hydrogen peroxide and the subsequent use of a silane coupling agent has been proposed as beneficial for the bond strength of fiber posts.[41,42] However, since the weak interface is most likely the dentin-composite bond, the use of a silane on the post surface can be considered optional.

Discussion. For metal posts, valid long-term clinical data are available. A 5-year survival of about 93% can be expected with either conventional cast posts and cores or direct restorations using prefabricated posts.[35,43] Smaller-scale trials have even shown the same survival over 10 years.[44]

Unfortunately, no data from long-term observations of fiber posts are available at this point. Over 2 years, a failure rate of 6% to 12% has to be considered.[45–47] Thus, the use of a fiber post in this case is a compromise between clinical data, esthetics, and the expectation of a favorable and restorable fracture in case of failure. Two reviews[35,48] and one recent large clinical trial[43] have also shown that cast posts and cores have no advantages over direct post-and-core restorations. Thus, a direct restoration is the treatment of choice in this case.

The restoration with a crown does not seem necessary at this point. Some studies have shown that post-retained direct restorations have an expected survival that is not statistically different from cases where crowns have been used as the final restoration.[43,49,50] Unfortunately, no such trial has been conducted with anterior teeth only.

A second-line treatment, which could be carried out immediately or after failure of the natural clinical crown, would be to use an all-ceramic or metal-ceramic crown as the final restoration. The post-and-core reconstruction could be completed as described above. The core could be built up using a hybrid composite. The clinical situation appears to allow for the preparation of a 1- to 2-mm-wide ferrule below the tooth-core line.[5,51] The magnitude of the required ferrule appears to be valid for fiber posts as well.[36]

Treatment choice of the perio-prosthodontist (N. U. Z.)

A PFM crown with either a fiber-reinforced resin post and direct composite buildup or a cast post and core is recommended.

Search strategy. The references referred to were obtained from several searches in Pubmed (different key word combinations including "post and core technique," "crowns," "dental abutments," "composite resins," "zirconium," "dental restoration failure," "tooth fractures," "treatment outcome," "materials testing," "color," etc). The reference lists of the relevant articles were also examined for pertinent literature.

Reasons for her choice/Discussion. The treatment recommendation was based on the following considerations:

1. Is the tooth maintainable, and are any therapeutic efforts reasonable?

Clinical parameters. Endodontic re-treatment was successful, and no apical radiolucency was observed in the radiograph. No loss of periodontal attachment is evident. The adjacent teeth require no additional treatment and have no color problems. Because of the fracture of the clinical crown and after removal of decay, very little coronal tooth substance is left. Crown lengthening can be considered and would entail a change in the gingival level, which is not acceptable in the present case for esthetic reasons. Alternatively, orthodontic extrusion could be performed to increase the clinical crown height, but would require lifetime palatal retention and is not favored by the patient. Although no parafunctional habits were recorded, the restored tooth will be exposed to substantial functional stress with limited interocclusal space in a deep-bite situation.

Patient-related factors. The patient wants to keep the tooth if at all possible and would even accept an increased risk of failure due to a limited long-term prognosis as a result of reduced coronal tooth substance. Treatment costs are not a factor in this situation.

2. Is a noninvasive procedure such as reattachment of the fractured segment feasible, or is a full-coverage crown restoration required to replace the missing tooth structure?

The amount of fractured tooth substance comprises the main coronal part of the endodontically treated tooth and is associated with a further increase in crown flexibility.[52] It is, therefore, assumed that reattachment of the fragment would run a high risk of recurrent fracture and/or of bacterial reinfection due to marginal leakage in the long term. Therefore, a full-coverage coronal restoration is indicated in this particular situation.

3. Is the residual coronal tooth substance adequate for the retention of a crown restoration, ie, 3- to 4-mm abutment height,[53] and/or is the tooth substance sufficient for retaining a direct resin composite buildup?

More than 50% of the coronal tooth structure has been lost, with a residual height of 1 to 2 mm supragingivally. Thin dentin walls may be expected following circular preparation. Hence, a post is required for retention of a core that can be used to retain the definitive restoration.[54,55]

4. Is a direct or an indirect post-and-core technique preferable?

The main advantage of direct posts and cores using resin composite materials for the buildup is that thin dentin walls can be maintained, and undercuts can be used for additional retention.[55,56] In vitro and clinical studies have indicated that the usage of fiber-reinforced resin post systems is successful and is associated with a lower incidence of root fractures than with direct metal posts, cast posts and cores, or zirconium oxide posts.[57–59] Contradictory results, however, have been reported as to the fracture resistance of fiber post systems, which was found to be above[60–62] or below that of metal or zirconium oxide posts.[59,63] These differences are related to the different physical properties of the reinforcing fiber material, where carbon and quartz fiber are more resistant than woven-fiber materials.[55,64]

Because of the deep-bite situation with very little interocclusal space available, the amount of the buildup material will be very limited on the palatal aspect. In this situation, an indirect laboratory technique may be preferable becaue of the improved bonding between the post and the cast-on/pressed-on buildup. This assumption is based on the results of in vitro studies showing that core failures occur more frequently with titanium posts and direct composite buildups than with cast posts and cores[59] or zirconia posts and pressed-on cores.[35,65,66]

In the current situation, the thin dentin edges have to be rounded off to provide a sufficient horizontal basis for an indirect post and core, but no major preparation entailing additional loss of tooth substance is required. Adequate evaluation of the dentin walls, however, is not feasible before the circular preparation for a crown has been performed. Depending on the resulting dentin thickness after this circular preparation, the decision will have to be made as to whether a direct or indirect post-and-core system would be most appropriate.

5. Is a light-conducting, nonmetal post system (ie, fiber-reinforced resin or zirconium oxide post) preferable to a metal post to improve esthetics?

In particular, when all-ceramic restorations are planned, light transmission may be impeded by metallic posts, and the use of a tooth-colored post system is a consideration.[67,68] According to in vitro measurements of light transmission, it has, however, been shown that even gold posts and cores (polished) can be used in combination with all-ceramic crown systems.[69] In the marginal gingiva, a grayish appearance may result from a metal post irrespective of the crown material applied, but this aspect should not influence the post selection in the present case because of the relatively thick soft tissue morphology, which, moreover, is not exposed during smiling.

6. Is a conventional PFM crown or an all-ceramic crown preferable in the current situation?

Several studies have clearly shown that a dentin ferrule, ie, a metal band or ring fitting the root or crown of a tooth,[70] of 1.5 to 2 mm is required for adequate fracture resistance in teeth restored with cast post-cores.[5,71–73] Reduced resistance was found in teeth with a nonuniform ferrule (varying between 0.5 and 2 mm), while the lowest values were provided by a cast post-core without a ferrule.[74]

A similar relation between ferrule length and fracture resistance was observed when fiber-reinforced and zirconia posts were used and restored with metal crowns. While an increase from a 1- to 1.5-mm ferrule had no effect, the 2-mm dentin height facilitated higher failure loads.[62] It is, however, questionable whether the stabilizing effect from the metal embracing the dentin is similarly provided by an all-ceramic crown. No references in the literature were found addressing this issue in a comparative study design. One reference was identified in which the use of a 2-mm circumferential ferrule was compared to that of an incomplete crown ferrule when

Table 1 **Literature selected by the 4 experts**

Citation	Clinical experts	Type of study							
		SR	RCT	CCT	UCT	CR	RS	NR	IVS
5	OP, GH, NZ								X
6	OP							X	
7	OP								X
8	OP						X		
9	OP						X		
10	OP				X				
11	OP								X
12	GK			X					
13	GK			X					
14	GK							X	
15	GK					X			
16	GK							X	
17	GK							X	
18	GK								X
19	GK							X	
20	GK							X	
21	GK					X			
22	GK								X
23	GK								X
24	GK								X
25	GK							X	
26	GK								X
27	GK								X
28	GK								X
29	GK								X
30	GK								X
31	GK							X	
32	GK					X			
33	GK					X			
34	GH								X
35	GH, NZ								X
36	GH								X
37	GH								X
38	GH								X
39	GH								X
40	GH								X

glass-fiber-reinforced posts were used together with resin composite cores and adhesively cemented all-ceramic crowns.[75] The highest fracture resistance was observed when the 2-mm ferrule was present only on the facial aspect, while lower values were found for the circumferential ferrule and the mesially and distally interrupted ferrule.[75] The great variety in load resistance observed in this study may indicate that the embracing of dentin with all-ceramic crowns does not entail the same reinforcement, and a comparative study where metal and all-ceramic restorations are included is required.

In the present case, the dentin ferrule will vary between 1 and 2 mm. The interocclusal space palatally is very limited and the functional contacts during anterior guidance cannot be entirely eliminated due to the deep-bite situation.

These factors indicate a PFM *(1)* with a metal stop on the palatal required in areas with less than 1-mm intermaxillary clearance and *(2)* with a circumferential ceramic margin for esthetic reasons, but without vertical reduction of the metal framework to best facilitate the ferrule effect.

Table 1 **Literature selected by the 4 experts (continued)**

		Type of study							
Citation	Clinical experts	SR	RCT	CCT	UCT	CR	RS	NR	IVS
41	GH								X
42	GH								X
43	GH				X				
44	GH		X						
45	GH				X				
46	GH		X						
47	GH			X					
48	GH	X							
49	GH		X						
50	GH		X						
51	GH								X
52	NZ								X
53	NZ								X
54	NZ							X	
55	NZ							X	
56	NZ							X	
57	NZ						X		
58	NZ						X		
59	NZ								X
60	NZ								X
61	NZ								X
62	NZ								X
63	NZ								X
64	NZ								X
65	NZ								X
66	NZ								X
67	NZ							X	
68	NZ						X		
69	NZ								X
70	NZ							X	
71	NZ								X
72	NZ								X
73	NZ								X
74	NZ								X
75	NZ								X
Total		1	4	3	3	4	5	13	38

(OP) Oliver Pontius; (GK) Gabriel Krastl; (GH) Guido Heydecke; (NZ) Nicola Zitzmann; (SR) systematic review; (RCT) randomized controlled trial; (CCT) nonrandomized controlled clinical trial; (UCT) uncontrolled clinical trial; (CR) case report; (RS) retrospective study; (NR) narrative review; (IVS) in vitro study.

DISCUSSION

First of all, the way each of the 4 experts relied on different articles for justifying their clinical decisions is striking. The overlap in the literature they used was minimal: Of the 73 citations, only 2[5,35] were chosen by more than one expert (Table 1). This may explain the different treatment suggestions for the presented case: While the endodontist preferred a metal post and core and a PFM crown, which was also a favorite choice of the perio-prosthodontist, both the operative dentist and the prosthodontist opted for a glass-fiber post/fiber-reinforced composite post. All 4 clinicians presented arguments against choosing the alternative post. The proposal of the perio-prosthodontist was similar to that of the endodontist, since both recommended a PFM crown. Hence, this paper clearly shows that, although it is now common practice in dentistry to base clinical decision making on external evidence from the literature, there is still little consensus about the best search strategies and resulting clinical recommendations.

An analysis of the literature cited revealed that, of the 71 different references given by the 4 experts, 38 refer to in vivo investigations and 13 to narrative reviews. Conversely, only 5 articles represent high-level evidence (1 systematic review[48]; 4 articles[44,46,49,50] about randomized controlled trials), while 6 additional publications[10,12,13,43,45,47] report the results of nonrandomized clinical trials, half of which were uncontrolled[10,43,45] (see Table 1). Thus, there seems to be only limited high-quality information available about what would be the best therapy for horizontal fractures of root-canal-treated anterior teeth.

The striking lack of overlap in the literature cited by the 4 experts may seem surprising. It could even cast some doubt on the literature used to support the decisions described above. However, only the degree of diversity of the citations is remarkable, not the observation that a discrepancy among the cited articles exists. Indeed, the widely observed variability of treatment decisions even under apparently similar or equal conditions has been one of the motivations for the development of the concepts of evidence-based medicine.[76–78] The variations in health care practice and quality have been empirically observed for several decades.[79] Nevertheless, the reasons for this variation are still not well understood. Unwarranted variations are unavoidable in situations with considerable scientific uncertainty. However, this explanation is not quite adequate because differences between experts' recommendations can also be observed under apparently similar conditions.

It is usually argued that the reason for the variability in diagnostic and therapeutic decisions lies in the individuality of each patient, which has to be taken into account by the clinicians. This argument does not apply in this example because the patient in question was the same for all 4 clinicians. Two explanations seem possible.

First, the specialists were trained in their different fields and gained their clinical experience in the context of their specialties. The different scientific backgrounds and treatment philosophies in the different specialities, as well as the general culture and discussions with colleagues, are the reasons for the different literature selections. The impact of medical (and dental) specialties on treatment decisions is particularly strong in situations where qualitatively different treatment strategies can be chosen, such as in cancer treatments.[80]

Second, the large discrepancy between the citations indicates the lack of strong evidence in favor of one of the treatment options. Ideally, there would be comparative trials or even systematic reviews to support the decision in favor of a particular treatment. The apparent lack of such clear evidence leads to uncertainty in decision making.

Unwarranted practice variations are a challenge to optimal treatment decisions for the individual patient and for all health care systems. Therefore, this issue has been addressed in many countries in an effort to reduce unnecessary variation and to improve health care quality.[81] The complex interrelationships among the individual decision processes of physicians and patients, patients' preferences, and the conditions provided by the different health care systems do not allow simple solutions. This article is intended as a contribution to finding solutions in this area. It is in the interests of both professionals and patients to strive to reduce substantially unwarranted and potentially harmful variation in health care.[81] Dentistry faces here the same problems as medicine and can also help to reduce this unwanted and quality-impeding variability.

In the present case, the patient considered the different treatment recommendations and decided to leave the maxillary right lateral incisor unchanged and to wait until the fragment retention fails. The advantage of his choice is that, after reattachment of the broken crown, the morphology and esthetics of the tooth remain exactly the same as before the fracture. However, the patient's decision has a functional implication: Immediately after the tooth fragment was adhesively luted to the root, he purposefully began to avoid biting with that tooth. Anticipating the possible consequences of exerting too heavy a load on the tooth, he modified his oral behavior in order not to load all anterior teeth but only those on the left side of his mouth during biting, with the maxillary right central incisor and its antagonists serving as a "spatial buffer." This is an example of how cognitive processes based on previous experience (from similar cases reported by his own patients), expert knowledge about biting forces and the physical properties of the chosen resin composite cement, and common sense may influence motor behavior to prevent unfavorable consequences.[82]

Still, despite the change in mandibular functioning, it is likely that sooner or later the tooth will refracture. If the fracture is favorable and restorable, the patient would like to follow the recommendations made by the operative dentist and the prosthodontist (reattachment of the natural clinical crown to the root using a fiber-reinforced composite post and a resin composite cement), unless new evidence becomes available in the meantime pointing to a more successful treatment alternative.

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