

## Review Article

# Specially Designed Copings for Stability of Overdentures

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**Abstract**

**Aim:** The aim of this study was to describe the process of fabrication of specially designed MCOP and define their function in improving of stability.

**Purpose:** In many clinical situations, exposed dentin surfaces of abutment teeth were restored with metal copings prior to fabrication of the overdentures. The aim of this study was to examine a procedure for fabrication of specially designed metal copings and assess their role in improving retention and stability of overdentures.

**Material and Methods:** Two groups of patients were analyzed in this study: the experimental group consisted of 31 patients (–18 partially edentulous women aged 50 to 64 yrs., and 13 partially edentulous men, aged 53 to 65 yrs). There were 73 endodontically treated teeth and 8 vital abutments. The control group included 31 conventional partial acrylic resin denture wearers' (–10 partially edentulous men and 21 women, aged 53 to 65 yrs). Milled retentive shoulders at right angles to the root axis were designed in COP for posterior abutments to have beneficial effect on the periodontal apparatus.

**Results:** Retroalveolar radiographs that were made at the baseline and several weeks after cementing of MCOP were control for a decent position of the coping. The individual Cronbach's alpha test result was 0.870 and 0.951 for experimental and control questionnaires, respectively.

**Conclusion:** The results of this study indicated that metal copings provided stability of overdenture construction in selected patients.

**Keywords**

- Overdenture
- Coping
- Partial denture
- Acrylic resin denture
- Jaws

**INTRODUCTION**

Definitive overdentures have been used to rehabilitate partially and completely edentulous patients [1-4]. Overdentures were defined as removable partial or complete dentures that cover and rest on one or more remaining natural teeth, roots, and/or dental implants [1,2]. Additionally, overdentures may be defined as dental prostheses that replace the lost or missing natural dentition and associated structures of the maxilla and/or mandible receiving partial support and stability from one or more modified natural teeth [1,2].

Advantages of overdentures have been reported to be: preservation of alveolar bone level, preservation of proprioceptive response, simple construction – easiness of obtaining accurate records, superior denture stability, subjective perception of a patient that he/she still has some of his/her own natural teeth, as well as a simplicity of use for certain types of challenging patients [1].

The scientific literature described considerations with respect to the location of the abutment teeth. Longitudinal study indicated the longest survival of canines (41% -49%) and premolars (18% -48%) under OD after ten years of follow-up. At least one tooth per quadrant should have existed [1].

In many clinical situations, exposed dentin may be restored with copings. A cast metal coping (MCOP) was suggested to cover exposed tooth surface.

Various authors have proposed different designs of COP. However, it seems that each of these COP designs could have been applied in a restricted number of clinical cases [3-9]. Basically, MCOP with a dome shaped surface and a chamfer finish line at the gingival margin were considered as an elementary design [2,3].

COP and OD prevent residual ridge resorbing (RRR) because the presence of remaining tooth-roots stimulates surrounding periodontal tissue [1]. Additionally, teeth that were too weak to serve as abutments for conventional removable partial dentures could have been successfully used as support of overdentures, since shortened retained teeth had improved crown-root ratio [10].

The basic principles for COP preparation, resulting in long COP fabrication, where root canal therapy is not the final procedure, and short copings – usually with a post have been published [1,8,9]. The COP should provide optimal distribution of loading forces to remaining tooth substance as well as to adjacent supporting tissues [1].

## MATERIAL AND METHODS

Non-randomly selected samples of patients treated at the Clinic of Dental Prosthetic, University School of Dental Medicine, were included in this study. The experimental group consisted of 31 patients (18 partially edentulous women aged 50 to 64 years and 13 partially edentulous men, aged 53 to 65 years), having a total of 81 remaining teeth; 73 were endodontically-treated and 8 vital teeth with significantly reduced clinical crowns supported the overdentures (Figure 1). Thirty one acrylic resin removable partial denture wearers (10 partially edentulous men and 21 partially edentulous women, aged 53 to 65 years) acted as control subjects.

All of the patients had normal oral bone structure and without advanced residual ridge resorption- RRR. Patients with firm and consistent dentin substances of the remaining teeth were included in the study (Figure 2).

The Institutional Review Board of the University approved this study and each participant signed a consent form before the study began.

### Methods

**Fabrication of MCOP:** Root canal preparation was done by the step-back technique and obturation was performed using the cold lateral compaction technique [11,12] of gutta-percha and Apexit plus (Ivoclar, Vivadent, Lichtenstein) endodontic sealer.

For the purpose of providing supplemental retention in the root-canal of each of the remaining teeth of the patients from the experimental group, gutta percha was removed from the canals using steel round burs, root reamer and conical bur with diamond dust subsequently. Preparation of root canal was 1/3 of length of each root. Displacement cords were positioned around each tooth prior to impression making was to facilitate accurate capture of intra-crevicular margins for casts. Impression of prepared teeth and supporting tissues was provided by zinc oxide-eugenol paste (Vikopres, Galenika a.d., Serbia) in the custom tray in combination with silicone impression material (Oranwash L, Zhermack, Italy) for areas of remaining tooth substance. COPs were fabricated intraoral, using auto polymerizing resin (Palavit G, Kulzer, Germany). Subsequent to tooth preparation and margin placement, COPs were first formed directly in the mouth and then refined on master casts (Figure 3). Metal carbide burs with crossed blades placed in a parallelometer (Heraeus



**Figure 1** Remaining roots and tooth substance in a partially edentulous mouth.



**Figure 2** Retroalveolar radiograph of the remaining teeth.



**A)**



**B)**

**Figure 3** a) Designed acrylic form of a COP with additional acrylic post after removal from the mouth; b) Casted definitive metal form of COP with the additional post.

Combilabor, Germany) were used for milling the patterns (Figure 4). COP then were invested and cast using semi-precious alloy (M-Palador Cast, Galenika a.d., Serbia); castings were finished and polished conventionally.

For the purpose of try-in, COPs were disinfected prior to placement (Figure 4). Copings were not luted at this time. Alginate impressions using standard impression trays were used to capture the COPs and pertinent oral morphology in each subject in the experimental group. Acrylic resin custom impression trays (Palavit-L, Galenika a.d., Serbia) were fabricated for each subject in the experimental group.

Border molding was undertaken using modelling compound (Kuprovent thermoplastic material, Galenika a.d., Serbia) and functional impressions made using zinc oxide-eugenol paste (Vikopres, Galenika a.d., Serbia) in combination with silicone impression material (Oranwash L, Zhermack, Italy) for areas immediately surrounding the COPs [13]. The stability and adhesion of the definitive impressions were confirmed intra-orally applying manual technique of resisting of custom tray to applied manual forces in latero-lateral directions and in forward-backward direction, too. Impression and copings were removed from the mouth and master casts were fabricated (Gipsogal, Galenika a.d., Serbia).

Occlusion rims (OR) and record bases (Bazogal G and D record bases, Galenika, and Vomogal S medium hardness wax, Galenika a.d., Serbia) were fabricated and the intaglio surfaces of the record bases were adapted to the COPs. Maxillo-mandibular relations were recorded using these record bases and ORs; and casts were mounted on a semi-adjustable articulator (Artex S,



**Figure 4** Assigning of "finishing lines" on the cast; the milling procedure for the COP; Metal COP positioned in the mouth.

Amman-Girrbach, Germany). Artificial teeth were arranged and trial arrangements evaluated at patient appointments. Occlusal contacts were definitely established after arrangement of the posterior teeth [14]. Prior to the delivery of processed and finished acrylic resin ODs, exposed tooth structure was cleaned disinfected and protected (Kavipran, Galenika a.d., Serbia) prior to cementation using zinc-phosphate cement (Cegal, Galenika a.d., Serbia) (Figure 4). Overdentures - OD were placed and adjusted as needed.

**Patient Denture Satisfaction Questionnaire method:** For all of the patients, the established and accepted questionnaire formed by Toolson and Smith was utilized [15] (Table1). Results were processed and calculated according to the scale: answer NO was assigned the number 1; positive a few complaints assigned the number 2; YES with small complaints assigned number 3, and answer YES assigned number 4.

For statistical analysis, inter-item correlation coefficients were calculated.

## RESULTS

### The results of the questionnaire

Reliability analysis has shown that the overall Cronbach's alpha was in the range of 0.870 and 0.951 for all patients' which

demonstrates very good internal consistency for the investigation method applied. Table 1 demonstrates the individual Cronbach's alpha when each item of the questionnaire is deleted (Table 1)

## DISCUSSION

Overdentures were designed as complete dentures in a number of clinical situations in prosthodontic treatment [5,6,9,15]. While the conventional design of COP allows for certain amount of rotation and movement of the OD base with diffuse distribution of masticatory and denture forces onto conventional convex coping-surface [1], the copings in this study were designed to have a preparation and outline form that utilized a milled chamfer and was intended to provide physiologic and vertically-oriented forces on the supporting and periodontal tissues with no rotation and dislodgement of the denture.

The procedure described in this study utilized both the direct method of modelling of coping in the mouths and indirect-cast method. Acrylic post patterns were fabricated and adjusted to fit the root canal preparations. Minor undercuts were identified and removed. Applied acrylic pattern resin has a volumetric polymerization shrinkage of 6.5% that provides a benefit with regard to intracoronal/intraradicular castings [16].

Does the height of the "platform" or the level of the chamfer-bevel position lead to improved retention? Based on questionnaire responses, it is clear that placement of the chamfer above the gingival margin of a MCOP increased retention of the OD notably in all subjects in the experimental group (Figure 5). Additionally, another item could be discussed regarding the fabrication of the copings in this study with regard to choice of precious or semi-precious alloy. In general, it is proposed that preference be given to use of precious alloys whenever possible (primarily Au-Cu, and possibly Au-Pt alloys and other metals), but that for economic reasons, semi-precious alloys (Ag-Pd) are acceptable as an alternative since in this study, the semi-precious alloy (M-Palador Cast, Galenika a.d., Serbia), was used with

**Table 1:** Cronbach's  $\alpha$  and average inter-item correlation coefficients Interval of confidence was 95 +/-10 %.

Question	Patients		Control	
	Corrected Item-Total Correlation	Cronbach's alpha if item deleted	Corrected Item-Total Correlation	Cronbach's alpha if item deleted
1. Are you satisfied with your dentures?	0.893	0.843	0.921	0.941
2. Do you like how your dentures look?	0.893	0.843	0.941	0.941
3. Are you satisfied with the retention of your upper complete denture?	0.639	0.854	0.928	0.940
4. Are you satisfied with the retention of your lower denture?	0.315	0.879	0.886	0.943
5. Do you realize how your retained natural teeth are of crucial importance for the quality and retention of your denture?	0.893	0.843	0.399	0.960
6. Is your mastication with dentures good?	0.618	0.859	0.921	0.940
7. Are you satisfied with your speech ability when using your dentures?	0.901	0.835	0.886	0.943
8. Are you satisfied with the retention of your upper complete denture and do you feel comfort when your dentures are in your mouth?	0.826	0.843	0.579	0.953
9. Are you satisfied with the comfort of your lower denture?	0.587	0.858	0.821	0.945
10. How did your relatives and friends comment on the aesthetic appearance of your dentures?	0.236	0.885	0.678	0.950
11. How often do you go to the dentist for check-ups?	0.330	0.894	0.709	0.950



**Figure 5** Retentive chamfer of cemented COP in the mouth.



**Figure 6** Control radiograph of the position of COP.

satisfactory results (Figure 3). It should also be noted that the COPs used in this study can be effective when rehabilitating teeth with short clinical crowns. When relining or rebasing ODs, care should be taken to remove additional acrylic resin from around the COPs before the relin or rebase impression is made.

Panoramic radiograph was made for each of the patient prior to the therapy. Separately, for all abutment teeth with root-canal filling radiographs were made prior, again after COP and overdentures placement, as well as at check-ups (Figure 2). Initial and control retroalveolar radiograph were made using specially constructed film-holder which provided positioning of radiograph each time in the same position in the mouth of a patient [1] Observations from radiographic examinations at follow-up appointments after completion of treatment showed no displacement of COPs in any of the abutments (100%) (Figure 6).

If advantages of double –outer and inner telescope crowns are compared to MCOP it should be stressed how in short clinical crowns, for misspositioned or malpomed remaining teeth of posterior sector, a retentive preparation technique would have been hard to provide. Moreover, the retainer system based on double crowns needs very careful cementing regarding harmful direction of intraoral lateral and horizontal forces which could have caused frequent decementing of inner crowns in clinical praxis [17,18]. The design of the COP presented in this study can be applied in all situations when in the partially edentulous mouth there are a number of remaining teeth which might not be good abutments for inner telescope crown, but which should be

ultimately remained to preserve the level of the residual alveolar ridge, as well as to improve retention of a future acrylic denture.

Many authors have advocated that MCOP should cover exposed tooth structure when supporting overdentures [1,3,4,6]. The question may be asked whether special canal preparation is required to use the COPs described in this study. Inasmuch as the use of a post in endodontically-treated is within the parameters of care and widely accepted as a retention mechanism for cast restorations, it is necessary to remove at least one third of the root filling material during post space preparation. In exceptional cases (distal –lower molar canal or palatal - upper molar canal; and canines) up to the half of the filling should be removed.

In this study, a questionnaire [15] specially designed and prepared for the purpose of testing the degree of patient satisfaction with overdentures was used. The reliability analysis of the Toolson and Smith questionnaire was good (Cronbach's alpha result was 0.870 and 0.951 for experimental and control questionnaires, respectively (Table 1) yielding the desired internal consistency of the chosen investigation method. Prosthesis worn by subjects in the experimental group was more stable as well as better in terms of chewing and speaking. All in all, these subjects experienced chewing similar to their own teeth. In addition, subjects from the experimental group were satisfied with their appearance while wearing their overdentures. Therefore, key determinants of patient satisfaction appear to be well-addressed by the treatment provided to subjects in the experimental group further indicating that overdentures supported by specially-designed COP are a validated and viable treatment option for edentulous patients.

## CONCLUSIONS

The results of this study indicated that MCOP have provided stability of denture construction in selected patients.

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