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# Impact of Platform-Switching On Interproximal Bone Levels in Two-Stage Implants: 1-Year Results From a Prospective Clinical Trial

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## Abstract

**Objective:** Several long-term clinical studies have shown a mean marginal bone loss around dental implants of 1.5 to 2 mm in the first year after prosthetic restoration. The concept of Platform Switching seems to preserve peri-implant bone levels. The purpose of this clinical study was to show that crestal bone height around dental implants could be influenced using a platform switch protocol in comparison to the conventional design.

**Materials and Method:** 28 patients were treated with fixed implant restorations. 14 patients were rehabilitated with platform switch protocol and the other 14 patients were treated with the conventional design. Standardized digital radiographs were obtained at regular intervals.

**Results:** The mean overall bone loss from baseline to 12$^{th}$ month was significant. The platform-switching design had less overall bone loss in a 1 year follow up.

**Conclusion:** The concept of Platform-Switching appears to limit crestal bone resorption and seems to preserve peri-implant bone levels.

**Keywords:** Crestal bone loss, Implant design, Platform-Switching, Implant Abutment Junction

## Introduction

The goal of modern dentistry is to restore the patient to normal contour, function, comfort, esthetics, speech and health, whether by removing caries from a tooth or replacing several teeth. What makes implant dentistry unique is the ability to achieve this goal, regardless of the

atrophy, disease or injury of the stomatognathic system. However, the more teeth a patient is missing, the more challenging this task becomes. As a result of continued research, diagnostic tools, treatment planning, implant designs, materials, and techniques, predictable success is now a reality for the rehabilitation of many challenging clinical situations.[1] After the insertion of the implant and its prosthetic connection, crestal bone undergoes remodeling and resorption processes. Although different techniques and procedures have been developed, post restorative reductions in peri-implant bone height have long been acknowledged to be a normal consequence of implant therapy involving 2-piece implants.[2,3,4] These crestal bone levels are typically located approximately 1.5 to 2 mm below the implant-abutment junction (IAJ) at 1 year following implant restoration, but are dependent on the location of the IAJ in relation to the bone crest.[4,5] Therefore, the inevitable microgap of the IAJ and its microbial colonization seems to play a major role in the remodeling process. This is also confirmed by the finding that crestal bone resorption is not evident as long as the implant remains completely submerged, but develops when once an implant has been exposed to the oral environment.[6]

New implant designs have appeared in the literature which claim that certain modifications may be helpful for maintaining crestal bone levels and consequently preserving normal soft tissue contours.[7] In addition to several ideas to limit crestal bone resorption, the concept of Platform Switching (PSW) appears to be promising. PSW refers to the use of a smaller diameter abutment on a larger diameter implant collar; this connection shifts the margin of the IAJ inward, toward the central axis of the implant. The inward movement of the IAJ is believed to shift the inflammatory cell infiltrate to the central axis of the implant and away from the adjacent crestal bone, which is thought to limit crestal bone resorption.[8]

The ability to reduce or eliminate crestal bone loss would be a major achievement in implant dentistry. Clinical benefits such as superior esthetics[9] (particularly for adjacent implant sites), better bone-to-implant contact, and improved primary stability, could be obtained.

Therefore, the purpose of this prospective study was to evaluate the crestal bone loss around two-stage implants placed with platform-switched technique and to compare these levels with the implants placed with traditional abutment design.

**Materials and Method**

**Standard Implants with Prosthetic Components: (ADIN, Israel):**

Touareg™ –S Spiral Implants with straight abutments were used. It is a tapered implant with a spiral tap that condenses the bone during placement for immediate stability. It has two large variable threads and a tapered design for accurate implant placement, self-drilling, improved esthetics and better load distribution. It is blasted with Alumina Oxide.

**Platform-Switching Implants including Prosthetic Components:**

Touareg™-S Spiral Implants with Slim Abutments

Michigan 'O' Probe with Williams Markings: API (Michigan, USA), Paralleling Kit- RINN (Dentsply-Sensor Holding Device for posteriors).

**Methodology**

**Presurgical Phase:** 28 subjects were selected and detailed case medical history was recorded. Diagnostic investigations were done that included the Intra-oral periapical radiograph, orthopantomogram (Fig.1), diagnostic casts and blood investigations. The soft tissue mapping was done using the bone mapping stent (Fig.2)

and evaluation of edentulous space was done to get the correct implant size for the respective patients.

Fig.1: Orthopantomogram depicting the edentulous area

Fig.2: Bone Mapping with Stent

**Preoperative Considerations and Precautions:** Prior to the surgical procedure, a comprehensive patient evaluation was done in order to determine factors that may put the patient at risk, due to implantation procedure itself, or factors that may affect the healing process of either the bone and/or the soft tissue.

**Surgical Phase:** The patient was prepared for the surgery and an informed consent was taken. Aseptic surgical protocol was followed. The implant site was prepared according to the ADIN Drill instructions. After this the implant was placed, surgical site was sutured, postoperative instructions were given and the patients were recalled after 7 days for follow up and suture removal. The first radiograph was taken with the paralleling kit after procedure (Baseline) (Fig.3 & 4).

Fig.3 &4 Paralleling Kit placed while taking the Intra Oral Peri-apical radiograph

**Prosthetic Phase:** The patients again reported after a period of 3 months and a standardized radiographic picture was taken at this appointment.

**Second stage Surgery:** The implant site was exposed, the healing cap was removed and gingival former was placed for the formation of gingival cuff around the implant to create and emergence profile for the prosthesis.

**Impression Procedures and crown cementation:** The standard prefabricated abutment (straight abutments-ADIN Implant system) was placed in Group 1 subjects and slim titanium abutment was placed in Group 2 subjects and indirect impressions were made (Fig.5).

The definitive restoration was fabricated and cemented with GIC luting cement. Standardized radiographs were taken at $6^{th}$ and $12^{th}$ month interval.

Fig.5 (i) : Radiographic Presentation of Traditional Abutment Design (Group 1)

(ii) Radiographic Presentation of Platform Switching Design (Group 2)

**Bone Loss Monitoring:** An image analysis program (OrisWin DG Suite) was used to perform calibration and measurements. The digital imaging software provides

numerous tools for image analysis. Digital rulers, densitometers, and various other tools are readily available). On the distal and the mesial portions of the implant, the apical and coronal intersects were marked. Calibrated measurements were conducted starting from the marked bone intersects to the first microthread (Fig.6). For both the mesial and distal side of each study implant site, the mean of the coronal and apical measurements was calculated. The peri -implant soft tissue health was also assessed so as to demarcate if it acted as a cofactor in causing bone loss around the implant. The indices chosen were Modified Sulcular Bleeding Index (MSBI) and Gingival Index (GI). Unpaired t-test was used for the statistical evaluation. Hypothesis tests were conducted at the p value= 0.05 level.

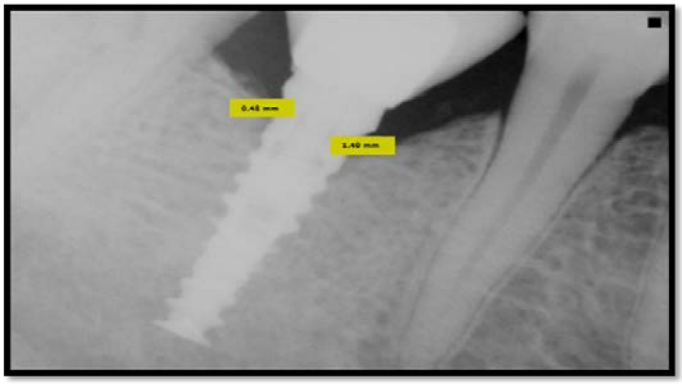


Fig 6: Bone Level Monitoring with OrisWin DG Suite
Mesial- 1.40 mm, Distal- 0.48mm

**Results**

Within the limitations of the study, the preliminary data revealed a significant difference that was evident regarding the bone levels when comparing the platform-switched and non-platform switched implants after 1 year of implant placement. The analysis was performed for bone levels of both mesial and distal sides separately and the overall bone loss was also calculated.

Fig.7 descriptive statistics shows, that the mean mesial and distal bone loss form baseline to 3rd month, baseline to 6th month and baseline to 12th month was significantly more in group 1 (control group) in comparison to group 2 (test group) (Table 1). Similarly, for distal the mean bone loss was significantly more in group 1 than group 2 (Table 2) (Fig.7). The mean overall bone loss from baseline to 6th month (Fig.8) and 12th month (Fig.9) were all significant (0.004, 0.002 respectively) and thus, the overall bone loss from baseline to 12th month was more in group 1 than group 2 (Fig.9). The results for the peri-implant soft tissue health assessment were found to be non-significant (Table 1 & 2). The overall results indicated that the platform switch design influenced the bone loss from baseline to 1 year in comparison to the traditional abutment design.

**Discussion**

Clinical observation of the bone-preserving effects of accidental PSW can be traced back some decades. The intentional use of PSW for bone-preserving reasons has been ongoing for several years. Preliminary data obtained from a longitudinal clinical trial are the first scientific evidence, with standardized radiographs, that PSW may illustrate beneficial effects on preserving peri-implant bone.[10]

In the study, 14 patients were rehabilitated with the traditional-abutment design and 14 patients were rehabilitated with the platform-switching concept. The surgical technique followed was same for both the groups. The difference followed in the prosthetic phase where in Group I the diameter of the abutment was similar to that of the implant whereas; in Group II the abutment diameter was lesser that the implant diameter. With respect to the limitations of these preliminary data, it could be shown that a significant difference was evident regarding peri-implant bone levels when comparing the platform-switched and platform-matched implant designs at baseline and 1 year after the implant placement. The radiographic observation suggests that the resulting post

restorative biologic process can be altered when the outer edge of the implant-abutment interface is horizontally repositioned inwardly and away from the outer edge of the implant platform.

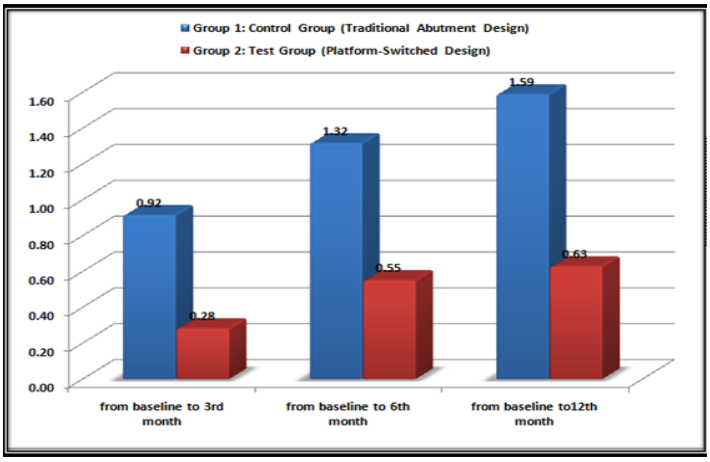
There appears to be 1 major consequence of the horizontal inward repositioning of the implant-abutment interface. As it has been shown, the IAJ is always encircled by an inflammatory cell infiltrate (0.75 mm above and below the IAJ).[8] To protect the underlying bone from this inflammatory infiltrate and microbiologic invasion, 1 mm of healthy connective tissue is needed to establish a biologic seal comparable to natural teeth. Thus, a close proximity of the IAJ to the bone, which is always established when implants are placed epicrestally, is eliminated by bone resorption and establishment of the mentioned biologic seal. By repositioning the IAJ inward and away from the outer edge of the implant and adjacent bone (platform-switching), the overall effect of the inflammatory cell infiltrate on the surrounding tissue, as described by Ericsson et al[11] may be reduced, thus decreasing the resorptive effect of the inflammatory cell infiltrate on crestal bone. This can be explained by the enhanced distance, which is generated between bone and the inflammatory cell infiltrate by shifting the platform inwardly. Furthermore, by inward positioning of the abutment an approximately 90° step will be created compared with a 180° step when using the traditional abutment design. The resulting confined area may have the consequence to the biologic material. This may result in a reduced inflammatory effect within the surrounding soft tissue and crestal bone.[12,13,14]

The results of the study are similar to a study conducted by Markus Hurzeler who performed a clinical trial to show that crestal bone height around dental implants could be influenced using the platform-switch protocol. The preliminary data and the statistical analysis revealed mean crestal bone loss in platform-switched implants to be 0.22 mm and for non-platform switched implants was 2.02 mm.[10] In a study by Vela Nebot et al[15], wherein he inserted abutments of a lesser diameter than the implant's platform to create a platform modification, the implants for the test group and the control group and the control group were placed at the same level as the alveolar crest. After abutment attachment, the implants were followed for 4-6 months to assess the bone radiographically. The results were significant revealing lesser bone loss in platform-switched design in comparison to the conventional implant-abutment design. The preliminary data obtained from a longitudinal prospective clinical trial confirms that PSW has considerable potential to limit crestal bone resorption. The technique of PSW requires additional long-term data and studies to establish the biologic process.

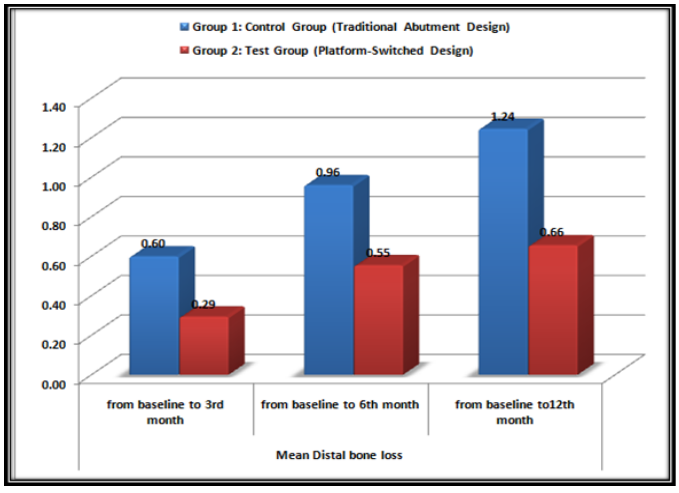
**Conclusion**

The concept of PSW seems capable of limiting crestal resorption and seems to be able to preserve peri-implant bone levels. Bone remodeling during 1 year after final reconstruction compared with the nonplatform-switched abutments are still evident 1 year after final restoration. At present, there are only a limited number of reports on Platform Switching, and as such, the scientific evidence on this topic is lacking in both quantity and quality. Excluding case reports, reports on platform switching can be broadly categorized into: (1) prospective or retrospective radiographic evaluation of crestal bone level in humans, (2) histological and histomorphometrical analysis in animals, or (3) finite element analysis of various types and location of implants. Most reports published so far conclude that platform switching is effective in the preservation of crestal bone loss. Researchers have attempted to explain the mechanism of action of platform switching; however, it is necessary to

conduct further studies, including histological studies using animals, to clarify the mechanism fully. With respect to radiographic evaluations of crestal bone level in humans, properly designed long-term observation is required, before establishing the long-term predictability of platform switching in preserving horizontal and vertical marginal bone levels or modifying the minimum distances between platform-switched implants and adjacent teeth or implants particularly through prospective, randomized, multicenter trials with large number of participants.




(i)




(ii)

Fig.7. Descriptive Statistics for (i) Mean Mesial and (ii) Mean Distal Bone Loss

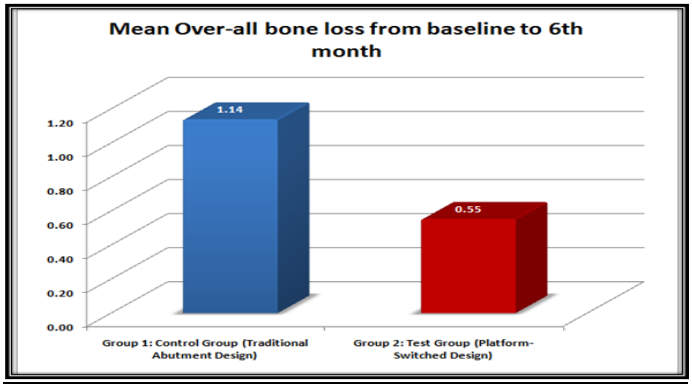



Fig.8: Descriptive Statistics for Overall Bone Loss from Baseline to 6th Month

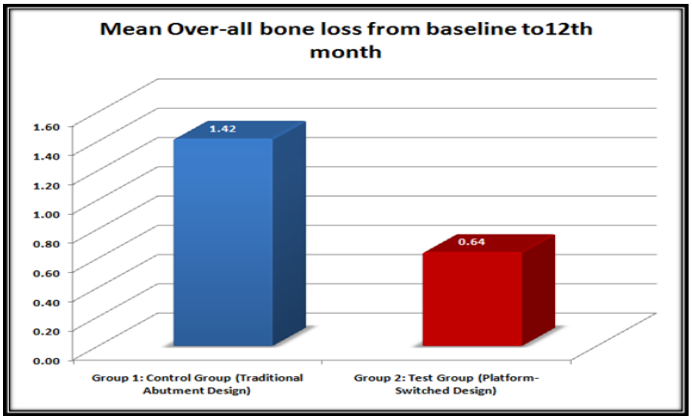



Fig.9: Descriptive Statistics for Overall Bone Loss from Baseline to 12th Month

| Gingival Index | Groups | Number | Mean | Std. Deviation | Mean Difference | t-test value | p-value |
|---|---|---|---|---|---|---|---|
| At baseline | Group 1: Control Group | 14 | 0.88 | 0.34 | 0.16 | 1.319 | 0.199* |
| | Group 2: Test Group | 14 | 0.71 | 0.31 | | | |
| At 3rd Month | Group 1: Control Group | 14 | 1.05 | 0.58 | 0.05 | 0.331 | 0.743* |
| | Group 2: Test Group | 14 | 1.00 | 0.17 | | | |
| At 6th Month | Group 1: Control Group | 14 | 1.25 | 0.59 | 0.04 | 0.211 | 0.835* |
| | Group 2: Test Group | 14 | 1.21 | 0.24 | | | |
| At 12th Month | Group 1: Control Group | 14 | 1.34 | 0.61 | 0.00 | 0.000 | 1.000# |
| | Group 2: Test Group | 14 | 1.34 | 0.30 | | | |
| Unpaired-t-test<br># Non-Significant difference | | | | | | | |

Table 1: Assessment of the Periodontal Health - Gingival Index

| MSBI | Groups | Number | Mean | Std. Deviation | Mean Difference | t-test value | p-value |
|---|---|---|---|---|---|---|---|
| At baseline | Group 1: Control Group | 14 | 1.14 | 0.53 | 0.00 | 0.000 | 1.000* |
| | Group 2: Test Group | 14 | 1.14 | 0.36 | | | |
| At 3rd month | Group 1: Control Group | 14 | 0.93 | 0.73 | 0.07 | 0.295 | 0.770* |
| | Group 2: Test Group | 14 | 0.86 | 0.53 | | | |
| At 6th month | Group 1: Control Group | 14 | 1.36 | 0.63 | 0.29 | 1.555 | 0.132* |
| | Group 2: Test Group | 14 | 1.07 | 0.27 | | | |
| At 12th month | Group 1: Control Group | 14 | 1.50 | 0.65 | -0.07 | -0.322 | 0.750* |
| | Group 2: Test Group | 14 | 1.57 | 0.51 | | | |
| Unpaired t-test<br>#Non-Significant difference | | | | | | | |

Table 2: Mean Sulcular Bleeding Index

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