# Fixed dentures versus milled bar over denture supported by four implants placed according to the 'All-on-Four® Concept.(Evaluation of marginal bone height)


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***Abstract:***

**Objectives**: The aim of this study was radiographic evaluation of bone level around dental implant of mandibular over denture versus fixed denture supported by four implants placed according to 'All-on-Four® Concept

***Materials and methods:*** Six completely edentulous patients, each patient received four implants in the mandible; two implants in canine area and two implants in second premolar area. Three patients received implant supported screw-retrained fixed prosthesis and the other three patients received a milled-bar overdenture, Radiographic evaluation will be performed in terms of Peri-implant alveolar bone loss using (CBCT).

***Results:*** FP recorded significant VBL than MB at T6 and T12 for distal sites of anterior implants. MB recorded significant higher VBL than FP at buccal site of anterior implants. For anterior and posterior implants at other sites and surfaces no significant differences in VBL between groups were noted. For FP no significant difference between anterior and posterior implants were noted at all implant surfaces at T6 and T12. For MB at distal site at T6 posterior implant recorded higher VBL than anterior implant and at buccal site anterior implant recorded higher VBL than posterior implant. MB recorded significant HBL than FP at T6 and T12 for buccal sites of posterior implants. For anterior and posterior implants at other sites and surfaces no difference in HBL between groups were noted. . For FP and MB, at all implant sites at T6 and T12, no difference in HBL between anterior and posterior implants except at buccal site of posterior implants of MB group at T6 where posterior implants recorded significant higher HBL than anterior implants.

***Conclusion:*** Within the limitation of this short-term study, taking the small patient cohort into account, it could be concluded that both FP and MB could be used successfully for All on four implant rehabilitations of edentulous mandible as both prostheses were associated with acceptable peri-implant bone resorption after 6 months of prosthesis insertion. However, MB may be advantageous than FP in terms of vertical peri-implant bone preservation and FP may be advantageous than MB in terms of horizontal peri-implant bone preservation.

## *Introduction*

Implant supported mandibular overdentures are the minimum treatment options for edentulous patients due to retention, simplicity, improved patient satisfaction, stability, EMG activity, chewing efficiency , bite force and cost effectiveness,(1-29) however resorption of posterior ridge might occurs.(30) Patients who had worn an upper conventional denture and lower implant-supported overdenture for years were subjected to resorption which occurs at the midline of the premaxilla, anterior occlusal pressure increased, and loss of anterior maxillary bone, similar to what happened in Combination Syndrome.(31-34) Regarding the survival and success rate, the quadrilateral design showed enhanced results particularly those with rigid connection also it showed minimal strain compared to curved or linear designs.(35-38) Using a fixed prosthesis to rehabilitate the full arch edentulous maxilla and mandible on four implants only in the anterior area is known as the All-on-Four® treatment concept.(39) The distal implants located in front of maxillary sinus are tilted approximately 30 degrees from the occlusal plane. Splinting the four implants with a milled bar is helpful in load distribution also it permit the laboratory to compensate for significantly malaligned implants or poorly positioned through fabricating a custom superstructure which accurately adapted to the denture base by developing a guide planes that also providing resistance to lateral forces.(40) The cantilevered segment of the bar increase the stability of prosthesis, the extension of the cantilevers will never become more than 1.5 times the antro-posterior distance between the anterior and posterior implants.(41) The choice between cemented and screw retained restorations depends on the understanding of advantages and disadvantages of each. Several factors affect the selection of prosthesis as retrievability, space requirements, retention, the framework passivity, aesthetics, simplicity of fabrication, cost.[42] Studies on immediately loaded implant supported full arch fixed prosthesis showing high success rates comparable to conventionally loaded implants. It also provide shorter treatment time and eliminate the interim stage, as well as the second stage surgery. Although it is possible to clearly distinguish a success from a failure, it is not easy to define intermediate stages. The presence of peri-implant radiolucency and mobility characterize a failure, while implants in the process of failure present progressive marginal bone loss even without mobility.[43] Therefore the aim of this study was to evaluation the clinical and radiographic outcomes of maxillary dentures supported by four implants inserted according to 'All-on-Four® Concept' which opposing mandibular implant supported overdentures.

## *Materials and methods*

Six completely edentulous patients age ranged between 55-65 years, were selected from outpatient clinic of the Prosthodontic Department, Faculty of Dentistry, University of Mansoura according to the following criteria.

***Inclusion criteria:***

Completely edentulous patients have a residual alveolar ridges covered by healthy mucosa and the patient unsatisfied because lack of the retention and stability of the denture. They were free from any systemic diseases. Sufficient bone quantity and quality in the inter foraminal area . Sufficient available restorative space of at least 15 mm to accommodate all types of planed prosthesis. At least one year passed after the last extraction.

## *Exclusion criteria:*

Patients with head and neck radiotherapy, bleeding disorders, hepatic patients and metabolic disorders that affect osseointegration. Long term corticosteroid drug therapy and immunosuppress. Abnormal parafunctional habits, e.g. bruxism and clenching. Smoking patient. Neuromuscular diseases and patient with TMJ problems.

After the patients were informed about the line of treatment and they all signed a written consent also informed about the need for regular and frequent recalls. The study was conducted according to the ethical principles stated and approved by the ethical committee of the faculty of dentistry.

***Surgical phase***

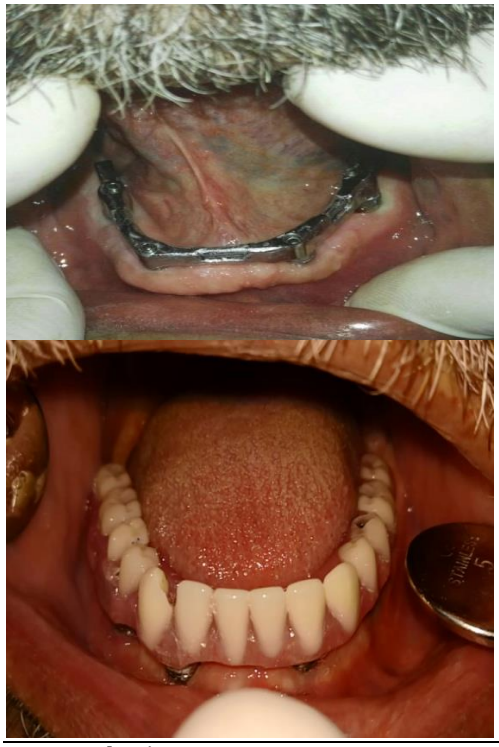
A customized surgical template will be constructed according to the preoperative CBCT, Surgery is performed under local anesthesia, they received four dental implants located anterior to mental foramen, anteriorly two axially placed implants and two distally tilted implants by about 30 degree posteriorly, and all implants will be placed by flaplessly technique.

***Immediate loading of implants***

Implants were immediately loaded by provisional acrylic dentures. The old mandibular denture was modified by removal of all denture flanges and the second molar artificial teeth and makes four hollows opposite to the abutments. Temporary abutment metal caps were roughened and screwed to the multiunit abutment then auto polymerized acrylic resin was used to picked up the temporary metal abutment. The metal caps were unscrewed, the denture was removed, and denture was finished and polished. The occlusal contact of first molar with opposing denture was removed to relieve the pressure on the inclined posterior implants.

***Prosthetic procedures for final restoration***

After 3 months of osseointegration period, obtaining a master cast by open tray abutment level impression procedure on which hybrid or milled bar prosthesis was constructed. The abutment level long transfer copings were screwed to the multiunit abutment, and splinted using the orthodontic ligature wire and light cure composite resin, a stock/special tray was perforated over the transfer coping. Light body rubber base impression was injected then the tray filled with heavy body impression material inserted intraorally. Unscrewed of transfer coping from multiunit abutment. Abutment analogues were screwed to the transfer coping and the impression was poured to obtain master cast. Plastic caps were screwed to the abutment analogues on the master cast. For fixed prosthesis, plastic caps were scanned by CAD/CAM scanner and suitable designing of the framework connecting the caps were made. Milling of duralay resin block was made to form CAD/CAM framework (resin jig) and the passive fit was tried in patient mouth. The bridge pattern was sprued, invested and casted with molten Co-Cr alloy. After devesting and cleaning the fit of the bridge is then verified intro-orally using schieffeld test ( single screw test). For milled bar overdenture, a bar pattern is built using duralay autopolymerized resin, common path of insertion was established for the accurate development of guide planes on the milled bar. The bar pattern was sprued, invested and casted with molten Co-Cr alloy. The fit of the restoration is then verified intro-orally using a single screw test. The bar was seated to the master cast. The undercuts are blocked out the milled bar and the master cast was duplicated into refractory cast using appropriate investment. Over the refractory cast the metal housing was waxed to cover the entire surface of the milled bar. The wax pattern of the metal housing was invested and cast in Co-Cr alloy, finished and polished. The retentive yellow plastic clips were fixed to the metal housing using appreciate adhesive. By a regular manner denture base was fabricated and was verified for vertical dimension, esthetics and occlusion. The denture was flasked, acrylic resin was packed, and the denture was finished and polished.



***Evaluation***

Evaluation of peri-implant bone height was made immediately after insertion (T0) , six months after overdenture insertion (T6) and after one year (T12). The vertical and horizontal alveolar bone loss was measured by cone beam CT from mesial, distal, buccal and lingual aspects

## *Results*

Comparison of VBL between groups is presented in table 1. FP recorded significant VBL than MB at T6 and T12 for distal sites of anterior implants. MB recorded significant higher VBL than FP at buccal site of anterior implants. For anterior and posterior implants at other sites and surfaces no significant differences in VBL between groups were noted. Comparison of VBL between observation times is presented in table 1. VBL significantly increased from T6 to T12 for both groups for anterior and posterior implants at mesial and distal sites only. For buccal and lingual sites VBL did not differ between T6 and T12. Comparison of HBL between groups is presented in table 2. MB recorded significant HBL than FP at T6 and T12 for buccal sites of posterior implants. For anterior and posterior implants at other sites and surfaces no difference in HBL between groups were noted. Comparison of HBL between observation times is presented in table 2. HBL significantly increased from T6 to T12 for both groups and implant positions at mesial, distal and buccal sites. At lingual site of anterior and posterior implants of both groups, HBL did not differ between T6 and T12.

**Table 1. Comparison of VBL between groups and between observation times**

| Position | Surface | Group | VBL_T6 X±SD | | VBL_T12 X±SD | | P |
|---|---|---|---|---|---|---|---|
| **Anterior** | **mesial** | **FP** | .75 | .59 | 1.99 | 1.33 | <.001* |
| | | **MB** | .48 | .19 | 1.38 | .30 | <.001* |
| | | ***P*** | .29 | | .14 | | |
| | **distal** | **FP** | .96 | .83 | 1.74 | 1.25 | <.001* |
| | | **MB** | .39 | .21 | .94 | .31 | .004* |
| | | ***P*** | .024* | | .049* | | |
| | **buccal** | **FP** | .10 | .18 | .16 | .30 | .77 |
| | | **MB** | .69 | .55 | .89 | .58 | .28 |
| | | ***P*** | .021* | | .048* | | |
| | **lingual** | **FP** | .19 | .00 | .28 | .01 | .61 |
| | | **MB** | .10 | .01 | .20 | .01 | .58 |
| | | ***P*** | .71 | | .83 | | |
| **Posterior** | **mesial** | **FP** | .82 | .70 | 1.46 | 1.28 | .001* |
| | | **MB** | .66 | .24 | 1.61 | .73 | <.001* |
| | | ***P*** | .52 | | .75 | | |
| | **distal** | **FP** | .75 | .62 | .99 | .70 | .004* |
| | | **MB** | .86 | .20 | 1.55 | .44 | <.001* |
| | | ***P*** | .65 | | .18 | | |
| | **buccal** | **FP** | .20 | .04 | .42 | .21 | .28 |
| | | **MB** | .16 | .10 | .42 | .34 | .16 |
| | | ***P*** | .86 | | .98 | | |
| | **lingual** | **FP** | .07 | .05 | .09 | .05 | .58 |
| | | **MB** | .04 | .02 | .25 | .25 | .24 |
| | | ***P*** | .90 | | .69 | | |

X; mean, SD; standard deviation, FP; Fixed bridge, MB; milled bar, * P is significant at .05

**Table 3. Comparison of HBL between groups and between observation times**

| Position | Surface | Group | HBL_T6 X±SD | | HBL_T12 X±SD | | P |
|---|---|---|---|---|---|---|---|
| **Anterior** | **mesial** | **FP** | .24 | .25 | .81 | .84 | <.001* |
| | | **MB** | .24 | .23 | .65 | .47 | <.001* |
| | | ***P*** | 1.00 | | .54 | | |
| | **distal** | **FP** | .21 | .11 | .44 | .24 | .026* |
| | | **MB** | .22 | .23 | .52 | .22 | .004* |
| | | ***P*** | .96 | | .77 | | |
| | **buccal** | **FP** | .03 | .01 | .16 | .01 | .047* |
| | | **MB** | .08 | .02 | .31 | .20 | .027* |
| | | ***P*** | .77 | | .58 | | |
| | **lingual** | **FP** | .00 | .00 | .00 | .00 | 1.00 |
| | | **MB** | .00 | .01 | .08 | .11 | .44 |
| | | ***P*** | .98 | | .75 | | |
| **Posterior** | **mesial** | **FP** | .17 | .11 | .39 | .18 | .030* |
| | | **MB** | .32 | .10 | .77 | .35 | <.001* |
| | | ***P*** | .36 | | .14 | | |
| | **distal** | **FP** | .34 | .36 | .55 | .45 | .041* |
| | | **MB** | .32 | .38 | .49 | .47 | .049* |
| | | ***P*** | .90 | | .82 | | |
| | **buccal** | **FP** | .05 | .04 | .14 | .13 | .048* |
| | | **MB** | .59 | .79 | 1.11 | 1.00 | <.001* |
| | | ***P*** | .002* | | .001* | | |
| | **lingual** | **FP** | .07 | .04 | .23 | .16 | .10 |
| | | **MB** | .01 | .02 | .02 | .04 | .99 |
| | | ***P*** | .72 | | .41 | | |

X; mean, SD; standard deviation, FP; Fixed bridge, MB; milled bar, * P is significant at .05

## ***Discussion***

l The mean marginal bone loss values observed for both groups at 1 and 3 years remain in the normal range of values reported in literature (<1 mm in the first year and <0.2 mm annually thereafter) 1-4 For FP, the mean VBL of all sites combined together of anterior implants was 1.04mm and for posterior implants was .74mm. Similarly, Weinstein et al.5, reported that marginal bone loss around axial and tilted implants was similar at 12-month evaluation, being, respectively, 0.6±0.3 (standard deviation) mm and 0.7 ± 0.4 mm. The mean VBL of anterior implants of MB was .85mm and .95mm for anterior and posterior implants respectively. This value was far lesser than the VBL obtained by Krennmair et al.6 around vertical implants supporting milled bar in edentulous mandible (1.4 ± 0.6). FP recorded significant VBL than MB at T6 and T12 for distal sites of anterior implants. This finding was in agreement with Wismeijer et al.,7 who reported that there was significantly more bone loss around the central 2 implants in comparison with the distal 2 implants. The reduced VBL with MB is in line with Alessandro Pozzi at al 8 who found the mean marginal bone loss was 0.29 ± 0.16 mm. MB recorded significant higher VBL than FP at buccal site of anterior implants. This may be due to increased gingival trumatization and irritation caused by the acrylic flanges of the overdentures during insertion and removal of the prosthesis. In agreement with this observation, Elsyad et al9 found an increased bone loss at buccal side of immediately loaded canine implants. For anterior and posterior implants at other sites and surfaces no significant differences in VBL between groups were noted. This finding was in agreement with Ayna et al.,10. VBL significantly increased from T6 to T12 for both groups for anterior and posterior implants at mesial and distal sites. In agreement with this finding Elsyad et al 12 demonstrated a significant increase in VBL at T6 and T12

compared with DIB at T0 with significant increase in VBL at T12 compared with T6. For FP no difference in VBL between anterior and posterior implants were noted at all implant surfaces at T6 and T12. Similar to these findings, a clinical study by lopes et al 13 found no significant difference in marginal bone loss between axially and distally tilted implants. For MB, no significant difference of VBL between anterior and posterior implants for mesial and lingual surfaces was noted. Sannino at al 14 found that no statistically significant differences in marginal bone levels between vertical and tilted implants were detected. For MB at distal site after 6 months, posterior implant recorded higher VBL than anterior implant. In agreement with this finding Alvarez et al, 15 found that the stress was located in the distal area of the coronal third of the periimplant bone surrounding the posterior implants in one-piece fixed implant prosthesis lead to more VBL. At labial site anterior implant recorded higher VBL than posterior implant. In agreement with finding Elsyad et al 16 found that immediate loading group recorded significant vertical bone loss and probing depth at distal and labial sites than the conventional loading group. For FP and MB at T6 and T12, mesial and distal sites of anterior and posterior implants recorded the highest VBL (without difference in between), and buccal/lingual site of recorded the lowest VBL without difference. This might be attributed to accumulation of plaque around the mesial and distal sites of the implant due to difficulty to maintain oral hygiene at these sites. MB recorded significant HBL than FP at T6 and T12 for buccal sites of posterior implants. Since HBL mainly caused be peri-implant gingival inflammation, plaque accumulation could be responsible for increased HBL in the MB group compared to FP group. For anterior and posterior implants at other sites and surfaces no difference in HBL was observed between groups. In agreement with this observation, Ayna et al.(ReF) found that no significant differences between the groups in terms of the bone loss. HBL significantly increased from T6 to T12 for both groups and implant positions at mesial, distal and buccal sites. The increased HBL with advance of time may be due to immediate bone response to healing and reorganization combined with function stresses 11. For FP and MB, at all implant sites at T6 and T12, no difference in HBL between anterior and posterior implants was observed. In agreement with this finding, Francetti et al. 17 found no significant difference in marginal bone loss between tilted and axial implants at 1-year evaluation. However, at buccal site of posterior implants of MB group at T6, posterior implants recorded significant higher HBL than anterior implants. This may be due to increased gingival trumatization caused by the acrylic flanges as stated before. For FP and MB, mesial and distal sites of anterior implants recorded the highest HBL (without difference in between), and buccal/lingual site recorded the lowest HBL without difference. This might be attributed to accumulation of plaque around the mesial and distal sites of the implant due to difficulty to maintain oral hygiene at these sites. In contrast, Elsyad et al (2012) found that there is no significant difference in HBL between sites of measurement at T1 and T3. No difference in HBL between anterior and posterior implants except at buccal site of posterior implants of MB group at T6 where posterior implants recorded significant higher HBL than anterior implants. In contrast, Calandriello and Tomatis 18 found a lower bone loss values for tilted implants supporting fixed prosthesis, as compared with upright ones. For MB at T12, buccal sites of posterior implants recorded the highest HBL, and lingual site recorded the lowest HBL. The increased HBL at buccal site of posterior implants might be attributed to accumulation of plaque around the mesial and distal sites of the implant due to difficult to maintain oral hygiene at these sites.

## Conclusion

Within the limitation of this short-term study, taking the small patient cohort into account, it could be concluded that both FP and MB could be used successfully for All on four implant rehabilitations of edentulous mandible as both prostheses were associated with acceptable peri-implant bone resorption after 6 months of prosthesis insertion. However, MB may be advantageous than FP in terms of vertical peri-implant bone preservation and FP may be advantageous than MB in terms of horizontal peri-implant bone preservation.

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