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Effect of Different Treatment Modalities on The Supporting Structures of Lower Kennedy Class II cases with Pier Abutment

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Abstract:

Aim: The aim of this study was to evaluate and compare the effect of different treatment modalities on the supporting structures of lower removable partial dentures rehabilitating unilateral distal extension saddles with pier abutments.

Materials and Methods: This study was conducted on twenty one partially edentulous patients having lower unilateral distal extension edentulous space (Kennedy class II) with a second premolar as a pier abutment. Selected patients were randomly divided into three equal groups; distal-extension removable partial dentures (RPD) were constructed for all patients following the same design except that; for group I, an implant was surgically installed in the modification space and was restored by independent cement retained porcelain fused to metal (PFM) crown before RPD construction. For group II, the pier abutment was splinted to the canine with a fixed partial denture before RPD construction. For group III, the denture design was modified to restore both the free end edentulous space and the modification space anterior to the isolated abutment. Follow-up visits were scheduled; data collection was performed at time of denture insertion, six, twelve months later.

Results: The greatest increase in both bone loss and pocket depth values was evident in group III patients. There was no statistically significant difference between group I & group II patients in the measured parameters.

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Conclusion: the use of fixed partial dentures or implant supported crowns to restore the arch integrity anterior to the distal extension bases could be considered a suitable line of treatment.

Introduction:

Functional forces applied to the distal-extension bases create an axis of rotation around the most distal abutment teeth subjecting them to distal tipping, rotation, torque and horizontal movement. When the most distal abutment is isolated one, it will be subjected also to mesial tipping due to lack of mesial contact, promoting a fulcrum like situation of mesiodistal torqueing leading to rapid destruction of its supporting periodontium. [1, 2]

Different treatment modalities have been recommended to reduce harmful forces directed to pier abutments. One of them involves splinting of the pier abutment to the nearest tooth by a fixed partial denture. Splinting creates an intact dental arch anterior to the free end edentulous space; stabilizes the abutment teeth in a mesiodistal direction and provides multiple abutment support. [1, 2]

The design of the distal-extension removable partial denture is a challenge when a solitary tooth is to be used as an abutment. Investigators recommend that pier abutments not be clasped but may receive two rests. [3] The use of only two proximal plates on the mesial and distal surfaces of the isolated tooth to minimize lateral forces directed to it also has been described in the literature. [4]

Nowadays many of problems associated with removable partial denture design can be solved with proper placement and use of one or more implant. Such therapy can result in exceptionally stable, retentive and esthetic restorations that are biomechanically sound and readily maintained. [2] It has been reported that restoring the modification space anterior to the pier abutment by independent implant supported crown can completely eliminate the fulcrum like situation associated with the pier abutment. [5]

In the dental literature, there is no consensus regarding treatment planning for lone standing abutments; there is little scientific evidence about the consequences and differences of splinting or not splinting isolated teeth. [2] So the idea of the current research was to investigate three different treatment modalities for unilateral distal extension cases with pier abutment, to determine which of them is more clinically and radiographically favorable for the health of the supporting structures.

Materials and Methods:

Twenty one partially edentulous patients were selected from the out-patients clinic, Prosthodontic Department, Faculty of Dentistry, Ain Shams University, to share in this study, according to the following criteria: Patients had lower unilateral distal extension edentulous space (Kennedy class II) with a second premolar as a pier abutment opposing dentate or partially dentate maxillary arch , Patients had substantial bone height and width at the modification space anterior to the pier abutment to accommodate a standard size implant, the remaining teeth free from any periodontal disease; with adequate bony support and free from mobility. The following patients were excluded: Patients with parafunctional habits, temporomandibular joint and neuromuscular disorders, Smokers, Patients receiving or undergoing radiotherapy or chemotherapy, and Patients with systemic diseases affecting bone metabolism.

Patients were randomly divided by special computer software into three equal groups, seven patients each:

Group I: Patients in this group were rehabilitated with a conventional distal extension removable partial denture after restoring the modification space by independent implant supported crown.

Group II: Patients in this group were rehabilitated with a conventional distal extension removable partial denture after splinting the isolated second premolar abutment to its neighboring canine by a fixed partial denture.

Group III: Patients in this group were rehabilitated with a conventional distal extension removable partial denture that also restored the modification space anterior to the pier abutment.

For group I patients' surgical installation of the implants was performed under strict aseptic conditions and delayed loading protocol was followed, each implant was restored by independent cement retained porcelain fused to metal (PFM) crown. **(Fig.1, 2)**

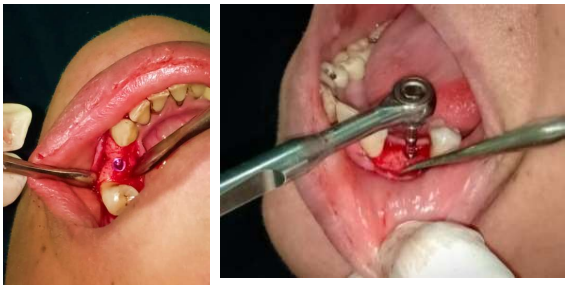

Fig.(1): Implant surgical placement.

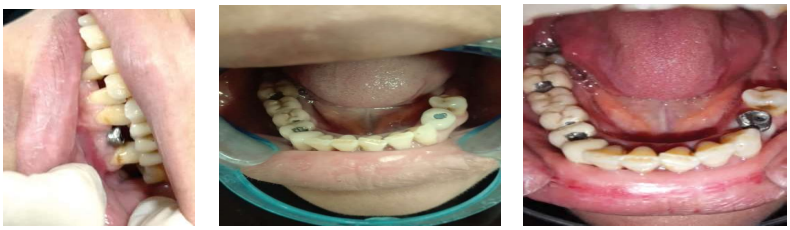

Fig.(2): Implant restoration.

For group II patients the pier abutment (the second premolar) was splinted to the canine with a fixed partial denture. The veneered bridges were surveyed to verify that their contours were suitable to support, retain and stabilize the removable partial denture and were adjusted on the milling machine whenever needed. **(Fig.3)**

Fig.(3): Porcelain veneer bridge fabrication for group II.

Removable partial dentures were constructed for all patients following the same procedures. For group I and group II patients the denture was designed with

lingual bar as major connector, double Aker clasp on the first and second molars on the intact side; a gingivally approaching clasp (RPI) on the last standing abutment on the edentulous side(the second premolar), cingulum or occlusal rest was used as indirect retainer on the intact side. For group III, the denture design was modified to restore both the free end edentulous space and the modification space anterior to the isolated abutment, two proximal plates were designed to barely contact prepared guiding planes on mesial and distal surfaces of the isolated abutment and were designed to promote disengagement during function, while the gingivally approaching clasp (RPI) was placed on the canine. **(Fig.4)**

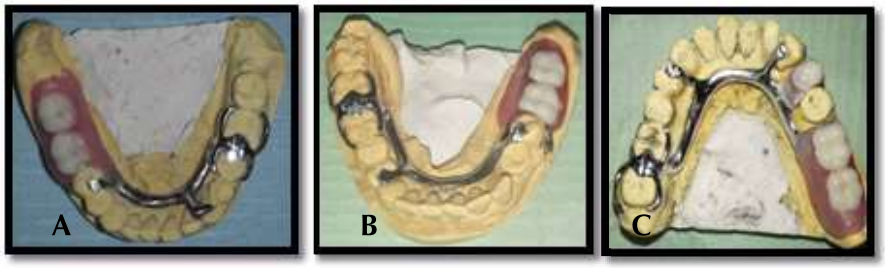

Fig.(6): RPD design for group I (A), group II (B) and group III (C).

Follow-up visits were scheduled and data collection was performed at time of denture insertion, six, twelve months later. The bone changes were assessed using digital periapical radiography (GXS-700™), following the paralleling technique. Marginal bone height changes mesial and distal to the implants, the principal abutments and 10mm from the distal aspect of the pier abutment were calibrated using the special software linear measurement system supplied with the GXS-700 digital sensor. The pocket depth was measured using William's graduated periodontal probe. **(Fig.5)**

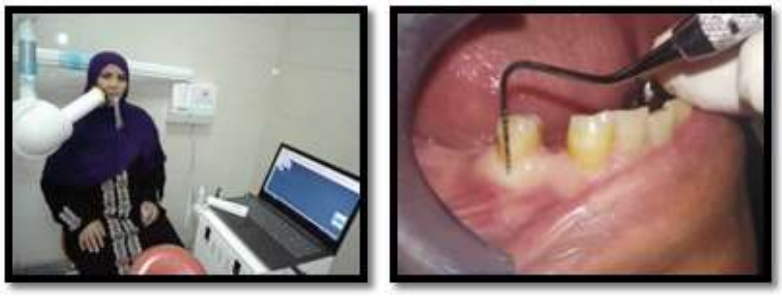

Fig.(5): Radiographic and clinical evaluation.

A computerized file was created for each patient including the measured pocket depth values and the radiographic bone height measurements through the entire follow up period. Collected data was tabulated for statistical analysis.

Results:

The results obtained from this study revealed that:

The greatest increase in both bone loss and pocket depth values was evident in group III compared to group I & group II, the difference was statistically significant ($P < 0.05$).

Although there was no statistically significant difference between group I & group II ($p>0.05$) in the measured parameters, more favorable results were observed for group II compared to group I as regards to bone height changes. On the other hand, an increase in pocket depth was more evident for the abutments bearing the fixed partial dentures in group II compared to group I abutments.

The mean value of peri implant bone loss was (0.88mm) which is within the permissible range reported to occur within the first year of implant placement.

Discussion:

Discussion of Materials and Methods:

For group I patients the two-stage surgical protocol was followed as it has been established that obtaining soft-tissue coverage over the implant and maintaining a minimally loaded implant environment for 3 months reduces the bacterial infection, prevents apical migration of the oral epithelium along the body of the implant, allows time for proper osseointegration, and minimizes the risks related to early implant loading during bone remodeling. [6] Closed tray impression technique was employed not only due to more simple application and lower impression time, but also it permits more accurate visual fastening of the analog to the coping. [7] The crown was fabricated with an occlusal screw access hole, allowing for the crown to a stock abutment on the laboratory model, taking the mechanical advantage of screw retention; in addition extraoral cementation technique allowed easy and complete cement removal prior to intraoral placement. [8, 9]

For group II, The bridge wax pattern was evaluated at the wax up stage to make sure that rest seat had proper position, form and adequate thickness. To ensure the porcelain veneer bridge was made satisfactory for all requirements of support, stabilization, and retention of the removable partial denture the added step of contouring the veneered surfaces on the milling machine before the final glaze was essential. [2, 10]

To obtain standardized serial radiographic images and to overcome the errors in the reproducible alignment of successive images, the parallel direct digital radiographic technique was employed in this study. This ensured standardized film focal distance, angulation and reproducible position in relation to the abutments and the x-ray source. [11, 12]

Discussion of results:

Splinting the isolated 2nd premolar to the canine by a fixed partial denture provides multiple rather than single abutment support, acts to stabilize the at-risk tooth, overcomes antroposterior, mediolateral and torque forces and provides wider load distribution. [1, 2] Restoring the modification space by an implant supported crown completely eliminated the fulcrum like situation associated with the pier abutment [5]; these may explain the better results detected in group I and II. In group III, the statistically significant decrease in bone height as compared to group I and II could be attributed to the inevitable mesiodistal torqueing of the isolated 2nd premolar that lacks proximal contact and generally has round and tapered root, so more likely to be damaged by the forces applied to distal extension removable partial denture. [1, 2] Also the increase in denture pivoting around the more anteriorly placed fulcrum axis, having multiple rotational axes could result in more traumatization of all supporting tissues. [2] Increased bone loss around the canine is most probably due to that more retentive forces needed to be driven from this abutment to keep the denture in place; this may be also attributed to the potential increase in torqueing action around the long axis of the tooth induced by the longer effort arm. [13]

The greatest increase in the pocket depth value recorded in group III patients could be attributed to the destructive changes affecting the pier abutments supporting periodontium in absence of fixed splinting or restoration of the modification space, [14] also crossing the gingival margin of the canine by the retentive terminal of the I-bar arm probably resulted in irritation of the buccal mucosa and trapping of food debris.[15] More but insignificant increase in the pocket depth values was recorded for group II patients compared to group I patients. This is most probably attributed to the crowning of the abutment teeth in group II patients; margins of fixed splints may cause gingival irritation if they encroach on the gingiva, fixed splints also compromise periodontal health care as the pontic overhang and the wide joints between the units of the splint can interfere with oral hygiene measures. [16, 17]

Conclusion:

Within the limitations of this study, it may be concluded that; the least successful removable partial denture design is that when tooth-bounded modification area in conjunction with isolated abutment teeth and distal extension bases is replaced with removable partial denture, while using fixed partial dentures or implant supported crowns to restore the arch integrity anterior to the distal extension bases can be considered a suitable line of treatment.

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