

CLINICAL SCIENCE

Survival of teeth treated with cast post and cores: A retrospective analysis over an observation period of up to 19.5 years



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A cast post and core has been a widely used technique in dentistry to restore a severely damaged tooth. For a long time, the belief was that posts inserted into root canals helped stabilize these teeth.¹ This belief has been proven wrong. Several studies have stated that endodontic posts lead to a weakening of the dental root and to an increased risk of root fractures.^{2,3} In contrast, many patients present with severely damaged teeth that need to be restored. Often, the tooth destruction extends subgingivally and an adequately dry environment for an adhesive foundation cannot be guaranteed. The conventional cementation of a cast metal post and core is more moisture tolerant and therefore less technique sensitive than adhesive bonding.⁴ In these situations, the clinician has to judge whether the weakening of the root is a tolerable risk compared to

ABSTRACT

Statement of Problem. Scientific data about the long-term survival of teeth treated with cast post and cores are scarce. Retrospective studies often use different target events for their analyses. A comparison is therefore complicated. For associated tooth-, jaw-, and patient-related factors little evidence exists as to their effect on survival.

Purpose. The purpose of this study was to extend the knowledge on the survival of teeth treated with cast post and cores for observation periods of more than 10 years. A decrease or increase in survival times according to the presence or absence of associated parameters needs to be evaluated.

Material and Methods. A retrospective evaluation was conducted of all cast post and cores inserted in 1 university clinic between January 1992 and June 2011. A Kaplan-Meier survival analysis was carried out by using extraction as the target event. The survival curves for different tooth types, the presence or absence of adjacent teeth, and the prosthetic restoration of the respective jaws were compared by using the log-rank test ($\alpha=0.05$). A Cox regression model was calculated for multivariate analyses.

Results. A total of 717 cast post and cores for 343 patients were recorded. The mean survival time was 13.5 years. A statistically significant decrease in survival times was found for canines (11.9 years) and premolars (13.4 years) versus molars (14.1 years), no adjacent teeth (10.6 years) versus at least 1 adjacent tooth (13.8 years), and the restoration with removable dental prostheses (12.5 years) versus fixed dental prostheses and single crowns (13.9 years). The largest reduction in survival time was found for teeth being used as an abutment for a double crown-retained removable partial dental prosthesis (telescopic denture) (9.8 years). Tooth type and adjacent tooth status remained as significant variables within the multivariate Cox regression model.

Conclusions. Cast post and cores have an acceptable long-term survival time. Because different factors may influence survival, considering these factors in treatment planning may increase the long-term success of these restorations. (J Prosthet Dent 2015;114:40-45)

alternative treatment options, such as tooth extraction. To make this decision, the clinician requires data about

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Clinical Implications

Cast post and cores provide an acceptable mean survival time and are still a treatment option for a severely damaged tooth that might otherwise have to be extracted. The prognosis of cast post and core-treated teeth seems to be reduced if involved in a removable partial dental prosthesis or used as an abutment tooth for a double crown removable partial dental prosthesis. The absence of any adjacent teeth also seems to reduce the prognosis for a cast post and core-treated tooth.

the influence of a cast post and core on tooth prognosis. Additionally, the influence of factors such as tooth type or prosthetic restoration has to be considered.

Few prospective clinical studies on the long-term survival of cast post and cores have been published, and very few studies with a high number of participants are available.⁵⁻⁷ The studies that do exist compared the performance of cast posts and cores and other foundation techniques with and without posts and agree in finding no statistically significant difference among these different kinds of restorations. Similar results have been reported in several studies evaluating similar foundation techniques but smaller numbers of participants and shorter periods of observation.⁸⁻¹⁰

Retrospective clinical studies on the long-term survival of cast post and cores are also scarce. However, more retrospective than prospective studies have been reported with larger numbers of participants and longer periods of observation.¹¹⁻¹⁵ The results are inconsistent. Some studies concluded that cast post and cores demonstrated poorer performance¹⁴ than other kinds of post-retained foundations.^{16,17} The survival rates of cast post and cores were found to be similar to those of adhesive composite resin foundations without a post.¹⁸ Long-term survival rates of 83% after 10 years,¹⁷ 90% after 9 years,¹⁸ and 89% after 7 years¹¹ have been reported. Some of these studies described associated factors that might influence the survival rates. These factors included the metal alloy used,¹¹ the kind of restored tooth, and the kind of prosthetic restoration.¹⁵

Data are lacking on the survival of cast post and core-treated teeth observed for more than 10 years. Additionally, most of the studies dealt with different complications as a target event. Survival rates have been reported on the restoration level, not on the tooth level. The purpose of this study was to describe survival rates on the tooth level. Associated clinical factors with potential influence on these survival rates require evaluation for correlations.

Table 1. Recorded parameters for each cast post and core restoration

Parameter	Category
Tooth type	Tooth number according to FDI-classification
Patient number	Number
Date of insertion	Date (dd.mm.yyyy)
Complication occurred (extraction)	Yes
	No
Date of extraction (if present)	Date (dd.mm.yyyy)
Date of last oral exam with tooth still present	Date (dd.mm.yyyy)
Existence of adjacent teeth	Both
	Only anterior
	Only posterior
	None
Type of prosthetic restoration in the same jaw	Fixed dental prostheses (including single crowns)
	Removable dental prostheses
Use as an abutment for a double crown- retained partial dental prosthesis	Yes
	No

FDI, World Dental Federation.

MATERIAL AND METHODS

This retrospective study was based on the treatment data of patients with prosthetic needs for the time between January 1992 and June 2011. The data were collected by using the digital treatment documentation system (Dentware; Dentware Computer GmbH).

All treatment reported in this database was carried out at the Universitäts Zahn Medizin (dental clinic of the university hospital) in Dresden, Germany, and was done by predoctoral dental students or licensed dentists. The study design was approved by the responsible ethics committee (EK 335092011). In order to detect all cast post and core treatments, a search was carried out in the database for the respective treatment codes. For each instance, the respective patient and the respective tooth were documented. By using the data as a basis, a number of parameters associated with the respective tooth were searched for within the database and recorded. These parameters and the type of recording the respective documented categories are listed in Table 1.

After data collection, the sample was characterized with descriptive statistical measures. To evaluate survival, the data underwent a Kaplan-Meier survival analysis as in other comparable studies.^{6,12,13} The extraction criteria was used as the target event. The start of the observation period was determined by the date of placement. If the target event occurred, the end of the observation period was determined by the date of extraction. If no complication was found, the end of the observation period was determined by the date of the most recent oral examination. Two examples of the data collection method are shown in Figure 1. The survival curves for different tooth types, the status of different adjacent teeth, and the

different prosthetic restorations were tested for statistical significance by using the log-rank test.¹² Prosthetic restorations were divided into fixed partial dental prostheses, double crown-retained removable partial dental prostheses (telescopic dentures), and all other types of removable partial dental prostheses. A telescopic crown attachment consists of one primary crown on the tooth and a secondary crown within the framework of the removable part of the prosthesis.

The statistical level of significance was $\alpha=.05$. For the univariate analyses, an adjustment of *P* values was judged to be not useful because of the different character of the parameters. A multivariate stepwise Cox regression model was calculated to estimate the influence of the independent variables, taking interactions into account.

RESULTS

Within the observation period between January 1992 and June 2011, 717 teeth restored with cast post and cores in 343 patients were obtained from the Dentware database. The mean age of the patients was 57.4 years (range 18.5 to 91.2 years). A total of 151 patients received 1 cast post and core, while 2 patients received a maximum of 12. Most of the teeth restored with cast post and cores were premolars (32.9%), followed by canines (25.0%), incisors (22.0%), and molars (20.1%). Most cast post and cores were made for the left maxillary canine (8.2%), followed by the right maxillary canine (7.9%).

The smallest number of tooth types receiving a cast post and core were third molars (0.3%). A mean observation time of 4.8 years per restored tooth was calculated. In 68.1% of observed teeth with cast post and cores served as abutment teeth for fixed dental prostheses or single crowns. In 32.9%, the respective jaws were treated with a removable dental prosthesis. Of these, 70 (9.8%) served as abutment teeth for double crown-retained removable dental prostheses.

Of the 717 teeth restored with cast post and cores, 96 teeth (13.4%) had to be extracted (target event). Details about the related tooth types are shown in Figure 2. The Kaplan-Meier survival analysis showed a mean survival time of 13.5 years (12.8 to 14.2 years) between the insertion of a cast post and core and the extraction of the respective tooth.

The Kaplan-Meier-Estimator revealed a 5-year survival rate of 86.9% ($\pm 1.6\%$) and a 10-year survival rate of 75.7% ($\pm 2.6\%$). The respective Kaplan-Meier survival curve is shown in Figure 3. Regarding the mean survival times of specific groups of teeth, an increase from the anterior region to the posterior region was noted (Fig. 4, Table 2). The differences in molar versus canine and molar versus premolar were found to be significant with the log-rank test ($P=.011$ and $P=.036$).

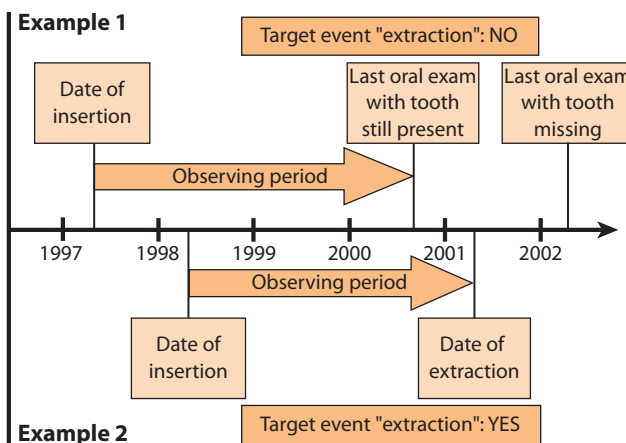


Figure 1. Method of data collection in 2 examples.

A reduced mean survival time of 10.6 years (9.4 to 11.8 years) was detected for treated teeth without any adjacent tooth compared with 13.8 years (13.1 to 14.6 years) for treated teeth with 1 or 2 adjacent teeth. The difference between these survival curves was statistically significant ($P=.008$) (Fig. 5).

A mean survival time of 9.8 years (8.5 to 11.1 years) was found for teeth treated with cast post and cores used as abutment teeth for double crown-retained removable dental prostheses. A mean survival time of 12.5 years (11.2 to 13.8 years) was detected for teeth treated with cast post and cores in jaws being restored with conventional removable dental prostheses. Both values were significantly decreased compared to treated teeth in jaws restored with fixed dental prostheses or single crown restorations (mean survival time: 13.9 years, 13.1 to 14.8 years, $P=.044$ and $P=.024$). The related Kaplan-Meier survival curves are shown in Figure 6.

In the multivariate Cox regression model, the existence of at least 1 adjacent tooth was found to positively influence survival. The risk of extraction was less than 50%, represented by an odds ratio of 0.47 (Table 3). The tooth types incisor, canine, and premolar were found to negatively influence survival. Detailed results are given in Table 3.

DISCUSSION

Teeth that need to be restored with post and cores are often severely damaged. Therefore, the long-term prognosis of these teeth is already reduced. Taking this fact into consideration, a mean survival time of 13.5 years in this study seems to be an acceptable result.

The number of teeth observed in this study is consistent with other studies. The most similar study concerning methodologic issues evaluated 516 teeth.¹³ Higher numbers of observed teeth were recorded by Wegner et al¹⁵ (864) and Balkenhol et al¹¹ (802), although these

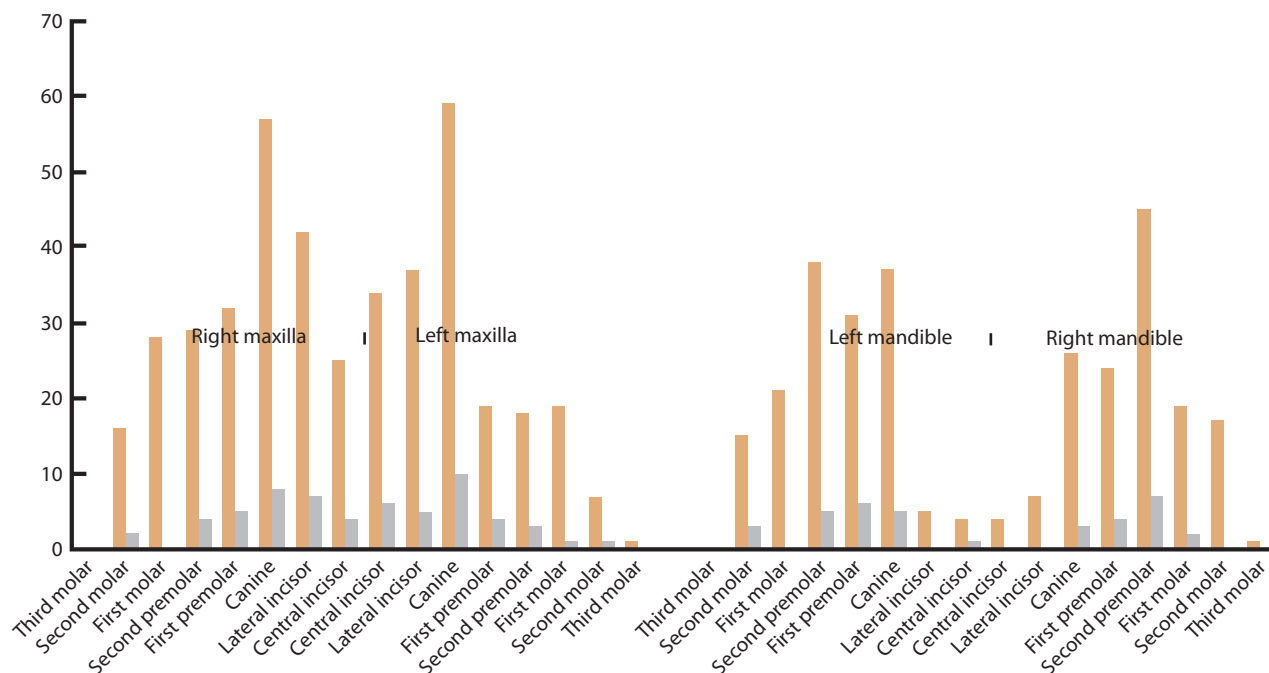


Figure 2. Frequency of teeth restored with 1 cast post and core (light brown) and extracted teeth (gray) per tooth type.

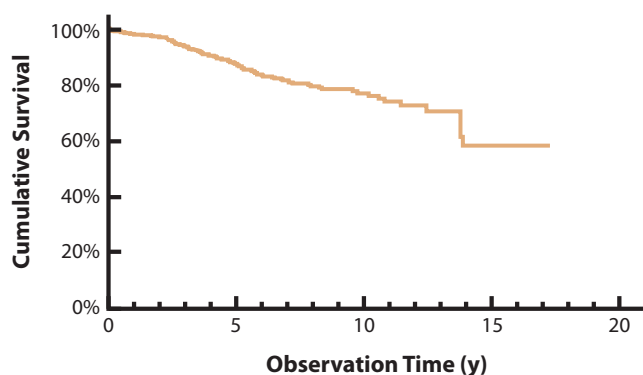


Figure 3. Kaplan-Meier survival curve for teeth that received cast post and cores for target event "extraction".

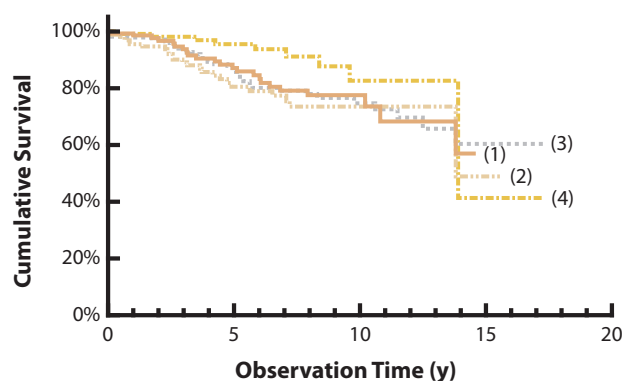


Figure 4. Kaplan-Meier survival curves for different groups of teeth that received cast post and cores (x-axis in years): (1) incisors, (2) canines, (3) premolars, (4) molars.

studies did not only observe cast post and cores. A higher number (1273) of post and cores, recorded in a private practice setting, were observed in a study by Morgano and Milot.¹⁴ Several other studies have been done with a smaller number of teeth and without discriminating among different types of post-retained foundation restorations.^{17,18} The maximum observation period was longer in the present study than in these other studies. The distribution of cast post and core restorations on the different teeth of the dentition seems to be logical. A maxillary canine has high prosthetic value and therefore receives a cast post and core treatment in an attempt to salvage this important tooth for a prosthetic restoration.

The rate of recorded extractions is lower than in other studies. One aspect may be different observation

periods in other publications.^{15,16} However, the major variable leading to a higher success rate of cast post and cores in this study was determined to be the selection of the target event. In other studies, other complications such as loss of retention were also considered as target events for failure.^{13,17,18} In contrast, the purpose of this study was to determine a survival time for the tooth, not the restoration.

The 5-year survival rate of 86.9% and for the 10-year survival of 75.7% offer different perspectives for interpretation. Taking the target event "extraction" into consideration, the survival time of teeth restored with cast post and cores seems to be short. In contrast, the different preconditions of this type of restoration have to

Table 2. Mean survival times for specific types of teeth treated with cast post and cores

Tooth Type	Mean Survival Time (y)	Confidence Interval
Incisors	11.839	10.856-12.821
Canines	11.913	10.708-13.118
Premolars	13.424	12.342-14.506
Molars	14.055	11.846-16.263

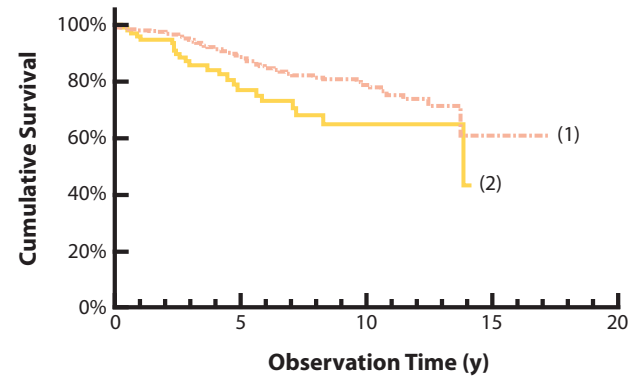


Figure 5. Kaplan-Meier survival curves for teeth that received cast post and cores (1) with and (2) without any adjacent teeth (x-axis in years).

be considered. Restoring a tooth with a cast post and core is, in most patients, reserved for a severely damaged tooth. Often, the only other alternative is extracting the tooth. Therefore, the calculated clinical survival rates still justify the use of cast post and cores for the restoration of severely damaged teeth. However, our results should remind clinicians to evaluate alternatives in situations where teeth are not severely damaged or still have a good long-term survival prognosis. The reduced mean survival time for teeth without any adjacent teeth was within the expectations of the authors but has not yet been published. The reduced survival time for restored teeth being used as an abutment tooth for a double crown-retained partial denture was expected but was not significant according to the multivariate Cox regression model. These results are in a line with another study.¹⁵ A tooth root weakened by inserting a post cannot resist the forces that occur when a double crown-retained removable dental prosthesis is inserted and removed regularly.

All of the results have to be interpreted with respect to the methodologic issues of this study. Because of the retrospective character of the study, the large number of different operators with different skill levels, and the change in clinical guidelines over time, no standardized clinical treatment procedure could be guaranteed. Treatment procedures at a university clinic, however, normally follow certain rules of quality control. Potential survival rates in a preselected study population within a prospective clinical study design are expected to be higher. However, the results from this study may be closer to

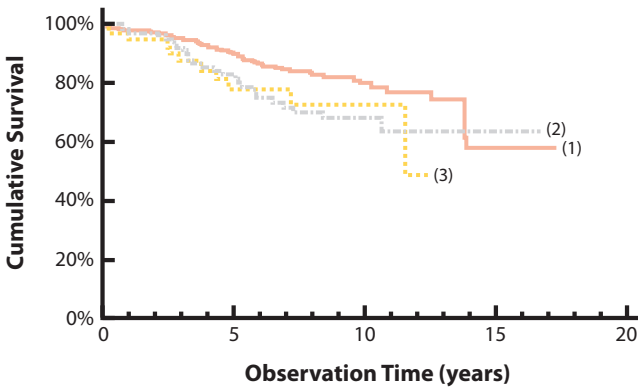


Figure 6. Kaplan-Meier survival curves for teeth that received cast post and cores. Teeth/jaws are restored with (1) crowns or fixed dental prostheses, (2) conventional removable dental prostheses, or (3) double crown-retained removable dental prostheses.

Table 3. Results of Cox regression model—odds ratios illustrate potential impact of independent variables on survival of cast post and cores

Independent Variable	Category	N	Odds Ratio	95% Confidence Interval	P
Adjacent teeth status	No adjacent tooth	108	R		
	At least one adjacent tooth	609	0.470	0.284-0.779	.003
Tooth type	Molar	144	R		
	Premolar	236	2.573	1.180-5.783	.012
	Canine	179	2.675	1.252-5.713	.011
	Incisor	158	2.612	1.266-5.399	.018

R, Reference categories.

actual clinical dental practice. Taking into consideration that no clinical standard procedure and no ferrule design can be guaranteed, the mean survival time is acceptable.

The use of the digital treatment database for data collection is the second major methodologic limitation of this study. Digital documented treatment codes are strictly related to a specific kind of treatment. A deviation between one documented treatment code and the respective clinical dental treatment is therefore very improbable. The influence of this method compared to an analysis of the clinical documentation charts could be judged minor. The use of a Kaplan-Meier survival analysis for the statistical processing of the data seems to be an adequate procedure and is in a line with other comparable studies.^{6,12,13} The log-rank-test is an accepted procedure for the comparison of subgroups within a Kaplan-Meier survival analysis.¹²

Conventional cast post and cores are increasingly being replaced by newer dental materials in clinical practice. These are mainly fiber reinforced resin composite posts or adhesively retained prefabricated metal posts. Whether these materials can achieve similar long-term survival rates has to be proved in further clinical studies.

CONCLUSIONS

Within the limitations of this retrospective study, cast post and core-treated teeth achieved an acceptable mean survival time. Alternatives like fiber reinforced resin posts do not have comparable scientific long-term data yet. Restoring with a fixed dental prosthesis might positively influence the survival time of these teeth. The use of those teeth as an abutment for a double crown-retained partial dental prosthesis might reduce their survival time. The presence or absence of adjacent teeth seems to influence the survival time of cast post and core-treated teeth as well. Both prospective clinical studies with precisely defined treatment procedures and strictly selected study populations as well as retrospective clinical studies with a wide variety of operators and a mixed study population are able to generate valuable scientific data.

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