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# COMPARISON OF PLATFORM SWITCHED AND PLATFORM MATCHED IMPLANTS ON SUPPORTING STRUCTURES OF MANDIBULAR OVERDENTURES: A THREE YEAR FOLLOW-UP LONGITUDINAL STUDY

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## ABSTRACT

**Objectives :** To compare the influence of platform switched and matched implants on supporting structures of mandibular overdenture by measuring marginal bone loss (MBL) and soft tissue changes including probing depth and implant stability.

**Material and Methods:** Twenty completely edentulous patients age 50- 60 years were selected for this longitudinal study. Complete dentures were performed for all patients, they were divided randomly into 2 groups; 10 patients each. The first group obtained 2 platform switched implants while the second group obtained two platform matched implants (3.6 × 11.5 mm) in the canine areas of the mandible. Radiographic measures were performed every 12 months for 3 years while clinical measures were made every 6 months for 3 years for each group. Data was examined by student's t-test and paired t-test.

**Results:** The mean age of patients was 54 ±3.3 years. No statistically significant difference was observed in MBL between mandibular overdentures supported by 2 platform switched and that supported by 2 platform matched implants ($p \geq 0.05$). Also, there were no statistically significant differences in pocket depth or implant mobility between two studied groups after 1, 2 and 3 years follow up ($p \geq 0.05$).

**Conclusions:** Platform switching appears to not influence marginal bone loss around implants or soft tissue in two implants supported mandibular overdentures.

**KEYWORDS:** Dental implant, platform switching, denture, overlay.

## INTRODUCTION

Implant-supported overdentures have been documented to be highly valuable in aged people showing great patient delight, comfort and masticatory efficiency. [1] An ideal implant prosthesis can bring back normal muscle activity and thereby improving the masticatory function to near normal limits as well it might stimulate the bone and maintain its dimension in a similar way done by healthy natural teeth. [2]

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Marginal bone loss (MBL) around an implant is inevitable due to bone remodeling and crestal bone resorption after implant installation and prosthetic insertion. [3] MBL around implant causes biological complications at the implant-abutment connection which prompt tissue inflammation around the implant and developing peri-implant diseases due to problems in oral hygiene maintenance. [4, 5] Preservation of crestal bone plays an important role in the success and survival of dental implants which keep peri-implant soft tissue healthy. [6]

Platform switching (PS) idea is based on the use of a small diameter abutment on a larger diameter implant neck. Implants placed using this idea have an implant-abutment interface closer to the implant center. This increases the volume of soft tissue, triggers gingival health and preserves the crestal bone levels. [7-9]

Advantages of platform switching concept over platform matching (PM) implant seems to include; distribution of load between the abutment and the implant, controlling circumferential bone loss around dental implants, increase the thickness of soft tissue collar around the abutment, preventing apical migration of soft tissue, preserving the integrity and location of the papilla on the bony ring and prompting bloodstream in the bone, especially with the small distance between the implants. [10- 12]

Additional clinical trials are required to affirm the benefits of PS as asserted by systematic reviews. Heterogeneous factors may affect the outcomes of PS study; implant insertion level, implant microstructure, the size of the implant and implant design. [13, 14] Many PS studies have been measured 3 months –1 year after implant installation and the inquiry of implants 3 years after implant installation is rare. [15, 16]

During the osseointegration process, primary mechanical stability is gradually replaced by biological stability. When the healing phase is completed, primary mechanical stability is totally replaced by biological stability. Thanks to resonance frequency analysis it is possible to control implant stability non-invasively throughout the entire healing period. [17, 18]

That longitudinal study was designed to compare platform switching (PS) and platform matching (PM) implants as regards their effect on; MBL and changes in soft tissue including probing depth and implant stability.

The null hypothesis (H0) was that there is no difference between PS and PM implants in their influences on supporting structures between loading and (1, 2 and 3 years) follow up periods.

## MATERIAL AND METHODS

A longitudinal study was designed. Following power calculations[19], twenty completely edentulous patients age 50 to 60 years were participated in this study according to special inclusion and exclusion criteria; patients were selected in good general health and free from any systemic or local diseases, bone disease, temporomandibular joint disorders or neuromuscular diseases. All patients had Angle’s class I jaw relationship and sufficient inter-arch space. They had well developed residual upper and lower ridges with firm mucosa free from inflammation, ulceration and flabby tissues. Smokers and patients performing abnormal tongue habits, bruxism or clenching were precluded to avoid the adverse effects on the oral functions and musculatures. All patients accepted the treatment and provided written accepted consent. This was approved by the Ethics Committee of the university institutional review board (No.AUFDREC/19-022). Preoperative panoramic radiograph and cone-beam computed tomography (CBCT) were made for all patients to examine bone height and conclude a preliminary idea about bone quantity and quality. CBCT was taken using a radiographic template to determine the availability of bone height and buccolingual width for implant placement. Bone quality, especially at the expected implant sites, was determined and the position of mental foramen was also detected. Maxillary and mandibular complete dentures were delivered to all patients. Stander conventional clinical and laboratory techniques were followed during dentures construction. For adaptation, all patients were informed to use their complete dentures 3 months after delivery. CBCT with a radiographic template in place was made for all patients to assess bone quantity and quality at the expected implants sites. Patients were divided randomly into two groups ten in each group. Group I **(GI)** were obtained two tapered, self-tapping, endosteal; platform switched implants (3.6 × 11.5 mm) in the mandibular canine areas (Deyna Dental Engineering BV, Holland). Group II **(GII)** were obtained two tapered, self-tapping, endosteal; platform matched implants (3.6 × 11.5 mm) in the mandibular canine areas (Dyna Dental Engineering BV, Holland). In both groups, implants were installed by flapless surgical procedures and were kept submerged for three months for osseointegration. After three months, the implants were exposed, and the implant cover screw was unthreaded and replaced by a healing collar. The fitting surface areas opposing the healing collars were relived to accommodate the healing collars. After ten days the healing collars were replaced by ball and socket attachments (Dyna Dental Engineering BV, Holland). Fitting surface of the lower denture was relieved to adapt to the female housing of attachments; self-cured acrylic resin was placed in the relieved areas for the pick-up. The patient was instructed to bite lightly in centric occlusion till polymerization is completed. Group I were received two ball and socket attachments connected to two platform switched dental implants supported mandibular overdenture, while Group II were received two ball and socket attachments connected to two platform matched dental implant-supported mandibular overdenture, figure 1 (fig.1).

Clinical measures and radiographic evaluation were done for all patients after implants loading. Patients used their dentures for 3 years in both groups. Panoramic radiographs and CBCT will be made at loading and every 12 months for 3 years for each group while clinical measures will be made at loading and every 6 months for 3 years, as follows:

Fig. (1) Two platform switched dental implants at canine areas of mandibular ridge.

**1- Radiographic assessment**

**Intraoral indirect digital radiographic measurements**

The radiographic template was constructed for each patient from auto-polymerized acrylic resin. Then the template was tried in the patient mouth and checked for extension, stability and fitting with the opposing occlusion. Assessment of mesial and distal bone heights for each implant was carried out at follow up periods. Radiographic exposure was done using the Orix x-ray machine (Orix-Aet, ARDET, S.V.R., Milano, Italy) at 65-kilovolt, 10-milliampere, for 0.4-seconds for the mandibular ridge to provide standardized radiographs. Exposure parameters were fixed for all patients at the baseline, as well as, during the follow-up periods. The film holder with the mounted image plate was placed inside the prepared area of the radiographic template so that the central x-ray beam was perpendicular to the plate. Then, Digora computerized system, image processing software, (Orion Corporation, Soredex Medical Systems, Helsinki, Finland), was used to calculate measurements of bone height.

The exposed image plate was loaded into the scanner, which reads the image and converts it to digital form. The image was displayed gradually within seconds on the monitor. After the readout was completed, the newly read image was evaluated; re-took or enhanced and/or finally saved on the previously prepared active patient card as needed. Images were exported in the Joint Photographic Experts Group (JPEG) file format. For each patient, information including the patient's name, age, radiographic images, and all data were recorded and saved in the patient's card. The saved images of each patient were interpreted and analyzed to study the changes in the amount of mesial and distal crestal bone levels. Image analysis measurements for MBL were performed. Implant shoulder and the crest alveolar bone were used as reference points. The distance between the two reference points, which represents the amount of crestal vertical bone loss, was measured at mesial and distal aspects. Distance from the apex of the implant to the implant shoulder was measured, which was then used to divide the original length of the implant from the finish line to the apex to calculate the magnification factor. The magnification factor was then multiplied by the measured distance on the mesial and distal sides of the implant to derive the actual distance of bone loss. This was performed at every arranged follow up appointment. The recorded data during the follow-up period were tabulated and statistically analyzed.

**2- Clinical evaluation**

**A. Probing depth measurement**

Hawe Neos colour-coded (3/5/7/9mm) plastic periodontal probe with flexible tip (Kerr, Lugano, Switzerland) specially designed for measuring pocket depth around implants was used. The probe was positioned parallel to the long axis of the implant and kept in contact with the implant surface. The gap between the gingival margin and the tip of a plastic periodontal probe was recorded as probing depth (PD). PD measurements are recorded for 4 specific sites on each implant on the following sequence; facial, lingual, mesial and distal. Only one reading per site is recorded. PD assessments were recorded to the closest full mm and recorded on a periodontal chart and become a permanent part of the patient chart. The average of right and left implant assessments for every patient was statistically analyzed.

**B. Implant stability**

Implant stability was estimated with the Implant Stability Quotient (ISQ) assessment scale and Resonance Frequency Analysis (RFA). The assessment was carried out by Osstell ISQ (Osstell AB, Gothenburg – Sweden). ISQ values are (1-100). When the ISQ value increased; the stability of the implant might be increased. The following steps were achieved: Ball attachment was unscrewed and a smart peg specially supplied for the previously used implants (smart peg number 27) was attached to the abutment utilizing the smart peg mount. That connection should be "finger-tight" (approximately4-6 Ncm tightening torque). The hand of the assessment probe was held near to the smart peg at a proximity free gap to ensure that the probe tip was directed to the summit of the smart peg magnet. The smart peg was stimulated with the probe magnetic pulses. An audible sound was heard when the measurement was recorded. ISQ value was shown on the display. Two perpendicular measurements were achieved, the highest and the lowest ISQ values. Occasionally, two values of ISQ were very near, or even identical, if not, the mean of both values was used for statistical analysis. ISQ values were recorded for each patient, the smart peg was removed and ball attachment was re-screwed. If at any of the mentioned visits, the ISQ fell to 45 or lower, the implant was considered a potential failure and placed under unloaded healing for 12 weeks before repeat stability testing. The average of right and left implant assessments for every patient was statistically analyzed.

**Statistical analysis**

Statistical Package for Scientific Studies (SPSS16) for Windows was used to measure the statistical analysis; utilizing student's t-test and paired t-test. The significance level was adjusted at $P \leq 0.05$.

## RESULTS

Twenty completely edentulous patients, the mean age was 54 ±3.3 years, participated in all follow-up periods of the study. The mean MBL in platform switched implants (mean of the mesial, distal, right and left measurements) after 12, 24 and 36 months were 0.61 ± 0.29 mm, 0.80 ± 0.28 mm and 1.24 ± 0.69 mm respectively and that in platform matched implants were 0.68 ±0.32mm, 0.87 ±0.31mm and 1.02 ± 0.33 mm. There were no statistically significant differences in MBL between lower overdentures supported by two platform switched implants and that supported by two platform matched implants after 12, 24 or 36 months follow up periods ($p \geq 0.05$), fig. (2) and table (1). Also, platform switched implants (mean of the mesial, the distal, the right and the left measurements) there were no statistically significant differences in pocket depth or implant stability between lower overdentures supported by two platform switched implants and that supported by two platform matched implants after loading, 6, 12, 18, 24, 30 or 36 months follow up periods ($p \geq 0.05$), table (2).

TABLE (1): Marginal bone loss (MBL) in GI and GII.

| Implants (n = 20) Switched implant (GI) | Mean(±SD) | | | Implants (n = 20) Matched implant (GII) | | | P-value | | |
|---|---|---|---|---|---|---|---|---|---|
| | **12 months** | **24 months** | **36 months** | **12 months** | **24 months** | **36 months** | **12 months** | **24 months** | **36 months** |
| Right side(n = 10) | | | | | | | | | |
| Mesial MBL | 0.76 ± 0.30 | 0.95±0.31 | 1.38±0.70 | 0.5±0.27 | 0.69±0.28 | 0.88±0.28 | 0.18 | 0.17 | 0.06 |
| Distal MBL | 0.54±0.29 | 0.73±0.27 | 1.17±0.70 | 0.83±0.38 | 1.02±0.39 | 1.21±0.38 | 0.15 | 0.16 | 0.90 |
| Left side (n = 10) | | | | | | | | | |
| Mesial MBL | 0.54± 0.29 | 0.83±0.32 | 1.27±0.63 | 0.70±0.25 | 0.89±0.25 | 1.08±0.2 | 0.32 | 0.35 | 0.42 |
| Distal MBL | 0.64±0.32 | 0.69±0.25 | 1.12±0.74 | 0.69±0.37 | 088±0.36 | 1.07 ±0.36 | 0.29 | 0.28 | 0.87 |

***SD, Standard deviation.***

TABLE (2): Pocket depth and implant mobility in GI and GII.

| | Mean(±SD) | | | | | | |
|---|---|---|---|---|---|---|---|
| | **At loading** | **6 months** | **12 months** | **18 months** | **24 months** | **30 months** | **36 months** |
| Switched implant (GI) | | | | | | | |
| Pocket depth | 1.5±0.4 | 1.3±0.5 | 1.5±0.2 | 1.9±0.5 | 1.9±0.2 | 1.7±0.3 | 2.2±0.3 |
| Mobility test | 68.29±6.99 | 71.75±5.35 | 73.29±5.02 | 73.14±4.6 | 74.14±4.8 | 74±4.2 | 74.57±4.4 |
| Matched implant (GII) | | | | | | | |
| Pocket depth | 0.9±0.4 | 1.5±0.4 | 1.9±0.4 | 1.9± 0.2 | 1.8 ±0.3 | 2.1±0.4 | 2.3±0.5 |
| Mobility test | 71.34±7.50 | 73.00±4.83 | 74.43±.57 | 73.86±2.8 | 74.29±2.2 | 74.43±2.9 | 75.43±2.7 |
| P value | | | | | | | |
| Pocket depth | **0.04*** | 0.36 | 0.11 | 0.79 | 0.17 | 0.10 | 0.77 |
| Mobility test | 0.51 | 0.58 | 0.40 | 0.75 | 0.95 | 0.85 | 0.68 |

***SD, Standard deviation. *, Significant.***

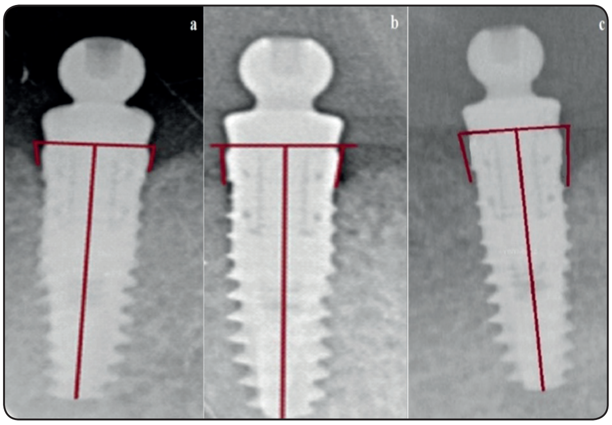


Fig. (2) Radiographic measurements for platform switched implant. a; MBL after 1 year, b; MBL after 2 years and c; MBL after 3 years.

## DISCUSSION

That longitudinal study was established to estimate MBL around PS and PM implants supported overdentures and changes in soft tissue as regarding probing depth and implant stability at 3 years follow-up.

The study was designed with standardized inclusion and exclusion criteria. Parameters that can affect the results of the study as; Patients' age, bone quantity, and quality, implant design, surgical procedures and loading time were standardized in the study.

Since installation and loading of implant, both PS and PM implants were survived and attained the success criteria for accepted implant. All of the 40 implants survived in good function with healthy overlying soft tissues and without any signs of infection, mobility around the implants or pain. There was not any persistent radiolucency or MBL around the mesial or distal sides of the implant as shown radiographically.

In that longitudinal study, a two-stage implant loading procedure was escorted. It was revealed that delayed implant loading is correlated with higher bone healing and is essential when there is less bone quality [19]. While the results of another study revealed that delayed and immediate implant loading procedures provide the same results in implant-supported lower overdenture. [20]

The current study sought to test the null hypothesis of no difference between PS and PM implants in their influences on supporting structures between loading and 3 years follow up periods. Based on the results of 3 years follow-up, that hypothesis was confirmed, there were no statistically significant differences between lower overdentures supported by two PS and that supported by two PM implants. These results are in accordance with one year follow up results of a study held by the authors on those patients. [21] This indicates that the resorption of crestal bone is not influenced by platform switching. This may be due to resorption of bone is almost associated with biological aspects, as biological bone width regeneration, more than to biomechanical aspects, as size of the abutment in relation to implant neck. [22]

These are in accordance with the results of previous studies revealed that PS may be less important for peri-implant crestal bone level maintenance as supposed. Also, the contribution of PS still arguable; resorption of crestal bone is to be affected by various factors. [23-25]

The results of pocket depths in that study revealed that there were no statistically significant differences between the studied 2 groups during the follow-up periods except at loading. This indicates that probing depth is not influenced by platform switching. It was reported that peri-implant probing depths may be a poor diagnostic tool, if not associated with signs and/or symptoms such as; purulent exudate, bleeding, radiographic radiolucencies, discomfort or pain. Accordingly, crestal bone loss over time is associated with increasing probing depths, but no evidence to an endosteal implant disease. These results are in accordance with the study found insignificant differences in peri-implant probing depth when platform switched and plate matched implants were compared. [26, 27]

There was an increase in implant stability during the follow-up periods but they are insignificant. Also, between both groups, there was an insignificant difference in ISQ values. This indicates that implant stability is not influenced by platform switching. It was concluded that implant stability in the GI was higher than GII at the beginning, but this difference vanish three months after healing before loading. Peri-implant health differences were negligible between PS and PM implant. Also, it was reported that the implant stability at the beginning changed due to bone compression created by mechanical factors as bone relaxation, biological variations through bone recovery and starting from resorption of crestal bone. [28, 29]

## CONCLUSION

Platform switching (PS) appears to not influence marginal bone loss (MBL) around implants or soft tissue in two implants supported mandibular overdentures.

### Conflict of interest

The authors declare no conflict of interest.

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