

EFFECT OF DIFFERENT EXTRA CORONAL ATTACHMENT DESIGNS ON THE BIOLOGICAL CONSIDERATION AND BACTERIAL GROWTH IN MANDIBULAR KENNEDY CLASS II CASES (A RANDOMIZED CLINICAL TRIAL)

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ABSTRACT

Aim of study: This study aimed to assess the bacterial growth and biological consideration of two removable partial dentures design retained by two different Extracoronary attachment designs.

Material and Methods: Fourteen Mandibular Kennedy class II partially edentulous patients who had the second premolar terminal abutment tooth were selected. The patients were divided into two equal groups, Group I; participants received partial denture retained by OT cap extra coronal attachment with bilateral cross arch stabilization, Group II: participants received unilateral partial denture retained by OT unilateral extra coronal attachment. To evaluate the biological state of the terminal abutment tooth, measurements of the pocket depth were made on four sides of the tooth. Furthermore, to assess the level of bacterial colonization, microbiological swabs were taken from each patient's buccal, lingual, mesial, and distal abutment surfaces.

Results: the study presented that there was statistically significant difference in the quantitative bacterial culture as group I was significantly higher than group II at all intervals. For pocket depth there was no statistically significant difference between the two groups at time of insertion. On the other side at 3 and 6 months, Group I was significantly higher than group II in pocket depth measurements.

Conclusions: It was found that extra coronal precision attachment (OT unilateral) applies less stress on the abutment teeth and their supporting structures in comparison to OT cap attachment. Moreover, it is more biologically conservative, humble, and more comfortable for the patients.

KEYWORDS: Attachment retained partial denture, Kennedy class II, colony forming unit, pocket depth, partially edentulous patients.

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INTRODUCTION

The restoration of partially edentulous patients with unilateral distal extension base has always been a challenge to the prosthodontists.^{1,2,3} The lack of a posterior abutment and the different support provided by the mucoperiosteum covering the edentulous ridge and the periodontal ligament of the abutment teeth are the primary causes of the issues with distal extension base cases. As a result, the denture base rotates when under pressure, applying undue torque to the abutment teeth and perhaps causing their early loss.^{4,5}

Different treatment modalities are present for unilateral distal extension cases, such as implant supported prosthesis, attachment retained partial denture, and conventional clasp-retained partial denture. Despite the greatest biomechanical advantages of dental implants, unfortunately, they can't be used in some cases due to anatomical, systemic, or financial causes.^{6,7}

Although the clasp retained RPD is less invasive, technically relatively simple, and inexpensive, it suffers from many problems such as, destructive loading, plaque accumulation and periodontal breakdown of the abutment teeth, poor retention, and poor esthetics due to metal display.^{8,9}

Attachment retained partial denture seems to be a good alternative to clasp retained RPD, as it can provide better desirable distribution of stresses on the abutment teeth, better retention and esthetics and greater patient satisfaction.^{10,11}

For unilateral free end saddle situations, a variety of extracoronal attachment options could be utilized.¹² The traditional design of attachment retained RPD for unilateral distal extension cases is frequently bilateral and cross-arch stabilization is typically necessary, which can worsen the patient's oral hygiene and increase biofilm formation on the abutment teeth surfaces. This accordingly can lead to periodontal breakdown with increased pocket depth.

The OT unilateral extracoronal attachment retained partial denture that doesn't span the other side of the arch is considered for this reason an optimal treatment options with better oral hygiene and less plaque accumulation.^{13,14}

The oral cavity is known to contain more than 500 different bacterial species, and wearers of RPD may alter this complex oral microbial environment. Further research into this microbial profile may yield new insights into the long-term periodontal state.¹⁵

Therefore, this study aimed to evaluate the microbiological condition and pocket depth of the terminal abutments in partial denture retained by OT cap extra coronal attachment with bilateral cross arch stabilization versus side plate partial denture retained by OT unilateral extra coronal attachment.

MATERIALS AND METHODS

A parallel randomized controlled trial was the intended design for this investigation. The Ethics Committee of Cairo University's Faculty of Dentistry accepted the study's procedure. Once they gave their consent and signed an informed consent form, eligible participants could begin the study.

From the outpatient clinic of the prosthodontic department at Cairo University's Faculty of Dentistry, 14 partially edentulous patients, in age ranging from 30 to 45, were chosen according to the following inclusion criteria,

- Patients had a mandibular Kennedy class II with the second premolar being the most posterior abutment with appropriate occluso-gingival height of its clinical crown.
- The abutment teeth were with good periodontal health without any symptoms of inflammation or movement.
- There was enough buccolingual and interarch space without any temporo-mandibular joint disorders.

- The opposing dentition had an unbroken arch that was either corrected with a suitable restoration or showed no signs of over eruption or tilting.
- None of the patients had a history of parafunctional habits, and they were all systemically free.

The eligible patients were divided into two equal groups randomly after being assigned a number from a series of opaque, sealed envelopes. Patients in group I received Bilateral Removable partial dentures retained by ball and socket extra-coronal precision attachment (OT CAP attachment) (OT CAP microsize, Rhein 83srl, Bologna, Italy). In contrast, patients in group II: received unilateral (side plate) removable partial dentures retained by another design of extra-coronal precision attachment (OT unilateral) (OT Unilateral, Rhein 83srl, Bologna, Italy).

All the patients had primary maxillary and mandibular alginate impressions. (Cavex CA37; Cavex Holland BV). The condition of the remaining teeth, inter-occlusal spacing, and occlusion were assessed on the mounted diagnostic casts.

The lower 1st and 2nd premolars on the experimental side were prepared for two full porcelain veneered crowns for each of the two groups. Putty and light rubber base impression

material (Zetaplus, Zermack, Italy) were used to create a secondary impression of the prepared teeth, which was subsequently poured into an extra-hard dental stone.

Wax patterns for both crowns were constructed. Using a parallelometer (Parallelometer key for O T cap), the cast was put on the table of the milling machine (BEGO miling machine, Germany) for attachment location. The patrix was positioned approximately 1 mm above the residual ridge and parallel to the long axis of the abutment tooth, vertically perpendicular to the underling ridge, in accordance with the wax pattern of the final abutment tooth.

To accommodate a lingual bracing arm, a ledge was created on the lingual surface of the first and second premolar wax patterns. The crown-attachment assembly was then created by sprueing, investing, burnout, and casting the attachment patrix and the crown wax design together as a single unit using nickel-chromium alloy.

The final crown attachment assembly was tried in the patient's mouth and temporarily cemented following the metal try-in. (Figure 1)

A Double Aker's clasp at the dentulous side and an OT CAP extra-coronal attachment attached to two cast crowns splinting the first and second premolars of the edentulous side held the prosthesis

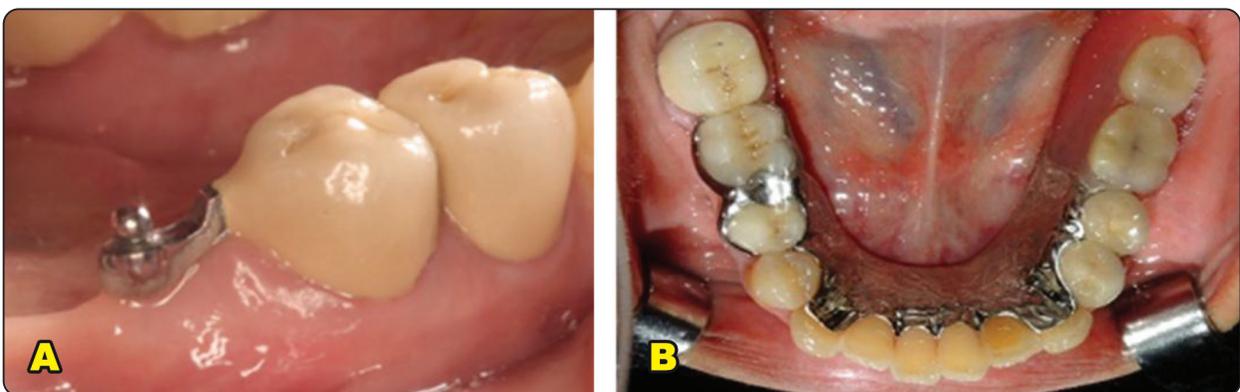


Fig. (1) A: The final crown attachment B: The RPD's metal structure within the patient's mouth

in place during the bilateral design utilized in group I. This design adhered to the principle of cross arch stabilization of the prosthesis with a lingual plate major connector. It was decided to install the Double Aker's clasp on both the first and second premolars. Through the lingual rests on the canines, the terminal extremities of the lingual plate function as an indirect retainer.

The first molar's occluso-mesial rest seat and the second premolar's occluso-distal rest seat were constructed on the intact side. On the lingual surface of the lower canines, lingual rest chairs were set up. A rubber base pick-up impression of the crown's attachment assembly was made overall after the assembly was checked.

The RPD framework's wax pattern was built up and the metal framework's try-in was completed on the refractory cast. Following the creation of an altered cast impression of the free end saddle area and the recording of the centric relation using an appropriate technique, the prosthesis was processed and finished, and artificial teeth were fitted and tried in.

The retentive cap inserting tool was used to snap the retentive cap into the denture's fitting surface. The patient was asked to return the following day for the final delivery of the RPD after the crown-attachment assembly was ultimately firmly sealed

using glass ionomer cement.

The intact side of the lower arch in group II was not prepared in any way. The UNI Box was cast into a cobalt-chromium metal framework after being connected to the castable connector using resin.

As previously mentioned, an altered cast impression was created for the framework's distal extension. Following the final cementation of the crown-attachment assembly, the patient was asked to return the following day for the RPD's final placement. After waxing the saddle, heat-curing acrylic resin was applied, and the retentive caps were inserted inside the framework. (Figure2)

Retentive caps were changed annually in group II (OT Unilateral attachment) and every six months in group I (OT CAP attachment). One week and twenty-four hours following delivery, all patients were summoned back. to get rid of any complaints from patients that can come up in the early stages of prosthesis adaptation. Upon receiving dentures, patients were encouraged to adhere to a regimen of good oral and denture cleanliness.

Clinical assessment:

Microbiological evaluation

Subgingival samples were collected at time of insertion, 2, 4, 6, and 8 weeks after denture delivery

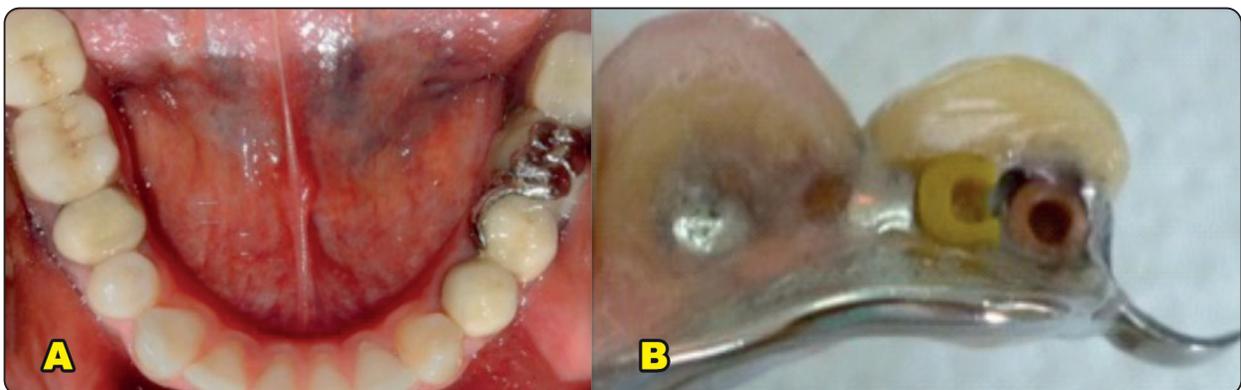


Fig. (2): A The patient's final prosthesis in place, B: Retentive caps hold in the framework.

from buccal, lingual, mesial, and distal surface of the abutment second premolar teeth. Patients were asked to wear their partial dentures for a few hours prior to submitting swabs, which were taken in the morning at nearly 10 o'clock. Additionally, they were told not to eat anything prior to the swab sample.

The gingiva surrounding the abutment was separated and given time to air dry before the swab was taken. Sterile paper point was inserted in the sulcular depth of the abutments and left in place for 10 seconds. After that the swab was pooled in 1ml of sterile saline for the inoculation.

Each sample underwent three sterile dilutions, producing sample dilutions of 10-1, 10-2, and 10-3. Using a micropipette, 50 microliters of each dilution were plated onto a blood agar plate. The sample was then spread out using a sterile glass rod, and the plate was incubated for twenty-four hours at 37°C.

For the quantitative assessment, each organism's visible colonies were counted visually on each plate. The colony-forming units (CFU) per milliliter on each plate was then calculated through multiplication by the appropriate dilution factor and by 10 to get the projected total number of colonies per milliliter of suspension.

Pocket depth evaluation

At the time of denture insertion, three months, and six months following denture delivery, all patients had clinical and radiographic evaluations. Williams graded periodontal probe was used to measure the probing depth to clinically evaluate the gingival condition surrounding the abutment teeth in both groups of patients. Six sites were used to measure the probing depth for the final abutment: the mesiobuccal, midbuccal, distobuccal, mesiolingual, midlingual, and distolingual aspects.

Along the long axis of the measured tooth, a probe was carefully inserted inside the gingival sulcus. Every abutment's mean value was then determined based on the recorded data. (Figure3)

RESULTS

To determine the ideal sample size, the T test power calculation was employed. As per the findings, a minimum of 14 participants per group was considered an acceptable sample size. One Way ANOVA was used to compare different intervals, and Tukey's Post Hoc test was used for multiple comparisons. The independent t-test was used to compare groups. The Pearson's correlation coefficient was also used for all correlations.

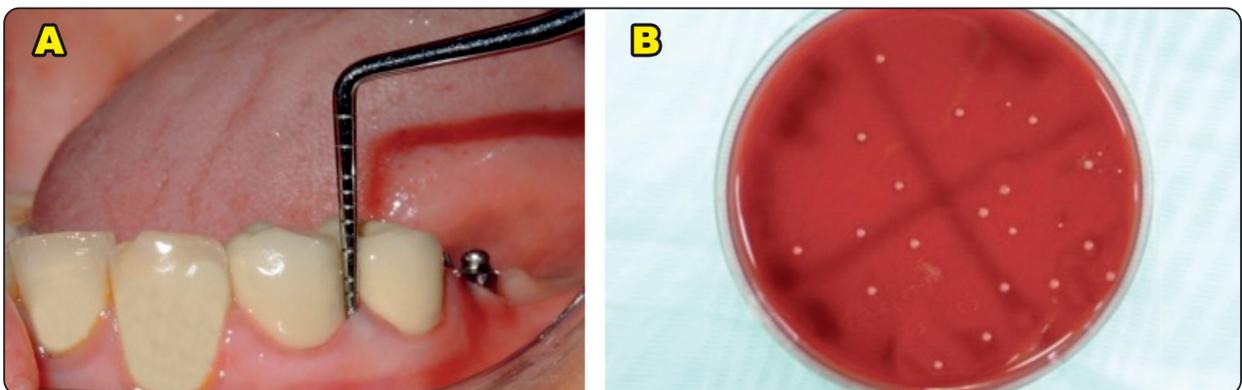


Fig. (3): a) Probing depth for the experimental side, b) Blood agar bacterial culture

Bacterial evaluation (CFU)

According to this study, group I outperformed group II at all intervals. Furthermore, a substantial rise was seen in group I and II from (27.67 ± 2.89) and (21.00 ± 2.22) at insertion to (78.83 ± 8.6) and (60.33 ± 4.74) after 8 weeks, respectively. This difference persisted across all intervals in both groups (P<0.0001). (table 1), (figure 6).

Evaluation of Pocket depth (PD):

An analysis of the two groups showed that, at the time of insertion, there was no statistically

significant difference between them. After 3 and 6 months: Group I was significantly higher than group II at all intervals. Additionally, there was a significant difference between all intervals in both groups as there was a significant increase from (1.04 ± 0.46) and (0.67 ± 0.18) at insertion to (2.77 ± 0.74) and (1.86 ± 0.19) after 6 months regarding group I &II respectively. (figure 4)

Regarding pocket depth and colony forming unit, a correlation was done between the two groups. There was a strong/ positive / significant correlation between CFU and PD. (Table 2).

TABLE (1) Mean and standard deviation bacterial colonies forming units in both groups at different intervals.

Colony Forming unit	GROUP I (Ot attachment)		GROUP II (Ot unilateral)		P value (Independent t test)
	M	SD	M	SD	
At time of insertion	27.67 a	2.89	21.00 a	2.22	<0.0001*
2-WEEK	42.83 b	3.11	32.50 b	4.23	<0.0001*
4-WEEK	51.50 c	7.05	41.50 c	3.07	<0.0001*
6-WEEK	61.50 d	4.55	51.83 d	4.13	<0.0001*
8-WEEK	78.83 e	8.60	60.33 e	4.74	<0.0001*
P value (One Way ANOVA test)	<0.0001*		<0.0001*		

Standard deviation (SD) and mean (M) at P ≤ 0.05

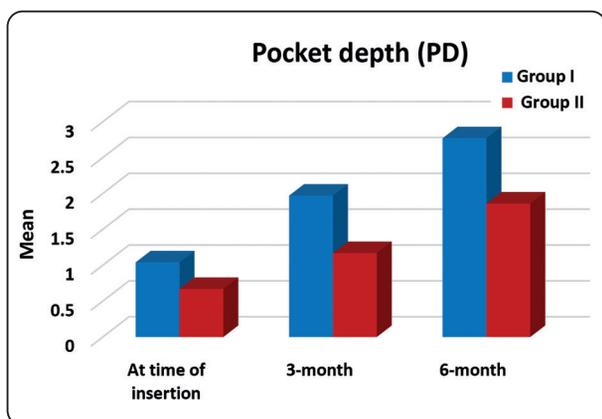


Fig. (4): bar graph displaying pocket depth at different intervals for both groups.

TABLE (2) Correlation between CFU and PD in the two groups

	Group I		Group II	
	CFU	PD	CFU	PD
CFU	-----	0.80 (0.001*)	-----	0.81 (0.002*)
PD	0.80 (0.001*)	-----	0.81 (0.002*)	-----

DISCUSSION

To minimize human error and rule out any element that could skew the study's findings, patients were carefully chosen and evaluated. A thorough medical history, a clinical assessment, and laboratory research were used to accomplish this.

Patients with fully dentate or partially dentate maxillary arch restored with fixed restoration were selected for standardizing the opposing occlusion effect and hence the range and distribution of forces transmitted to the mandibular arch. Furthermore, none of the patients had a history of parafunctional habits.

The carefully chosen patients were free from any systemic diseases or TMJ disorders that may affect the results of this study.^{16,17}

There was enough interarch space in all the selected patients as interarch and buccolingual space are crucial clinical factors when selecting ball attachment and its retentive matrix. This was to avoid problems that can occur when limited inter-occlusal distance is not recognized.¹⁸

In this study partial dentures retained with attachments were selected. Attachments had many benefits including minimization of stress and elimination of metal display which improves esthetics.¹⁹

It was stated that it is possible to restore distal extension areas with unilateral attachment without the necessity for crossing the arch. Authors of a study claimed that the support of RPD and its connection with fixed prosthesis produces cross arch stability during the masticatory activity and permits function like that of fixed prosthesis.²⁰

Unilateral attachment can offer lateral stability and distal support to the prosthesis. Additionally, it proposes better retention, managed resilience, general functionality, and cost-effective solutions.^{21,22}

All patients were given the same instructions at the time of delivery regarding how to utilize their dentures, which included taking them out at night to allow their oral tissues to heal.

Additionally, patients were told to rinse their dentures under running water after every meal, avoiding the use of any chemicals or other devices that can alter the microbial flora and plaque accumulation.

To schedule the sample collection period and to avoid the impact of food on the microbial flora, the samples were collected in the morning almost simultaneously before consuming any type of food. To allow for denture adjustment and ensure that the patients were comfortable wearing the new denture, further swabs were obtained at intervals of 2, 4, 6, and 8 weeks following the date of placement.²³

Because *Streptococcus sanguinus* is the earliest bacterium to colonize dental surfaces and restorative materials, it was selected for microbiological evaluation. It is also easily isolated and identified using inexpensive, low-tech experimental methods.²⁴

Probing pocket depth (PD) was evaluated using a Williams Probe from the crest of the gingival margin to a probable pocket depth and read to the nearest millimeters (mm). Measurements were made in the four surfaces in abutment teeth: Mesial, oral, distal, and vestibular surfaces. Scores ranging from 0 to 3 represented the highest PD observed: 0 - Normal probe depth of 2 mm or less; 1 - Probe depth of about 2 mm, but not >3 mm; 2 - Probe depth >3 mm but <5 mm and 3 - Probe depth greater than 5 mm or more.^{24,25}

Studies have suggested that minimum two teeth on each side should be splinted when extra-coronal distal extension attachment prostheses are used.^{26,27}

Results from the bacterial count indicated a significant difference between all intervals in both groups. These findings are consistent with those of a different study that involved 11 women who underwent unilateral or bilateral free-end saddle RPD in the mandibular arch. Abutment, non-abutment, and antagonist teeth's clinical and microbiological characteristics were evaluated at baseline (RPD installation) and after 7, 30, 90, and 180 days of operation.¹³

Following 180 days, both the total and individual microbial genome counts showed a considerable rise, and after six months of denture loading, the microbial counts overall showed a significant increase. This may be explained by the claim that RPD can increase the risk of dental plaque, gingivitis, and root caries.²⁸

At the time of insertion, there was no significant difference between pocket depth in both groups as shown in another study compared pocket depth for abutment and non-abutment teeth in 107 partial denture wearer and found significant increase in pocket depth of abutments after 3 months, although the mean pocket depth of the abutment teeth and non-abutment teeth were no statistically significant at the time of insertion of RPD. And this may be due to the lack of oral hygiene and health care management.²⁹

Another study observed an increased prevalence of plaque, gingival recession, and gingivitis, especially on dentogingival surfaces within 3mm proximity to the dentures. Furthermore, it was stated that probing depth had increased significantly in abutment teeth compared to non-abutment teeth at a follow-up period of 3 months^{30,31}, this resembles the results of this study showing a significant difference in pocket depth between all intervals in both groups.

Again, in prior research on removable partial denture wearers, there was a significant difference between all intervals in both groups. These investigations demonstrated that RPD users' pockets got deeper and more numerous with time.^{32,33}

The findings of this study are consistent with those of other studies in that OT unilateral attachment has little effect on the supporting structures of the abutments. This may be because, unlike OT cap attachment, which requires cross-arch stabilization, OT unilateral attachment has the advantage of not requiring the preparation of additional abutment teeth, minimizing the bulk of material in the mouth, and reducing the areas of soft and hard tissue coverage.¹

The results indicate that RPD's wearers should be motivated for extra adequate oral hygiene instructions. To eliminate the periodontal damage caused by RPD's regular recall system is strongly recommended.³⁴

Some clinical studies have shown that after the regular examinations, reinstructions, and the patient's remotivation oral hygiene maintenance, RPD's will not cause changes in periodontal abutment teeth.³⁵

CONCLUSION

In this RCT study, the unilateral OT attachment system was more conservative to the abutment teeth as it showed less bacterial colonization and less pocket depth. In addition to its biological advantages, it can function well regarding retention and stability. Therefore, it was concluded that OT unilateral attachment is preferred and can provide better prognosis for the abutment teeth in comparison with OT cap attachment with bilateral design.

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