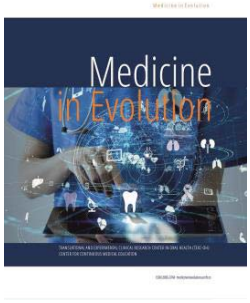
Coronary reconstruction after endodontic treatment



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Abstract

Endodontic treatments, known as root canals, are essential for saving teeth severely damaged by deep decay or infection by removing infected pulp and cleaning the root canal system. This process prevents the spread of infection and eliminates pain, allowing the natural tooth to be preserved. After root canal treatment is completed, the tooth becomes more fragile and vulnerable to fracture, making crown reconstruction crucial. A simple endodontic treatment, which only involves cleaning and sealing the root canals without subsequent coronal reconstruction, has a success rate of about 85-93% over a period of 2-3 years. Coronal reconstruction involves restoring the structure of the tooth using materials such as dental crowns, which cover and protect the tooth, restoring its functionality and aesthetics. Together, endodontic treatments and crown reconstruction provide a complete solution for preserving the health and integrity of affected teeth.

Keywords: endodontic treatment, success rate, coronary reconstruction

INTRODUCTION

Endodontic treatments, also known as root canals, are procedures used to remove the infection from inside the tooth and save the natural tooth, preventing the need for extraction. After endodontic treatment, crown reconstruction is essential to restore the structure and functionality of the tooth, using materials such as dental crowns or other restorations to protect and strengthen the treated tooth.

Comparing the success rates of simple endodontic treatments with those followed by a coronary reconstruction shows significant differences, depending on the protection offered to the treated tooth and the prevention of future complications [1].

A simple endodontic treatment, which only involves cleaning and sealing the root canals without subsequent coronal reconstruction, has a success rate of about 85-93% over a period of 2-3 years, according to clinical studies. The main risks associated with endodontic treatments unaccompanied by coronal reconstruction are tooth fractures and canal re-infection, due to weakened tooth structure exposed to external factors [2].

When endodontic treatment is followed by an appropriate coronal reconstruction, for example by using a dental crown, the success rate increases significantly, reaching approximately 95-98% over a similar period. Coronary reconstruction provides additional protection by preventing fractures and ensuring a good seal against microbes, thus reducing the risk of re-infection. Studies have shown that teeth treated endodontically and protected with a crown are much more likely to remain functional in the long term [3,4].

Thus, endodontic treatments followed by a coronary reconstruction offer a significantly higher success rate compared to simple endodontic treatments. Coronal reconstruction protects the fragile structure of the treated tooth and prevents complications, thus contributing to its longevity and functionality [5,6].

Purpose and objectives

The aim of the present study is to highlight the methods of reconstruction using endodontic treatments through various adjacent dental restoration elements such as inlay elements, dental crowns and replacement crowns represented by coronary root devices.

MATERIAL AND METHODS

To examine and evaluate different types of reconstructions at the level of devital teeth, 196 patients were entered into the study. Each participant was asked to consent to participate in the study of patients who were endodontically treated and prosthetically restored, in a dental clinic in Timişoara, between November 2022 and April 2024.

The protocol began with a specialist consultation, a well-established treatment plan analyzed on the basis of a dental radiograph and with the informed consent of the patient on the entire treatment plan. Therefore, after a prior, objective consultation, the necessary endodontic treatments and fillings were performed using the lateral condensation technique. Then followed the verification of the treatments through a control radiograph, and then each endodontically obturated tooth was coronally restored.

The parameters followed in this study were the type of tooth treated, the type of endodontic treatment performed (per primam/endodontic retreatment), reinforcement or not, with glass fiber pivot, the type of reconstruction, the presence or not of a failure after the completion of the reconstruction.

Regarding the types of coronal reconstructions performed on these devitalized teeth, they were: direct reconstruction with composite resins; composite resin or ceramic inlay;

composite resin or ceramic overlay; covering crown made of composite resins, metal-ceramic or all-ceramic; indirect veneer and fixed partial denture.

The cases were kept under observation, following the appearance of changes at their level over time. To observe the events that occurred, from cementation to the moment of the end of the study, the patients' files were analyzed, in which the status of the reconstructions was recorded at the periodic sanitation visits, through clinical and radiological examinations. At the end of the study, the collected data were organized and then highlighted by graphs to better highlight the follow-up aspects.

At the level of the studied group, we registered a total of 566 non-vital teeth on which endodontic treatments were applied per primam or retreatments. We present in Fig. 1 and 2 the distribution of non-vital teeth at the level of the upper and lower arches and in figures 3 and 4 the percentages of treatments per primam respectively of retreatments performed.

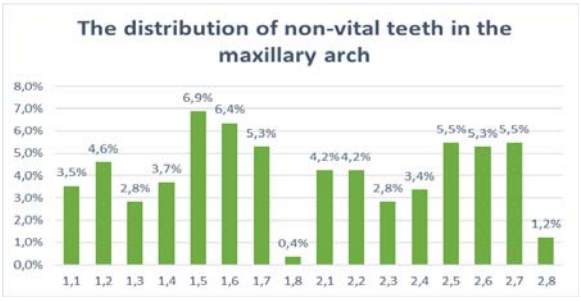

Figure 1. The frequency of the presence of non-vital teeth in the maxillary arch

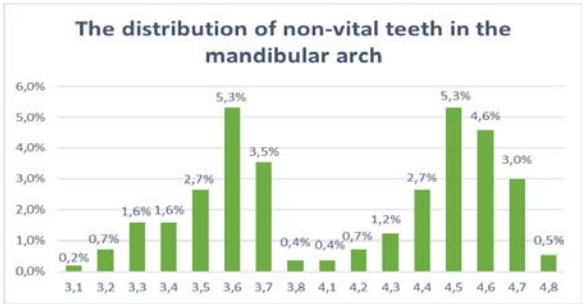

Figure 2. The frequency of the presence of non-vital teeth in the mandibular arch

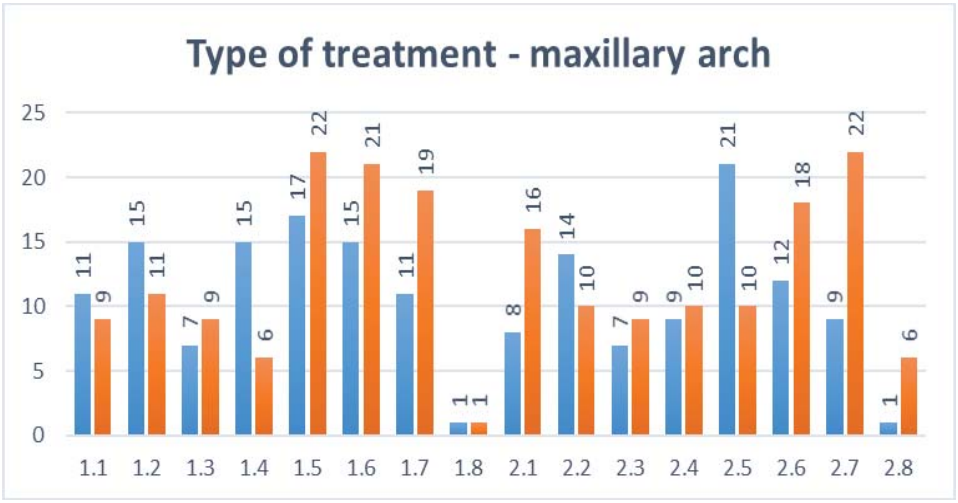

Figure 3. Distribution of treatments per primam ■ versus retreatments ■- maxillary arch

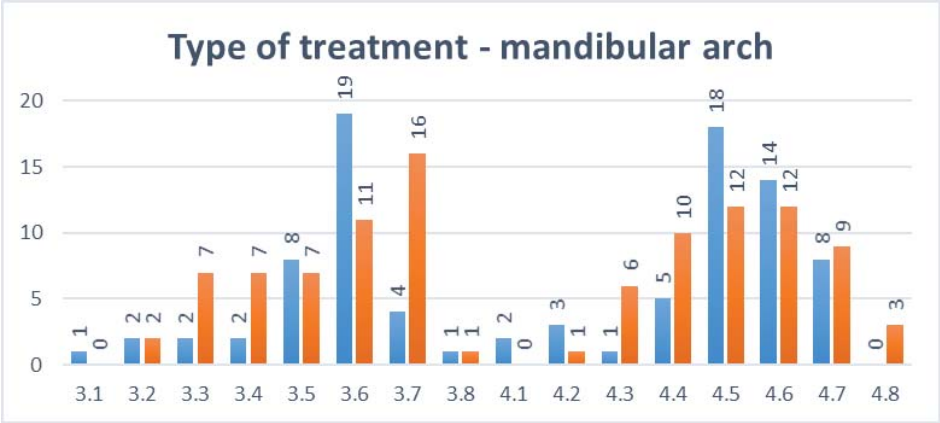

Figure 4. Distribution of treatments per primam ■ versus retreatments ■ - mandibular arch

Analyzing the data from the graphs above, we can see that most situations related to endodontic treatments were registered at the level of the lateral teeth (413 out of 566; 73%) and among them, the 2nd premolars and 1st molars have a high predisposition to endodontic treatment (237 teeth; 42% of total teeth and 57% of lateral teeth). At the same time, of the 566 treated teeth included in the study, 263 (46.5%) represent retreatments and 303 treatments per primam (53.5%).

In Figure 5 we present a distribution of the reinforcement types chosen for each tooth. For 469 teeth (82.9%) the doctor opted for reinforcement with a pivot, for 6 situations it was decided to use a DCR made in the dental laboratory and for 91 of the cases (16.1%) it was considered that reinforcement is not necessary.

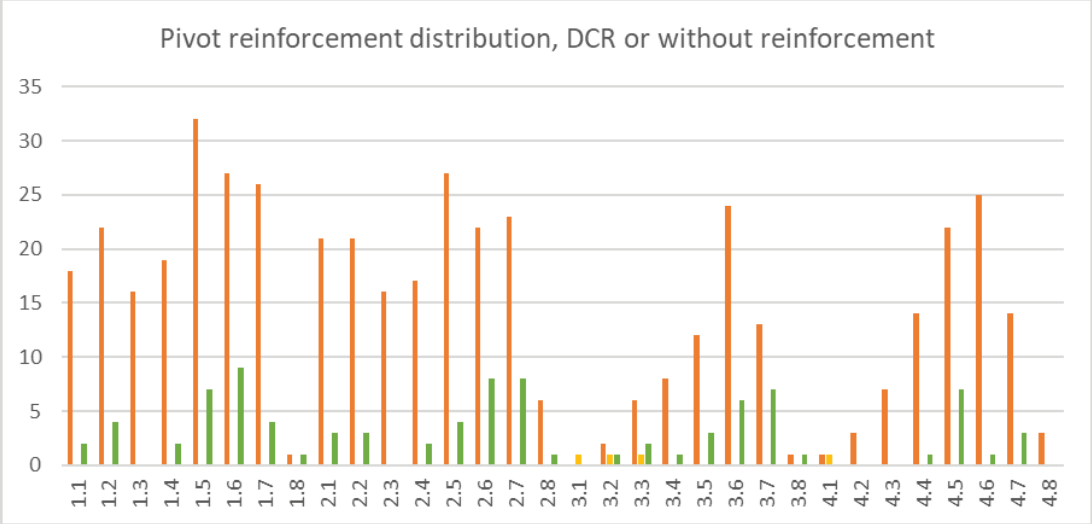

Figure 5. Pivot reinforcement distribution ■, DCR reinforcement ■ or without reinforcement ■

After the endodontic treatment, 427 of the treated teeth were chosen for coronal reconstruction and 139 for direct reconstruction. I summarized in table no. 1 the types of reconstruction chosen by doctors as well as the failure rates measured at intervals of 6 months, 1 year and 2 years respectively after the treatment.

Table 1. Distribution of failure rates of endodontic treatments between direct and coronary reconstruction

	Direct reconstruction			Coronary reconstruction			Total cases		
	Per primam	Retreat-ment	Total	Per primam	Retreat-ment	Total	Per primam	Retreat-ment	Total
Number of cases	81	58	139	222	205	427	303	263	566
6-month failure	2	1	3	0	0	0	2	1	3
	2,47%	1,72%	2,16%	-	-	-	0,66%	0,38%	0,53%
1 year failure	2	1	3	2	1	3	4	3	7
	2,47%	1,72%	2,16%	0,90%	0,49%	0,70%	1,32%	1,14%	1,24%
2 years failure	1	1	1	4	2	6	5	2	7
	1,23%	1,72%	1,44%	1,80%	0,98%	1,41%	1,65%	0,76%	1,24%
Failure - total	5	3	8	6	3	9	11	6	17
	6,17%	5,17%	5,76%	2,70%	1,46%	2,11%	3,63%	2,28%	3,00%

Analyzing the data obtained, we can state that the direct reconstruction of the endodontically treated tooth has a failure rate of more than 2.5 times higher compared to an endodontic treatment followed by a coronal reconstruction. Also, in situations of retreatment of the tooth, the failure rate of a direct reconstruction is even 3.5 times higher than that of the coronal reconstruction. Another conclusion that can be drawn from the measurements made is that using the coronal reconstruction the failure of the endodontic treatment is significantly delayed, of the 2.11% cases of failure none were registered in the first 6 months and only 0.7% in the first year after endodontic treatment. We present in the graph in figure 6 the evolution of failure rates over time.

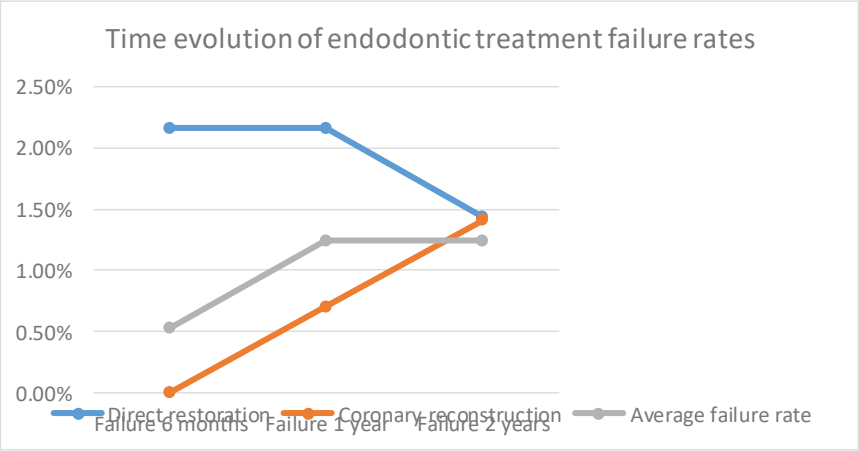

Figure 6. Time evolution of endodontic treatment failure rates

From the total number of 427 cases for which the coronal reconstruction of the endodontically treated tooth was chosen, inlay/onlay/overlay was chosen for 64 of the cases, for 174 the coronal restoration took the form of a composite or ceramic construction on a metal support, for 2 cases opted for a temporary skin-type reconstruction and 187 of the patients received an all-ceramic or zirconium-supported reconstruction. We present in the graph in figure 7 the percentages of the coronary reconstruction variants adopted.

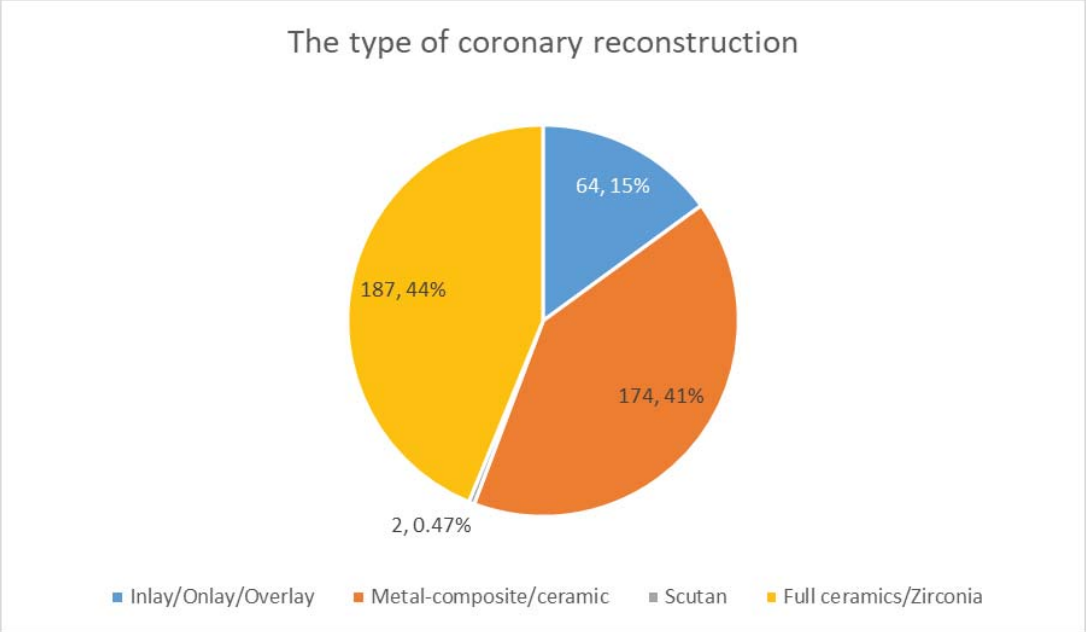

Figure 7. The type of coronary reconstruction opted for

In table no. 2 we present a distribution of the failure rates of endodontic treatments recorded according to the type of coronary reconstruction chosen, followed over time at intervals of 6 months, 1 year and 2 years respectively. It should be noted that the inlay, onlay or overlay reconstructions had a 0% failure rate and the SCUTAN ones, even if they were used less, a 100% failure rate 2 years after implementation. It can also be observed that all-ceramic or zirconium crown restorations have a much higher success rate than metal-ceramic ones, mainly due to a much more precise closure at the level of the tooth.

Table 2. Distribution of failure rates of endodontic treatments among different types of coronary reconstruction

	Inlay/Onlay / Overlay			**Metal-composite/ceramic**			**Full ceramic**			**Scutan**			**Total cases**		
	Per primam	Retreatment	Total	Per primam	Retreatment	Total	Per primam	Retreatment	Total	Per primam	Retreatment	Total	Per primam	Retreatment	Total
Number of cases	42	22	64	84	90	174	88	99	187	2	0	2	222	205	427
6-month failure	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1 year failure	-	-	-	1	1	2	-	-	-	1	0	1	2	1	3
	-	-	-	1,19%	1,11%	1,15%	-	-	-	50%	-	50%	0,90%	0,49%	0,70%
2 years failure	-	-	-	3	2	5	1	-	-	1	-	1	4	2	6
	-	-	-	3,57%	2,22%	2,87%	1,14%	-	-	50%	-	50%	1,80%	0,98%	1,41%
Failure - total	-	-	-	4	3	7	1	-	-	2	-	2	6	3	9
	-	-	-	4,76%	3,33%	4,02%	1,14%	-	-	100%	-	100%	2,70%	1,46%	2,11%

RESULTS

After carrying out this study, we were able to observe the fact that most of the situations related to endodontic treatments were registered at the level of the lateral teeth (413 out of 566; 73%) and of these the 2nd premolars and 1st molars have the largest share (237

teeth; 42% of total teeth and 57% of lateral teeth). Of the 566 treated teeth, 263 (46.5%) represent retreatments and 303 per primam treatments (53.5%), which underlines the fact that most endodontic treatments have a high success rate, even if to strengthen this conclusion, more research or even repetition of the present study is needed.

For 469 teeth (82.9%) the doctor opted for reinforcement with a pivot directly in the dental office, for only 6 cases it was decided to use a DCR made in the dental laboratory and for 91 of the cases (16.1%) it was considered that no reinforcement is required. We believe that the reinforcement of devital teeth with pivots is of increased importance, in order to restore their strength lost following endodontic treatment.

After the endodontic treatment, for 427 (75.44%) of the treated teeth, coronal reconstruction was chosen and only for 139, direct reconstruction was chosen. Due to the evolution of science and technology, in the last decade a multitude of techniques, materials and medical equipment have appeared, which makes the reconstruction of devital teeth an essential and common operation in dental practice, almost all patients resorting to it, thanks to the various solutions to who can opt to solve their problems.

Based on the analyzed data, it can be stated that the direct reconstruction of an endodontically treated tooth has a probability of failure more than 2.5 times higher compared to endodontic treatment followed by a coronal reconstruction. In retreatment scenarios, the failure rate for direct reconstructions is as much as 3.5 times higher than for coronary reconstructions. Data also suggest that the use of coronal reconstruction considerably delays endodontic treatment failure; of the 2.11% failure cases observed, none occurred within the first 6 months, and only 0.7% were reported within the first year after endodontic treatment.

If we have sufficient dental structure, which is also healthy, we prefer reconstruction by means of inlays, onlays or overlays, based on the principle of minimally invasive dentistry, the failure rate in their case being 0% in the range analyzed. At the same time, modern materials such as full-ceramic or zirconium crowns are preferable to metal-ceramic or metal-composite ones, having a much higher success rate. Regardless of the type of coronal reconstruction chosen, it is a much better option to cover the endodontically treated tooth than that of the direct restoration.

DISCUSSIONS

Coronal reconstruction after endodontic treatment is a critical aspect in dentistry, directly influencing the long-term success and functionality of the treated tooth. There are several important discussions in the literature and in clinical practice regarding this procedure, including materials used, timing of reconstruction, and application techniques.

After an endodontic treatment, the tooth becomes more fragile due to the loss of natural tooth structure and dehydration. Coronal reconstruction provides structural support, preventing fractures that are common in untreated teeth afterward. An adequate coronal reconstruction completely seals the root canal, preventing the entry of bacteria and other pathogens, which can lead to endodontic treatment failure through reinfection [7].

Dental crowns are considered the "gold standard" for post-endodontic protection, providing complete coverage of the tooth and distributing bite forces evenly. Materials used may include ceramic, porcelain fused to metal, and all-ceramic crowns, each with advantages and disadvantages in terms of aesthetics and durability [8].

For cases where the structural loss is not that severe, these partial restorations may be enough to restore function and protect the tooth. Composites are frequently used for temporary coronal reconstructions or in cases where extensive protection is not required and are preferred due to their superior esthetics [9,10].

Some studies suggest that coronary reconstruction should be performed as soon as possible after endodontic treatment to reduce the risk of fracture and reinfection. The ideal recommended time is generally a few days to a few weeks after endodontic treatment is completed. Other approaches allow for a delay if there are signs of complications, such as persistent pain or infection. These cases may require further monitoring before definitive reconstruction [11,12].

Posterior teeth (molars) are subjected to greater occlusal forces, requiring additional protection, usually by full crowns. The anterior teeth, being more visible and under lower forces, may require more aesthetic and conservative restorations. Teeth with extensive loss of tooth structure are more susceptible to fracture and would benefit from crowns or onlays. Teeth with minimal loss can be reconstructed with composites. The presence of other dental or periodontal conditions may influence the decision to reconstruct. For example, in patients with active periodontal disease, it may be necessary to manage this condition before coronary reconstruction [13].

In teeth with massive loss of tooth structure, the use of posts can provide additional support for crowns. However, there is debate about their necessity and the risk of root fracture associated with their excessive use. The choice of canal obturation materials and how they interact with coronary restorative materials is an evolving topic, with research continuing to evaluate the biocompatibility and durability of various combinations [14].

Coronal reconstruction after endodontic treatment is essential for the long-term success of the treatment. The choice of appropriate materials and techniques must be based on the individual assessment of each case, considering the protection of the tooth structure, the prevention of reinfection and the restoration of function and aesthetics. Continued discussions and research in this area help to refine and improve treatment protocols, thus ensuring the best possible care for patients [15].

CONCLUSIONS

Coronal reconstruction after endodontic treatment offers numerous benefits that contribute to the long-term success of the treated tooth. First, it provides structural support and additional protection to the endodontically treated tooth, preventing fractures and further damage. This is especially important because teeth become more fragile and more susceptible to fracture after the loss of the pulp and a significant part of the tooth structure.

Coronal reconstruction completely seals the tooth and prevents bacteria and other pathogens from entering the treated root canal. Thus, the risk of reinfection is reduced, and the long-term prognosis of endodontic treatment is improved. Also, through coronal reconstruction, the tooth regains its normal functionality in chewing and speaking, allowing the patient to use the tooth effectively and without discomfort. This contributes to maintaining a balanced occlusion and preventing functional problems in the temporomandibular joint.

The dental crown restores the natural appearance of the tooth, providing a satisfactory aesthetic result. This is important not only for the patient's psychological comfort, but also for ensuring the integrity of the smile and facial expression.

Studies show that teeth treated endodontically and protected with adequate crown reconstruction have a significantly higher survival rate compared to untreated ones. Coronal reconstruction is essential in treatment planning and to ensure long-term clinical, functional and esthetic success, providing fracture protection, preventing reinfection and restoring tooth function and aesthetics.

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