

## **BONE RESPONSE TO DIFFERENT IMPLANT ABUTMENT CONNECTIONS IN IMMEDIATELY LOADED PARTIAL OVERDENTURES; A RANDOMIZED SPLIT MOUTH CLINICAL TRIAL**

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### **ABSTRACT**

**Introduction:** Management of long span anterior edentulous area is considered a prosthodontics challenge related to many problems as length of the span, as well as functional principles are considered upon diagnosis, in addition to other biomechanical consideration and esthetics.

**Materials and Methods:** This study was carried out to detect the effect of using different implant abutment connections on supporting structure of implants supported partial overdenture in maxillary Kennedy class IV cases with immediate loading. Ten male patients were selected each patient received maxillary two implants, one with platform switch connection and other with conventional platform design. Both implants were immediately loaded with partial overdenture through a pair of locator attachment. Radiographic evaluations for bone height changes around installed implants were carried out at the time of overdenture insertion and after 3, 6 and 9 months follow up.

**Results:** A statistically significant difference between the two implant designs was reported for all the follow up periods with Platform switched implant showing less values of bone loss compared to conventional platform implant.

**Conclusion:** The current study concluded that platform switching with immediate loading protocol are capable of reducing the amount of crestal bone loss.

### **INTRODUCTION**

Dental management of the missing teeth in the anterior area should always fulfil the aesthetic as well as functional principles through meticulous diagnosis and accurate execution of the proposed treatment plan<sup>1</sup>. The presence of the term “aesthetic” may serve to beautify a procedure, but

in reality, this is an adjective that must be inherent to any formula applied to the anterior zone. Today’s dental patient are expecting an aesthetic result from the practitioner and current standards dictate the importance of avoiding procedures that will result in aesthetic compromise as well as the concept of providing patients with improved aesthetics whenever possible<sup>2</sup>.

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There are many factors that might influence the results of the smile analysis during diagnosis and planning as the appearance of gingival tissue surrounding the tooth, lips support, proper position of the lip line, the contour of the gingival margin and the most important factor is the anterior teeth that must be symmetrical and in harmony with each other.<sup>3-4-5</sup>

Loss of anterior teeth can be either solved by fixed restoration supported by implants or by a removable one which might also be supported by implants, the fixed option has some shortcomings when compared to the removable one due to its higher cost and increased number of implants in addition to its bone volume requirements which might be compromised in cases with anatomical limitation or bone defects. On the contrary the removable one will be supported with less number of implants which will reduce the cost as well as having an acrylic flange will be considered a plus in cases which need lip support.<sup>6,7</sup> Over and above overdentures provide a satisfactory option due to preservation of residual ridge adjacent to the abutment tooth, as well as improved retention and stability which will increase the chewing efficiency, preserve the vertical dimension of the ridge and ease of removal from the mouth which provide better abutment and prostheses hygienic control.<sup>8,9</sup> Finally the rotation of the over-dentures around the implant attachment to settle on the resilient soft tissues of the ridges decrease the stresses on the implants.

Implant supported partial over denture is considered the treatment of choice when the ridge show considerable resorption allowing few implants to be placed, unfavorable ridge relationship, the opposing arch restored with denture or the opposing anterior teeth have compromised prognosis, medically compromised patient who needs less surgical procedure and when the financial limitation prevent the use of fixed prostheses.<sup>10,11</sup>

It was believed that, non-loading of endosseous dental implants for a period of 3 to 6 months after insertion, was necessary for successful osseointe-

gration. This period may be inconvenient for some edentulous patients especially in the esthetic zone because of the delay of final rehabilitation or difficulty in wearing a conventional denture during healing period. During the last 10 years, researches have increasingly focused upon immediate loading after implant placement. The use of immediate loading protocols has obvious advantages for the patients, which include reduction in the number of surgical interventions and in the overall treatment time. Furthermore, there is substantial evidence that immediate loading of implants can be carried out without jeopardizing the survival rates, providing high initial stability of the implant and controlled loads.<sup>12</sup>

The maintenance of peri-implant bone is a major factor in the prognosis of prosthetic rehabilitation supported by implants; the crestal bone loss can also lead to a collapse of soft tissues and adversely affect the aesthetics of implant-prosthetic elements after the insertion of the implant and its prosthetic connection, crestal bone undergoes remodelling and resorption processes<sup>13</sup>. In an attempt to improve long-term bone maintenance around implants, a new implant-to abutment connection referred to as "platform switching" has been proposed.<sup>14</sup> This type of connection moves the perimeter of implant abutment junction (IAJ) to the center of implant axis, which is more likely that moving the IAJ inward brings out bacteria more internally and, therefore, away from the bone crest; this would explain the limitation in bone resorption<sup>15,16</sup>

From this point, this study was carried out to evaluate the effect of different abutment connection combined with immediate loading protocol of implants on the supporting structure of implants used in maxillary implant supported partial overdentures restoring long span anterior edentulous area.<sup>17-18-19</sup>

## MATERIAL AND METHODS

Ten maxillary male patients with long maxillary Kennedy class IV were selected from the Outpatient Clinic of the Prosthodontics Department, Faculty of Oral and Dental Medicine, Cairo University

with good oral hygiene and free from any systemic diseases that affect osseointegration or bone resorption around the implants. Oral and general examinations were carried out accompanied by laboratory investigations including complete blood picture and glycosylated hemoglobin level. The opposing occlusion was set to be natural teeth or fixed restoration. Patients with apparent TMJ troubles or abnormal oral habits as well as those having anterior malocclusion were excluded. This research has been approved by the local research ethics committee and informed consent have been taken from selected patients before any clinical intervention. Preoperative panoramic radiograph as well as Cone Beam Computed Tomography (CBCT) images using was done to evaluate bone volume at the proposed implant sites.

Study casts were obtained from an alginate impression followed by final impression using polyvinyl siloxane material in a special try to obtain a master cast which was mounted on an articulator according to centric jaw relation record. Artificial teeth with matching color, shape and size to adjacent natural teeth were set and try in was done to authorize patient approval. A waxed-up partial denture was duplicated into clear acrylic resin to be utilized as surgical stent, to locate the exact position of the implant during surgery. The finished dentures were delivered to the patients and any occlusal interferences were detected and corrected.

Each patient was planned to receive two implants at anterior area with same surface treatment, diameter and length, but with different implant abutment connection as one with conventional design (Group I) and the other with platform switch design (Group II). It was also intended for both implants to receive a locator abutment to retain the partial overdenture. When the patients were ready for surgery, full thickness flap was raised to expose the bone followed by sequential drilling till reaching the desired size of the osteotomy. For

the conventional implant design\*, bone tapping was done using engine driven bone tap at a speed 300 RPM and torque of 35N/cm to the full depth till the final length of implant. Then the implants were threaded till the smooth part of the implant flushes with the bone. While for platform switch implant design\*\* after completion of osteotomy sites, platform was done using counter sink drill at a speed of 1000 RPM and a torque of 30-45 N/cm. The actual diameter of the countersink drill is 0.1mm larger than the fixture platform. So that the top level of fixture needs to be located 0.5mm below the marginal crestal bone level, moreover the drilling depth of the countersink was done and the implant was threaded until the implant top flushes with the alveolar bone surface fig.(1).

After implants placement primary stability was judged for immediate loading using torque wrench to guarantee that insertion torque exceeds 35N/cm and also it was evaluated using Osstel device to ensure that the ISQ value exceeds 65, then locator abutments were screwed to both implants and torqued to 20 N/cm fig (2).

The partial dentures were relived opposite to the locator abutments, the two female sockets with their metal housing were then placed on their abutments in the patient mouth and were directly picked up into the fitting surface of the partial overdenture using self-cure acrylic resin while the patients were asked to close in centric occlusion firmly until polymerization had taken place, then excess material was removed and dentures were finished, polished and delivered to the patient Fig (3). Patients were instructed how to remove and insert their dentures as well as sticking to a soft diet especially on the anterior area for one month, and were also motivated for meticulous oral hygiene and plaque control measure. All patients were recalled every 3months for checkup and digital x-rays which were done at the time of delivery (base line), 3, 6 and 9 months to evaluate the implants supporting structures. Fig (4)

\* Simple line II , Dentium implants, Korea.

\*\* Supra line II , Dentium implants, Korea.

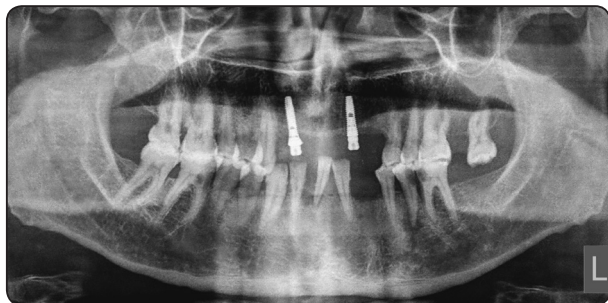


Fig (1) Panoramic radiograph showing the two implants with different platform designs



Fig (2) Locator attachment installed on implants intraorally



Fig (3) Finished partial denture after pickup of locator housings

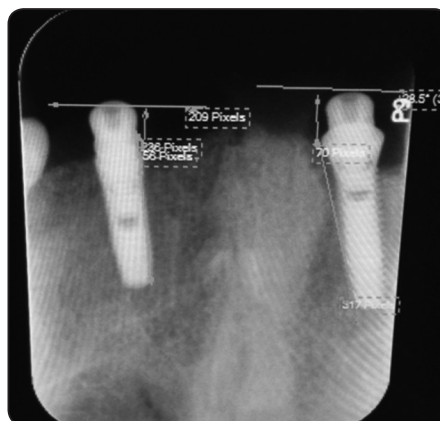


Fig (4) Bone height measurement on the Digora software

## RESULTS

### Bone Height

This study was classified as case-control study and was performed to evaluate bone height around immediately loaded implants with locator attachments during nine months follow up period between platform switch and non-platform switch implant. Measurements were taken mesially and distally to the implant .In each group, there was no statistically significant difference between bone height measurements at the mesial and distal sides, so the mean of the two sides will be used for further comparisons.

For more accurate significance, mean change percentage was calculated for both groups for each follow up interval using the following equation

$$\frac{\text{Bone height (Base line)} - \text{Bone height (Post-operative)}}{\text{Bone height (Base line)}} \times 100$$

Using t test for comparison between both groups regarding bone height, there was insignificant difference between both groups at the baseline which indicated the absence of any bias during this study as (P value > 0.05).

While during three, six and nine months follow up period, there was significant difference between both groups as listed in table (1)

After mean change percentage calculation, t test was performed to calculate and significance between both groups which concluded that there was significant difference between both groups as (P-value < 0.05), listed in table (2).

TABLE (1) Comparison between bone heights measurements of the two groups during nine months follow up period:

Group Period	Platform switch		Non-Platform switch		P-value
	Mean	SD	Mean	SD	
Base line	1.94	0.50	1.38	0.18	0.113
3 months	2.20	0.53	1.65	0.14	0.078
6 months	2.50	0.62	2.16	0.23	0.214
9 months	2.79	0.66	2.62	0.20	0.575

*M; Mean, SD; Standard deviation, P; Probability Level \*\*significant difference*

TABLE (2) Mean change percentage for both groups for each interval:

Group Period	Platform switch		Non-Platform switch		P-value
	Mean %	SD	Mean %	SD	
Base line – 3 months	14	6.3	21	15.3	0.345
Base line – 6 months	29.6	7.6	58.2	24.6	0.080
Base line – 9 months	45.4	14.8	89	25.4	0.030*

*M; Mean, SD; Standard deviation, P; Probability Level, \*\*significant difference*

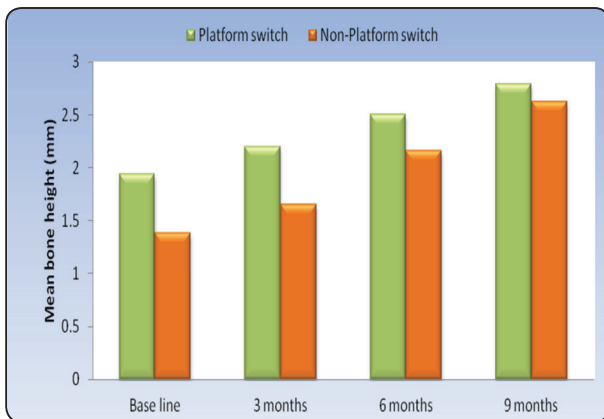


Fig. (5) Bar chart representing comparison between bone height measurements in the two groups

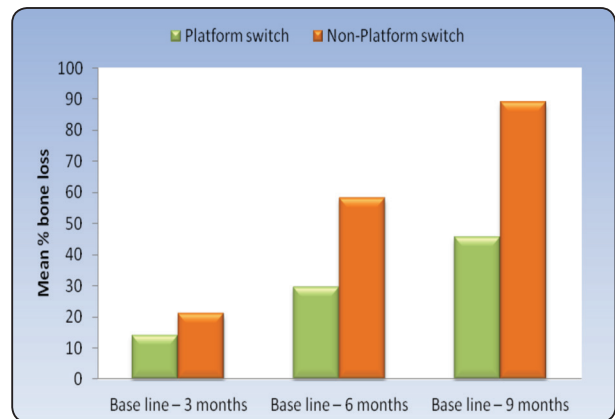


Fig. (6) Bar chart representing comparison between percentages of bone loss in the two groups

## DISCUSSION

Loss of anterior teeth especially upper anterior is considered one of the reasons for psychological upset and even social problems to the patients. There is no doubt that the most accepted line of treatment for such cases is a fixed restoration due to its superior advantages over the removable one. However, there are some cases that cannot be treated with fixed restoration and the only line of treatment may be removable prosthesis. Among these cases is the long anterior edentulous span and need for lip support.<sup>20</sup>

Functional stability and preservation of the remaining alveolar bone are primary objectives when restoring the partially edentulous arches. The incorporation of dental implant to support removable prosthesis can fulfill these objectives.<sup>8,21</sup>

The constructed partial overdentures in this study were minimally extended in the palate with no direct retainers or occlusal rests, as dentures were mostly retained and supported by implants on both sides. Patients of both groups were satisfied and accommodated to their dentures successfully in a short time after insertion, which may be most probably related to the design simplicity of the partial denture, having no traditional components. Moreover, the area of palatal tissue coverage was relatively less, allowing the tongue to move freely and the tissues to feel normal.

The clinical outcome of the present study demonstrated some differences in the outcome between immediately loaded platform switched and conventional implants designs in the Kennedy class IV cases after nine months follow up.

The reasons for the reduced bone loss observed in platform- switched implants in the present study can only be speculated upon the horizontal inward repositioning of the implant–abutment interface has been suggested to overcome some of the problems associated with two-piece implants. Platform switching may increase the distance between the

abutment-associated inflammatory cell infiltrate and the marginal bone level, consequently decrease its bone-resorptive effect. Also, there might be a reduction in the amount of marginal bone loss necessary to expose a minimum amount of implant surface to which the soft tissue can attach.<sup>22-23</sup>

Another reason for reduced bone loss in the present study that platform switching implants with micro- threads in the marginal portion were used. The possible influence on such a design on the marginal bone loss the marginal bone level was located at a more coronal position at implants when compared with conventional implants design with smooth collar in the marginal portion, and suggested that the possible positive effects may be related to the osseous healing events after implant placement rather than bone preservation during function.<sup>24-25</sup>

## CONCLUSION

Within the limitation of the present study, it may be concluded that immediate loaded implant supported partial overdenture utilizing platform switch concept are superior to conventional design implant in terms of their more favorable bone changes regarding bone height and density.

Implant supported partial overdentures utilizing locator attachment are considered successful treatment options when restoring long span Kennedy class IV cases.

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