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# Implant platform switching concept: a literature review

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**Abstract. – BACKGROUND: The platform switching concept involves the reduction of the restoration abutment diameter with respect to the diameter of dental implant. Long-term follow up around these wide-platforms showed higher levels of bone preservation.**

**AIM: The aim of this article is to carry out a literature review of studies which deal with the influence of platform-switched implants in hard and soft oral tissues.**

**MATERIALS AND METHODS: All papers involving "platform switching" that are indexed in MedLine and published between 2005 and 2011 were used. Clinical cases, experimental and non-experimental studies were included, as well as literature reviews.**

**RESULTS: In our search, we analized 18 clinical cases and 3 reviews. The results indicate that peri-implant bone resorption is reduced with platform switching system.**

**CONCLUSIONS: All papers written by different researchers show an improvement in peri-implant bone preservation and satisfactory aesthetic results. Further long-term studies are necessary to confirm these results.**

*Key Words:*
Platform switching, Crestal bone remodeling, Crestal bone loss, Biologic width, Bone implant contact (BIC).

## Introduction

The goal of modern implant therapy entails more than just the successful osseointegration of the implant. A successful result must also include an esthetic and functional restoration surrounded by stable peri-implant tissue levels that are in harmony with the existing dentition[1,2]. 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 remodeling and resorption processes[3]. In particular, after one year from the prosthetic restoration, the crestal bone levels resulted approximately 1.5-2 mm below the implant-abutment junction (IAJ)[4]. Although the etiological factors underlying bone loss have not been fully established[5], the main causal factors of crestal bone loss are occlusal overload and peri-implantitis. Regarding the submerged implants, some studies have correlated the loss of bone tissue with the relations between IAJ and bone crest[6]. Given that a sufficient dimension of peri-implant mucosa is necessary to allow for proper epithelial-connectival attachment, where the size of the tissues is not suitable this would generate a certain peri-implant bone resorption to ensure the stabilization of an attack with adequate biological width. In particolar, soft tissue inflammation localized at the implant-abutment interface following the attempt of the same soft tissues to establish the biologic width, would be responsable for a certain bone loss[7].

Many Authors, however, have identified in the presence of a microgap at the implant-abutment interface, resulting in bacterial colonization of implant sulcus, the possible etiologic mechanism[8]. It is likely that there is a bacterial leakage within the implant system, after its prosthetic connection, with subsequent penetration of bacteria and their products within the microgap between implant and abutment. This would cause an inflammatory process close to the crestal bone, resulting in bone support loss[9].

It was pointed out, however, that the resorption resulting from biological processes after prosthetic restoration change with the use of a platform switching model[10].

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[4].



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The platform switching concept is based on the use of an abutment smaller than the implant neck[11]; this type of connection moves the perimeter of IAJ to the center of implant axis[12-14]. It is 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[15-19]. Recent studies suggest the formation of a more consistent connective sleeve when the abutment's base is smaller than the implant platform, with advantages in the ability to form a mucosal seal[20]. Regarding biomechanical advantages in the use of platform switching, the results indicate that, unlike conventional implants where a high stress area around implant's neck and along its lateral surface is present, in the model with platform switching the stress area is localized to the center of the implant. Moreover, in this type of implant, the strong tension is concentred near the implant-abutment interface and the shear force exerted on the cortical bone in the platform switching model is lower than in the normal model[21].

## Materials and Methods

The present study offers a review of the literature dealing with the impact of platform-switched implants on the oral hard and soft tissues. To this effect, a Medline search was carried out, using the PubMed search engine with the key words "platform switching", "crestal bone loss', biologic width", "crestal bone remodeling", "bone implant contact (BIC)" and, as well as combinations of these key words. A total of 21 works published between 2005 and 2011 were examined; most of these studies are clinical cases or single clinical cases. In addition, we found 2 finite element analyses and 3 literature review.

### Inclusion Criteria:

**1.** Papers published in journals indexed in MedLine, between 2005 and 2011;
**2.** Human studies, both of males and females;
**3.** Papers in which modified platforms in dental implants are studied (platform switching concept), using different surgical techniques and clinical situations (immediate loading, delayed loading).

### Exclusion Criteria:

**1.** No indexed manuscripts;
**2.** Studies with no results.

## Results

The results described by the different Authors are encouraging. The bone loss is lower in all those cases in which platform geometry is modified resulting in a better aesthetic outcome.

The principal aspects of the consulted articles refer to biomechanical behavior of the abutment-implant complex in response to occlusal loading, bone crest level preservation and biological space repositioning.

Sample sizes varied between 1 and 180 implants (the average number of implants was 67.6 ± 1.3) and a follow-up period varied from 4 to 168 months (average follow-up 27.06 months).

In the studies on platform switching involving a follow-up period of 4-168 months, the reported bone loss varies between 0.09-2 mm (Table I).

## Discussion

The biological space adjacent to an implant is greater than the space adjacent to a natural tooth, with histological differences in terms of the organization and distribution of the fibers.

According to Lazzara and Porter[4], the deliberate creation of a space for the mentioned physiological barrier minimizes the space for repositioning of the fibers. By displacing the junction with the abutment to a more medial position with respect to the axis, an increased surface area of the implant is freed, thus favoring controlled repositioning of the biological space[22,23].

The space is created in the horizontal plane one millimeter from the implant-abutment junction, supported over the external margin of the platform. In addition, this procedure keeps the inflammatory infiltrate away from the crestal bone margin, with a 50% reduction in occupation surface[4,22].

Eighteen texts described clinical studies and these proved more useful for the purposes of this review. All of the authors agree with the fact that firstly, the main bone loss is observed during the first month after oral exposure and secondly, that the bone loss is lower in all those cases in which platform geometry is modified resulting in a better aesthetic outcome.

Enkling et al[24] confirmed that platform-switched implants showed very limited peri-implant bone level alterations.

Wagemberg et al[1] in their prospective study evaluated implant survival and crestal bone levels around implants that used the platform – switch-

**Table I.** Crestal bone loss, number of placed implants and follow-up according to the clinical studies found in the Medline search of dental implant platform switching in human subject.

| Author | Mean crestal bone loss (mm) | N° implants | Follow-up (months) | Study caracteristics | Surgical caracteristics |
|---|---|---|---|---|---|
| Enkling et al 2011[24] | 0.74 | 42 | 25 | Clinical cases | One step and two steps surgical protocol |
| Calvo-Guirado et al 2011[34] | 0.97 | 83 | 60 | Clinical cases | One step surgical protocol |
| Wagenberg & Froum 2010[5] | 1.8 | 94 | 132-168 | Clinical cases | Two steps surgical protocol |
| Cocchetto et al 2010[28] | 0.86 | 15 | 18 | Clinical cases | One step surgical protocol |
| Bilhan et al 2010[29] | 1.39 | 126 | 36 | Clinical cases | Two steps surgical protocol |
| Canullo et al 2010[13] | 0.83 | 44 | 33 | Test and control group | Two steps surgical protocol |
| Trammel et al 2009[19] | 0.99 | 25 | 24 | Test and control group | One step surgical protocol |
| Canullo et al 2009[12] | 0.65 | 22 | 25 | Clinical cases | Immediate post-extraction restoration |
| Rodriguez-Ciurana et al 2009[22] | 0.89 | 82 | 15 | Clinical cases | Two steps surgical protocol |
| Prosper et al 2009[3] | 0.65 | 180 | 24 | Test and control group | One step and two steps surgical protocol |
| Calvo-Guirado et al 2009[10] | 0.13 | 59 | 12 | Clinical cases | Immediate functional loading |
| Cappiello et al 2008[15] | 0.95 | 75 | 12 | Test and control group | One step surgical protocol |
| Calvo-Guirado et al 2008[20] | 0.6 | 104 | 16 | Clinical cases | Immediate loading and immediate restoration |
| Hürzeler et al 2007[17] | 0.12 | 148 | 12 | Test and control group | Two stage surgical protocol |
| Canullo & Rasperini 2007[18] | 0.78 | 10 | 22 | Clinical cases | Immediate post-extraction restoration |
| Calvo-Guirado et al 2007[26] | 0.09 | 10 | 6 | Test and control group | Immediate post-extraction restoration |
| Vela-Nebot et al 2006[24] | 1.15 | 30 | 6 | Test and control group | One step and two steps surgical protocol |
| Gardner 2005[25] | 2 | 1 | 4 | Clinical cases | Immediate post-extraction restoration |

ing concept, with a follow-up period ranging from 11 to 14 years. The results of this investigation showed that 99% of all the surfaces examined had ≤ 2.0 mm of bone loss over this observation period, confirming that the platform-switching concept was effective in preserving interproximal crestal bone levels.

Cocchetto et al[25] evaluated both clinically and radiographically the biologic effect of using a wide platform-switching restorative protocol in human. The results of this preliminary study indicated that, when properly selected, patients receiving wide platform-switched implants may experience less crestal bone loss than that resulting from the use of regular platform-switching or non-platform-switching approaches.

In their study, Bilhan et al[26] compared bone around platform-switched and regular platform implants that supported removable prostheses and reported that, after a period of 36 months, the marginal bone loss was statistically significantly lower in platform-switching situations.

Canullo et al[20,27] observed that implants restored according to the platform-switching concept experienced significantly less marginal bone loss than implants with matching implant-abutment diameters. In addition, it was observed that marginal bone levels were even better maintained with increasing implant-abutment mismatching. The authors was in favour of platform switching and they evaluated the relation between immediate loading with these implants and its effects on soft and hard tissues[28,29].

Trammell et al[30], in a case-control study, measured the biological width with reduced and conventional platform abutments in the same individual. Although the biological width was similar in both groups (1.57 ± 0.72 mm with the expanded platform and 1.53 ± 0.78 mm with conventional abutments), bone loss was significantly smaller with the expanded platform.

Rodriguez-Ciurana et al[31], in a two-dimensional biomechanical study involving platform switching integrated into the implant design, failed to obtain peri-implant bone force attenuation values as high as those reported in earlier studies, when comparing platform expansion with a traditional restoration model. In addition, the authors concluded that force dissipation in the platform switching restoration is slightly more favorable in an internal than in an external junction, since it improves distribution of the loads applied to the occlusal surface of the prosthesis along the axis of the implant.

Prosper et al[5] in a randomized prospective study revealed that the use of platform-switching concept and of implants with an enlarged platform, as compared to cylindric implants inserted with conventional surgical protocols and with abutments of matching diameter, significantly reduced postrestorative crestal bone loss when placed in both two-stage and one-stage techniques. Moreover, it seemed that the positive effect of the platform-switching concept was stronger when implemented on implants with an enlarged platform.

Calvo Guirado et al noted the success of the placed implants after eight months with minimal marginal resorption (less than 0.8 mm) and highly satisfactory aesthetic results in the anterior zone[32-34].

Cappiello et al[35] confirmed the important role of the microgap between the implant and abutment in the remodeling of the peri-implant crestal bone. Platform-switching seemed to reduce peri-implant crestal bone resorption and increase the long-term predictability of implant therapy.

Hürzeler et al[23] observed that a certain amount of bone remodeling occurred 1 year after final reconstruction.

Vela-Nebot et al[36] conclude that platform switching improves aesthetic results and that when invasion of the biologic width is reduced, bone loss is reduced ($p < 0.0005$). However, they say that further microbiological, pathological and clinical studies are necessary to confirm both these results as well as the study's working hypothesis.

Gardner[37] discusses the literature dealing with the changes that occur when an implant is placed in bone and he presents a case study using platform switching implants. He states that its main advantage is that it is an effective way to control circumferential bone loss around dental implants but he concludes that platform switching needs further investigation. Furthermore, he notes several potential disadvantages of this procedure such as the need for components that have similar designs (the screw access hole must be uniform) and the need for enough space to develop a proper emergence profile.

Serrano-Sànchez et al[22] in a literature review reached the conclusion that the expanded platform obtains excellent aesthetic outcomes, but further investigations are necessary to show long term results.

López-Marì et al[29] reviewed published articles dealing with platform switched implants in order to assess survival rates and clarify their influence

on the marginal bone loss and on soft tissue. The Autors concluded that the platform switching is capable of reducing crestal bone loss to a mean of 1.56 mm ± 0.7 mm; it alsocontributes to maintainingthe width and height of crestal bone and the crestal peak between adjacent implants.

Atieh et al[38] reached similar results and, in addition, they observed that the degree of marginal bone resorption is inversely related to the extent of the implant-abutment mismatch.

In 2009, Hsu et al[39] analyzed the behavior of reduced platform restorations in the context of a finite elements study in three dimensions. Their results showed a 10% decrease in all the prosthetic loading forces transmitted to the bone-implant interface.

Maeda et al[21] used 3D finite element model to examine the biomechanical advantages of platform switching. They noticed that this procedure shifts the stress concentration away from the bone-implant interface, but these forces are then increased in the abutment or the abutment screw.

## Conclusions

Having reviewed available literature, we have concluded that platform switching is capable of reducing or eliminating crestal bone loss.

All the Authors agree that the use of implants with modified platform (platform switching) improves bone crest preservation and leads to controlled biological space reposition. According to the different papers, this expanded platform obtains excellent aesthetic outcomes. Moreover, the implant design modifications involved in platform switching offer multiple advantages and potential applications, for example in the anterior zone where preservation of the crestal bone can lead to improved aesthetics.

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