Tooth-Supported Telescopic Crown–Retained Dentures: An up to 9-Year Retrospective Clinical Follow-up Study

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Purpose: This study evaluated outcome and quality of treatments with telescopic crown–retained dentures. **Materials and Methods:** A total of 72 subjects (27 men and 45 women; mean age 67 years) wearing 75 telescopic crown–retained dentures (18 in the mandible and 57 in the maxilla) participated in the study. There were a total of 368 abutment teeth, 272 in the maxilla and 96 in the mandible. Each patient was clinically examined. Using the CDA evaluation system, four calibrated evaluators also examined, independently, the inner crowns for margin integrity and the superstructure for retention, occlusion, stability, wear, and esthetic appearance. Observer consistency was measured with Cohen's κ. **Results:** The observation period varied from 9 months to 9.3 years (mean 3.8 years). One telescopic crown–retained denture was lost, and 24 abutment teeth (7%) were extracted during the observation period. In 49 abutment teeth (13%), technical complications had occurred, and a total of four framework fractures (5%) were observed. Based on the CDA criteria, most of the characteristics were evaluated as satisfactory. The characteristics "condition of denture-supporting soft tissue" and "superstructure wear" showed the highest frequencies of not acceptable ratings, 44% and 45%, respectively. **Conclusion:** In this retrospective follow-up study, satisfactory outcome was found for tooth-supported telescopic crown–retained dentures over a mean observation period of 3.8 years.
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In the prosthodontic rehabilitation of partially edentulous patients, removable partial dentures (RPD) have frequently been used. Functional denture stability, good retention, oral comfort, and satisfactory esthetics are important factors for successful treatment outcome.[1–5] Oral hygiene should be easy to perform, and the distribution of the functional loads should be optimized among the abutment teeth and alveolar ridge.[1,2] In the literature, treatments using different systems of double crown techniques for retention of RPDs have shown good longevity.[6–12] The double crown system retains dentures more effectively than do conventional clasp-retained RPDs and also shows more favorable transmission of occlusal loading to the axis of the abutment teeth.[13–15] Compared to clasp-retained RPDs, the double crown system may also provide advantages with insertion and removal of the denture for older people with decreased manual dexterity.

In general, two different retention principles are used: *(1)* parallel-sided inner and outer crowns; or *(2)* conical shaped inner and outer crowns, where the degree of taper of the individual crown is kept within a certain well-defined range of inclination.[14] Manufacturing dentures supported by double crowns is difficult and expensive and requires special technical skills that only a well-trained and experienced dental technician can master. The fabrication of the parallel-sided crowns in particular is considered to be very difficult because this system requires a clear fit between both crowns for appropriate retention.[14] However, by using a modified technique with inner and outer crowns designed

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Table 1 Characteristics of Telescopic Crown–Retained Dentures (n = 75) and Distribution of Attachments

Prosthesis design	No. of prostheses in maxilla	No. of prostheses in mandible
Tooth supported	17	4
Tooth and unilaterally mucosa supported	17	6
Tooth and bilaterally mucosa supported	23	8
Maxillary bar connector	32	—

with a 2-degree angulation, an appropriate and more predictable retention of the RPD may be achieved.[16]

The aim of the present study was to evaluate the long-term clinical outcome of treatments with telescopic crown–retained dentures (TCRD) and to evaluate the clinical quality using the California Dental Association (CDA) system for quality assessment of dental care.

Materials and Methods

All patients in the Department of Prosthetic Dentistry, Central Hospital, Skövde, Sweden, provided with TCRDs between 1991 and 1999 were included in the study. A total of 88 individuals, 36 men and 52 women, were invited to attend a clinical examination. Of the total sample, 16 individuals did not attend the examination, rendering a sample size of 72 individuals (27 men and 45 women), with a mean age of 67.1 years (median 68.5, range 44 to 85, standard deviation 9.05). The reasons for not attending the examination were: deceased (three individuals), severe illness (six individuals), moved (one individual), and other reasons (six individuals). Bivariately, no significant differences were found in age and gender between participants and nonparticipants.

The 72 subjects received a total of 75 TCRDs, of which 18 were placed in the mandible and 57 were placed in the maxilla (Table 1). There were 368 abutment teeth supporting the TCRDs, 272 in the maxilla and 96 in the mandible. All abutment teeth were provided with cemented copings. The copings were all designed with a 2-degree angulation and a chamfer at the margin of the inner crown (Figs 1 and 2). All copings were provided with outer crowns, and a cobalt-chromium framework was designed and cast for the edentulous parts of the TCRDs and soldered to the outer crowns. As additional retention, various numbers of replaceable snap attachments (Ipso-Clips, Cendres et Métaux) were used. All but one patient received copings and outer crowns manufactured in high precious gold alloy; in that patient, copings, outer crowns, and framework were fabricated in titanium for allergy reasons. Acrylic resin veneers were used in all superstructures.

For each patient, information about social and demographic attributes, systemic and oral conditions, and reasons for tooth loss was collected. The main reason for TCRD treatment was that fixed partial denture treatment was not possible because of factors such as unfavorable position and/or number of abutment teeth. In some patients, however, the reason for TCRD treatment was uncertain prognosis for some of the abutment teeth. Five prosthodontists performed all treatments, and all TCRDs were manufactured by three experienced dental technicians.

Clinical Examination

Each patient was examined by a prosthodontist who had not performed the treatment. Radiologic examination included intraoral radiographs on all abutment teeth using the parallel technique. The clinical examination included registration of caries lesions, lost cemented bond of abutment coping, or abutment tooth fracture. Periodontal conditions were evaluated, and gingival pockets > 4 mm and bleeding on probing were registered. Abutment tooth mobility was registered according to the criteria suggested by Bergman et al[17] (0 = no mobility; 1 = tooth mobility ≤ 1.0 mm in horizontal plane; 2 = tooth mobility > 1.0 mm in horizontal plane; 3 = tooth mobility in vertical direction). Finally, all observed endodontic complications were noted.

CDA Evaluation

After the clinical examination, each patient was further examined using the CDA evaluation system for quality assessment.[18,19] The four examiners had been trained in using the CDA system, which is based on two main categories: satisfactory and not acceptable. Two subratings are available within each main category. Each patient was examined by two prosthodontists independently, with a dental assistant keeping two separate protocols, one for each examiner. Again, no patient was examined by the clinician who had performed the treatment. Each protocol was evaluated after the registration. If the examiners had different opinions, concordance could be reached after a reexamination and discussion between the two examiners. The variables evaluated were superstructure retention, margin integrity, occlusion, denture stability, condition of denture-supporting soft tissue, superstructure wear,

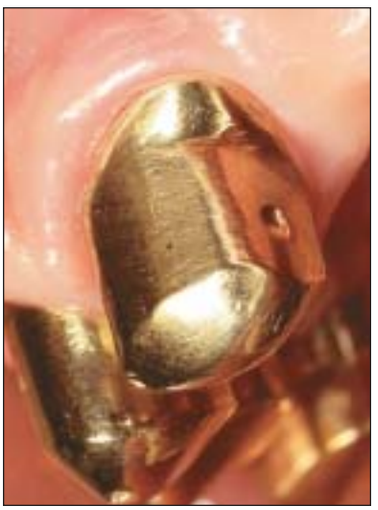

Fig 1 *(left)* Coping with hollow for the Ipso-Clip.

Fig 2 *(below)* Interior view of outer crown with Ipso-Clip on lateral surface.

Table 2 Rating Criteria for Quality Assessment

Parameter	Satisfactory		Not acceptable	
	R	S	T	V
Retention	Excellent	Superstructure can be removed with a firm grip	Superstructure can be removed very easily	No retention
Design/surface	Excellent	Minor discoloration and roughness	Obvious discoloration and roughness	Severe discoloration and roughness
Design/anatomy	Excellent	Acceptable	Obvious disharmony	Complete disharmony
Stability	Complete stability	Minor superstructure mobility when loaded	Obvious superstructure mobility when loaded	Complete instability
Mucosa	Healthy	Impressions, no inflammation	Impressions, slight inflammation	Severe inflammation
Wear	No wear	Minor signs of wear on metal surfaces and/or veneers	Obvious wear on metal surfaces and/or veneers; changed tooth anatomy	Severe wear; lost tooth anatomy
Occlusion	Maximum of intermaxillary tooth contacts; no occlusal disturbances	Bilateral intermaxillary tooth contacts; no occlusal disturbances	Bilateral intermaxillary tooth contacts; minor occlusal disturbances	Unilateral intermaxillary tooth contacts; major occlusal disturbances
Articulation	Balanced; no occlusal disturbance	Group function/canine protection; no occlusal disturbance	Working-side disturbances	Nonworking-side disturbances
Protrusion	Anterior guidance with bilateral contacts	Anterior guidance or bilateral contacts	Occlusal disturbances preventing anterior guidance/bilateral contacts	Occlusal disturbances preventing protrusion
Marginal integrity	No crevice detectable wih probe	Slight marginal discrepancy	Faulty margins	Severe cervical overcontouring and/or large crevice

R = range of excellence; S = range of acceptability; T = replace or correct for prevention; V = replace immediately.

superstructure finish, and esthetic appearance. Characteristics for the copings and removable denture components were evaluated according to the guidelines defined for fixed and removable prosthodontics.[19] However, some of the characteristics, such as retention, stability, wear, and occlusion, were further developed and are presented separately (Table 2).

Data were analyzed in frequency tables. Observer consistency was measured with Cohen's κ.[20] For survival analysis, the life table technique was used. All data analysis was done in SPSS.

Results

Clinical Examination

The observation period of the treatments varied from 9 months to 9.3 years (Table 3), with a mean observation time of 3.8 years. Twenty-four (7%) abutment teeth were extracted during the observation period. The most common complication was lost cement bond of abutment coping and abutment tooth fracture (Table 4). About 10% of the abutment teeth showed caries lesions, and 20% showed periodontal pocket

Table 3 Life Table Analysis of Telescopic Crown–Retained Dentures (TCRD; n = 75)

Observation period (mo)	No. of prostheses	No. of TCRDs exposed to risk	No. of failed TCRDs	Proportional survival rate (%)	Cumulative survival rate (%)
≤ 12	75	73.5	0	100.0	100.0
13–24	72	62.5	0	100.0	100.0
25–36	53	46.0	0	100.0	100.0
37–48	39	36.0	0	100.0	100.0
49–60	33	27.0	1	96.3	96.3
61–72	20	14.0	0	100.0	96.3
73–84	8	5.5	0	100.0	96.3
85–96	3	2.0	0	100.0	96.3
97–108	1	0.5	0	100.0	96.3
109–120	1	0.5	0	100.0	96.3

Table 4 Technical and Biologic Complications (%)

Type of complication	Maxilla (n = 272 abutment teeth)	Mandible (n = 96 abutment teeth)
No. of extracted abutment teeth	6	7
Abutment tooth fracture/loss of coping cement bond	16	6
Endodontic	6	5
Caries	10	12
Periodontal pocket depth > 4 mm	20	23
Tooth mobility (2 and 3)	12	2

Table 5 Rating Criteria (%) for Various Parameters Using the CDA Evaluation System

Parameter	Satisfactory		Not acceptable	
	R	S	T	V
Retention	46	43	5	5
Design/surface	24	70	5	0
Design/anatomy	30	69	0	1
Stability*	37	37	24	2
Mucosa†	25	32	34	10
Wear	1	54	42	3
Occlusion‡	45	38	15	1
Articulation‡	12	86	0	1
Protrusion‡	11	85	4	0
Marginal integrity	37	44	10	9

*Data registered only for dentomucosal-supported prostheses.
†No data on one tooth-supported telescopic crown–retained denture.
‡No data on one patient who was edentulous in the opposing jaw.
R = range of excellence; S = range of acceptability; T = replace or correct for prevention; V = replace immediately.

depth > 4 mm. However, the prevalence of endodontic complications was low. Four framework fractures (5%) were observed during the study period. One TCRD was lost because of abutment tooth failure, rendering a TCRD survival rate of 96% (Table 3).

CDA Evaluation

The majority of the variables evaluated were rated satisfactory. However, for the variables "condition of the denture-supporting tissue" and "superstructure wear," high frequencies of not acceptable ratings were seen (Table 5). Almost 20% of the copings showed a margin integrity evaluated as not acceptable.

Along with the evaluations, an analysis of interexaminer standardization was performed. The evaluation showed high agreement ratings (> 86%) for most characteristics. However, for the characteristics "stability," "mucosa," and "wear," somewhat lower values were registered (76% to 86%). Cohen's κ was .19 for "stability" but relatively high for all other characteristics (.32 to .70).

Discussion

During the observation period, only one of the 75 TCRDs failed, rendering a cumulative survival rate of 96%. In this patient, two of the five abutment teeth in the maxilla were lost about 4 years after loading because of severe caries. After another 2 months, the remaining three abutment teeth fractured. The patient's unfavorable jaw relation and poor oral hygiene may have been contributing factors.

TCRDs require a higher level of maintenance than do conventional clasp-retained dentures.[21] When the denture is designed with distal extensions, the relining procedure is of special importance. If a careful evaluation of the denture-mucosa fit is not performed during the annual examinations, risk of overload and fracture of the abutment teeth may increase.

Follow-up studies on telescopic and conical crown–retained dentures report survival rates between 92% and 100%, which is in accordance with the findings in the present study.[9,12,22] Moreover, the percentage of lost abutment teeth (7%) corresponds to findings in similar studies.[23,24] The number, position, and distribution of the abutment teeth are factors that influence their survival rate.[23] A significantly higher failure rate has been reported in subjects with few remaining abutment teeth compared with subjects with conical crown–retained dentures supported by a higher number of abutment teeth.[10,23] In the present study, the majority of the fractured abutment teeth were observed in patients wearing prostheses designed with bilateral mucosa-supported distal extensions.

The number of fractured abutment teeth and lost cement bond of the copings may, at first glance, seem high. However, the majority of the abutment teeth were already heavily restored prior to the TCRD treatment, and the main reasons for choosing this therapy were that fixed partial denture treatment was not possible because of unfavorable disposition of abutment teeth and uncertain prognosis of the abutment teeth. The fact that the dentures in some cases had not been relined or adjusted by the patients' regular general dentist may also have contributed to decreased mucosal support, causing abutment tooth failure. Since many of the abutment teeth had an uncertain prognosis, an increased risk for complications could naturally be expected. Nevertheless, especially for older people, abutment teeth with an uncertain prognosis can be valuable for the retention of a removable prosthesis. In retrospective studies, it is difficult to evaluate factors associated with abutment tooth complications such as endodontics or major restorative treatment. Such information can only be obtained in long-term prospective studies.

Despite the fact that treatments using double crown systems were established more than 30 years ago, few reports about technical complications exist.[10,21,22] In a retrospective study on 117 subjects with telescopic or conical crown–retained dentures, loss of cementation of the coping was the most common complication, and a higher rate was observed for TCRDs (26%) compared with conical crown–retained dentures (19%).[22] Another long-term follow-up study on TCRDs reported 17% loss of cementation after an observation period of 8 years.[21] In the present study, a total of 49 copings (13%) failed because of loss of cementation and/or abutment tooth fracture. Six of the copings failed more than one time. In most situations, the copings could be recemented, while in some cases endodontic treatment was needed. Within the aims of the present study, no analysis of operator variability has been performed. Such analysis will be performed in a forthcoming study.

A total of four framework fractures (5%) were observed in the present study, which is in congruence with findings in a similar study.[22] The soldering procedure between the high precious alloy in the outer crowns and the cobalt-chromium framework in the edentulous parts is complicated and requires great technical skill. In one patient with a tooth-supported TCRD, the framework fractured twice in the connection between the outer crowns and the cobalt-chromium framework. The patient was diagnosed as a bruxer, and inadequate dimension of the framework together with an unfavorable distance between the abutment teeth may have been contributing factors.

The CDA system was used to evaluate items such as quality and function of the TCRDs. The overall assessments were rated satisfactory. Since TCRD treatments include fixed and removable appliances, guidelines for both removable and fixed prosthodontics were used. For some of the characteristics (retention, stability, occlusion, and wear), separate evaluations were performed. The quality evaluation criteria proposed by the authors were developed according to the CDA general guidelines.[19] For each of the characteristics, well-defined criteria were used. For most of the characteristics, high satisfactory rates ($>$ 80%) were registered. However, for the characteristics "mucosa" and "wear," almost 45% of the dentures were rated as not acceptable, indicating a high number of bruxers among the subjects. For most characteristics, high agreement ratings among the examiners were observed. The somewhat lower ratings for the characteristics "stability," "mucosa," and "wear" may be explained by a higher degree of subjectivity. The kappa value measured the association between judges considering the probability for random congruence.[20]

A 40-month follow-up study on conical crown–retained dentures evaluated retention.[6] Of the 62 dentures, 86% were rated as satisfactory, which is in congruence with the findings in the present study (89%). Similar results also were found when evaluating the margin integrity of the copings. In both studies, margin integrity was rated as not acceptable about 19% of the time. The major reason for this rather high figure was presence of caries at the crown margin. Compared to fixed prosthodontics, the incidence of caries seems to be considerably higher for the double crown system.[25] In the present study, the main reason for previous tooth loss was caries. It should also be noted, however, that the mean age of the subjects in the present study was fairly high (67 years), and several of the patients were medically compromised.

Although several technical failures occurred, all but one TCRD could be repaired and successfully replaced. Even if one or a few of the abutment teeth are lost, it is possible for the patient to use the denture after proper adjustment or repair. TCRDs can therefore be regarded as a favorable treatment option in situations where it is not possible to perform conventional or implant-supported fixed restorations. However, it should be stressed that it is important to provide for regular examinations and individually designed oral and denture hygiene programs.

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