ORIGINAL RESEARCH

Mini-poll Coping as an Alternative Attachment in Tooth-supported Overdenture Prosthesis: A Randomized Controlled Trial

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Received on: 12 October 2023; *Accepted on:* 10 November 2023; *Published on:* 30 December 2023

Abstract

Purpose: Evaluation of the resistance to dislodging resistance in the conventional overdenture, mini-poll coping, and telescopic crown.

Materials and methods: A sample size of 45 participants (15 in each group) was determined. Partially edentulous patients with only the two lower canines present were selected. After the fabrication of the three prostheses, using a force gauge, a dislodging pushing force was applied to the three groups at the labial frenal notches. Measurements were taken at insertion, after 1 and 3 months. One-way analysis of variance (ANOVA) and Tukey was calculated for the groups.

Results: The mean values for the conventional overdenture, mini-poll, and telescopic at insertion were 2.45 ± 0.095, 6.47 ± 0.101, and 6.66 ± 0.239 newton (N), respectively. The mean values for the conventional overdenture, mini-poll, and telescopic after 1 month were 3.58 ± 0.13, 8.5 ± 0.5, and 7.80 ± 0.435 N, respectively. The mean values for the conventional overdenture, mini-poll, and telescopic after 3 months were 3.7 ± 0.147, 8.56 ± 0.598, and 8.56 ± 0.452 N, respectively.

Conclusion: The mini-poll coping and telescopic crown recorded the highest retentive values, however, the mini-poll had the advantage of much lower cost when compared with the telescopic crown.

Keywords: Dislodging resistance, Mini-poll coping, Overdenture, Patient satisfaction, Telescopic crown.

International Journal of Prosthodontics and Restorative Dentistry (2023): 10.5005/jp-journals-10019-1425

Introduction

Overdenture is a dental prosthesis overlaying 2–3 remaining teeth and severe loss of teeth is present.[1] Underlying teeth are usually used to provide support to the overdenture. Some modifications have been made to the supporting teeth to provide some retention against the dislodging forces.[1,2]

Overdentures can be classified according to the design of the underlying teeth. It is suggested that when crown-to-root ratio is favorable telescopic crown can be used, as it provides good retentive forces as well as giving support to the overlaying prosthesis.[1,2] In telescopic crowns retention is achieved by the friction between the primary coping cemented to the teeth and the secondary coping embedded in the prosthesis. Fabrication of telescopic crowns is a complicated, and highly sensitive procedure, with a high level of precision required to achieve satisfactory results.[1–5]

When the crown-to-root ratio is not optimum, teeth are prepared to a dome-shaped abutment with an amalgam plug. The abutments are 2–3 mm from the gingival margin, they provide support to the prosthesis, but with minimal retentive means. The dome-shaped abutment is a simple design and cost-effective.[1,3,6] On the contrary, the abutments are susceptible to caries, so there is a risk of losing the supporting abutments and compromising the whole success of the prosthesis. The risk of losing the abutments due to caries has directed dentists to cover the dome-shaped abutment with a metallic coping. Metallic coping provides a shield against caries and good support, but they also lack any retention means.[1,3,6,8]

The mini-poll coping was suggested as an alternative coping design to the conventional metallic coping. Mini-poll has the advantage over the conventional metallic coping of providing sufficient retention besides adequate support. Mini-polls are created by shaping a metallic cap into the shape of a root, measuring 2–3 mm in height from the proximal sides and 3–4 mm buccolingually. An undercut of 0.5–1 mm is formed around the cap by the overhanging occlusal edge.[1] Retention of the dental prostheses can be evaluated with several devices including universal testing machines, force meters, and force gauges.[9]

Can adding a low-profile attachment improve retention without increasing the cost of the overdenture prosthesis? The purpose of this study was to compare the resistance to the dislodging force of the conventional overdenture, with mini-poll overdenture and the telescopic crown overdenture. The null hypothesis considered was that conventional overdentures, mini-poll copings, and telescopic crowns would have a significant impact on resistance to dislodging forces.

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How to cite this article: Elsherbini AN. Mini-poll Coping as an Alternative Attachment in Tooth-supported Overdenture Prosthesis: A Randomized Controlled Trial. Int J Prosthodont Restor Dent 2023;13(4):187–190.

Source of support: Nil

Conflict of interest: None

Materials and Methods

Study Design and Ethics

This is a three-arm parallel randomized controlled trial. The protocol and consent were approved by the Institutional Review Board/Ethical Committees (IRB/ECs), No: REC-D417-3 with respect to scientific content, compliance with applicable research, and human subjects' regulations.

Sample Size

A sample size of 45 participants (15 in each group) was determined based on a power calculation with a significance level of 0.05 and a power of 0.8 for detecting a significant difference in retention.

Inclusion Criteria and Exclusion Criteria

Partially edentulous patients with only the two lower canines present were included in the study. Patients with interarch space of 12 mm and Angle's class I, and having healthy abutments were only included. Patients having periodontally affected teeth, severe bone loss around abutments' roots, and limited interarch distance were excluded from the study.

Randomization

Participants were selected from our clinic, MSA University, Egypt. They were randomly assigned to one of three groups using computer-generated randomization lists using randomizer software. Concealment was ensured through sealed envelopes. The first group includes subjects with conventional overdenture with dome-shaped abutments. The second group was with telescopic crown overdenture and the third group was with mini-poll coping overdenture.

For the duration of the study, the participants were not aware of the type of treatment they were receiving. The treatment modality assigned to each participant was not disclosed to the investigators. This was accomplished by identifying the participants' interventions with coded labels or numbers without revealing the true treatment modality. Data analysts were blinded by using anonymized data sets with the coding labels of the treatment modalities.

Mouth Preparations and Fabrication of the Overdenture

Conventional Overdenture

Endodontically treated canines with prepared to 2–3 mm from the gingival margin with a composite plug placed. Afterward, steps of fabrication of the complete overdenture were done conventionally.[1]

Telescopic Crown Overdenture

Vital canines were prepared into a 6° convergence, and then the wax pattern of the primary coping was modeled on the master cast and milled to 0° parallel walls using a milling machine. Casting, finishing, and polishing of the wax pattern was done. After the try-in of the primary copings intraorally, secondary copings were waxed up. Retention pearls were added to the wax pattern of the secondary coping to aid in its retention in the acrylic resin. Secondary copings were placed on the primary cast on the master cast, and then the steps of fabrication of the overdenture proceeded conventionally.[1]

Mini-poll Coping Overdenture

Endodontically treated canines with prepared to 2–3 mm from the gingival margin. Using polyethylene sheets (3A Medes, Medes, South Korea), a celluloid crown of the original design done by Elsherbini[1] was fabricated. The celluloid crown was cut to the height of the prepared dome-shaped abutments. After cutting the celluloid crown to the required height, it was filled with dual cure core material resin (Charm Core, CHARM, South Korea), and placed over the prepared abutments. Excess material was removed; then complete curing was done with the light cure. Celluloid crowns were removed the borders were finished and smoothed using finishing stone. Afterward, steps of fabrication of the complete overdenture were done conventionally. At the insertion stage, grinding of the fitting surface of the overdenture opposing to the mini-poll copings was done, to give space to place the retention silicon (Mucopren Soft, Kettenbach, Germany) (Figs 1 to 4).[1]

Measuring Procedure of Dislodging Resistance

Using a force gauge (Extech, United States of America), a dislodging pushing force was applied at the mid line of the dentures at the labial frenal notches. Measurements of the dislodging resistance were taken for the three groups at insertion, after 1 month and 3 months.

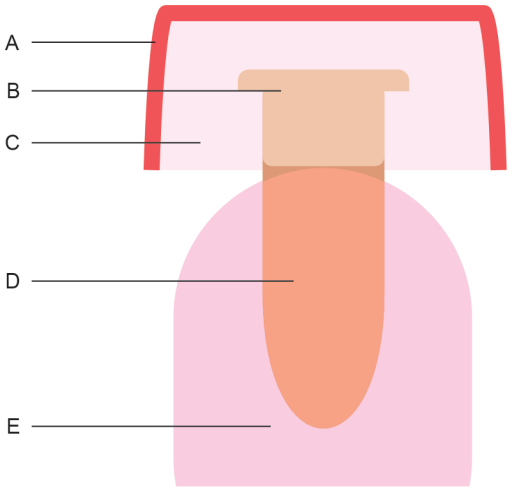
Statistics

The 2013 release of IBM Corp.'s SPSS program was used to examine the data. Version 22.0 of IBM SPSS Statistics for Windows. New York, Armonk: IBM Corp. One-way ANOVA was done to find the significance difference within the groups. Pairwise comparison done with Tukey post hoc test.

Results

Resistance to Dislodging Forces

The mean values for resistance to dislodging forces at insertion for the conventional overdenture, mini-poll, and telescopic at insertion were 2.45 ± 0.095, 6.47 ± 0.101, and 6.66 ± 0.239 newton (N), respectively (Table 1 and Fig. 5). The F ratio value is 2542. The result is significant at $p < 0.05$.



Figs 1A to E: Illustrating diagram of the mini-poll coping. (A) Denture base; (B) Mini-poll coping (beige) covering root with an undercut; (C) Silicon (light pink) surrounding the coping and engaging undercut; (D) Abutment; (E) Residual ridge

The mean values for the conventional overdenture, mini-poll, and telescopic after 1 month were 3.58 ± 0.13, 8.5 ± 0.5, and 7.80 ± 0.435 N, respectively (Table 1 and Fig. 5). The F ratio value is 767. The result is significant at $p < 0.05$.

The mean values for the conventional overdenture, mini-poll, and telescopic after 1 month were 3.7 ± 0.147, 8.56 ± 0.598, and 8.56 ± 0.452 N, respectively (Table 1 and Fig. 5). The F ratio value is 430. The result is significant at $p < 0.05$.

For the Tukey *post hoc* test results for comparison of dislodging resistance values between the treatment options, there was a significant difference $p < 0.05$ between all groups along the follow-up period, except for mini-poll vs telescopic crown after 3 months of follow-up period (Table 2).

Discussion

The hypothesis was verified as the increase in dislodging resistance was accompanied. The mini-poll showed higher retention values when compared with the conventional overdenture; this can be directly attributed to the retention means found in the mini-poll. It depends on the engagement of the silicon placed in the fitting surface of the overdenture with the undercut present in the mini-poll coping. The higher values of retention in this study when compared with Elsherbini[1] can be related to the nature of the study, in which this is a clinical study, so there are other means of retention, such as peripheral seal, saliva film, lingual undercut, and muscle adaptation.[10–12]

Fig. 2: Abutments prepared to dome shape with a height of 2–3 mm from the gingival margin

Fig. 4: Abutments after filling celluloid crowns with core buildup material

Fig. 3: Mini-poll coping celluloid crown placed on the prepared abutments

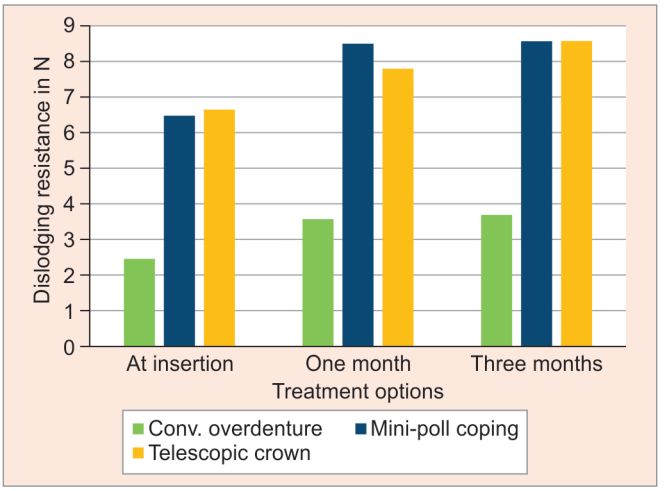


Fig. 5: Bar chart showing the different treatment options along the follow-up period

Table 1: Showing mean values of dislodging force (N) of all treatment options along the follow-up period with standard deviation

Treatment option / *Follow-up period*	*Conventional overdenture*		*Mini-poll coping*		*Telescopic crown*	
	Mean	*Standard deviation*	*Mean*	*Standard deviation*	*Mean*	*Standard deviation*
At insertion	2.45	0.095	6.47	0.101	6.66	0.239
1 month	3.58	0.130	8.50	0.500	7.80	0.435
3 months	3.7	0.147	8.56	0.598	8.56	0.452

Table 2: Tukey test results for comparison of dislodging resistance values between the treatment options

Follow-up / *Pairwise comparison of treatment options*	*At insertion*		*1 month*		*3 months*	
	Difference of mean	*Q (p-value)*	*Difference of mean*	*Q (p-value)*	*Difference of mean*	*Q (p-value)*
Convent overdenture—mini-poll	4.02	Q = 90.70 (p = 0.001*)	2.90	Q = 62.23 (p = 0.001*)	4.86	Q = 39.76 (p = 0.001*)
Convent overdenture—telescopic crown	4.22	Q = 95.12 (p = 0.001*)	3.09	Q = 66.44 (p = 0.001*)	4.87	Q = 39.82 (p = 0.001*)
Mini-poll—telescopic crown	0.20	Q = 4.42 (p = 0.009)	0.20	Q = 4.21 (p = 0.013)	0.01	Q = 0.06 (p = 0.998)

*p = 0.001 is significant

The conventional overdenture recorded the lowest resistance to dislodging force when compared with the mini-poll and the telescopic overdenture. This is related to the design of the abutment which provides only support to the overdenture, without providing any retention. The limited height of the abutments doesn't allow friction with the fitting surface of the overdenture This result conforms with Elsherbini[1] and Mekawy et al.[8]

The mini-poll showed similar retention values to the telescopic crown overdenture. The retentive force of the telescopic crown is obtained from the friction between the primary and secondary copings. Telescopic crown provides good retention values when used in overdenture.[1,7,13] This contradicts Bayer et al.,[3] in which they reported that telescopic crown retention values may vary and reach values of down to 0.08 N.

The retention values for the mini-poll are comparable with stud attachments as reported by Mekawy et al.[8] In which it was reported that stud attachments provided around 6.6 N.

For the three groups, there was an increase in the retention values throughout the follow-up period, this is due to the settling of the overdenture, and adaptation of the muscles on the polished surface of the overdenture, leading to more resistance to the dislodging force. This result confirms Milić-Lemić et al. and Elsherbini[14,15] who reported an increase in retention values over the follow-up period.

Patients showed the highest satisfaction for the mini-poll coping as the mini-poll had the conventional number of visits as the conventional overdenture, had better retention values than the conventional overdenture, and was more cost-effective than the telescopic crown. Hakkoum and Wazir[16] reported that patients treated with telescopic crowns were satisfied with their telescopic crowns, however, they complained of longer treatment time.

Limitations of this include that it's a short-term study with just 3 months follow-up. Longer follow-up is required to monitor if wear of the core build material will occur which can have an effect on the long-term effectiveness of the mini-poll in retention.

Conclusion

The mini-poll coping and telescopic crown recorded the highest retentive values.

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