



THE IMPACT OF PLATFORM-SWITCHED IMPLANTS ON THE MARGINAL BONE LEVEL AND SOFT TISSUE DIMENSIONS

ABSTRACT

Objectives: The objective of this study is to compare the characteristics of the concept of platform-switched implants (PSW) that have recently emerged in implant dentistry and its effects on the marginal bone loss (MBL) around the implant with platform-matched implants (PMI).




Data: In the study, PSW implant-abutment connection system, MBL, and peri-implant hard and soft tissue changes were examined. The research terms used in the study are dental implant, platform switching concept, switched platform, platform mismatch, platform-matched implants, and dental implant-abutment design.

Sources: In the electronic research, the language was selected as English and studies conducted until March 2018 were investigated without year limitation. The electronic studies include the National Library of Medicine, PubMed/Medline, Web of Science, Cochrane Oral Health Group Trials, and Cochrane Central Register of Controlled Trials.

Study selection: Studies, retrospective or prospective clinical human studies, either randomized systematic review and meta-analyses, and finite element analyses (FEA) were examined. Case reports and studies of animal experiments were excluded from the review.

Conclusions: It was observed that clinical trials consisted of short and medium-term follow-ups and biomechanical studies were limited. It was observed that PSW implant systems obtain positive results in reducing the MBL and are more aesthetic in terms of soft tissue formation compared to PMI systems, and interest has been gradually increasing in the PSW system in recent years. It was revealed that long-term clinical trials for the PSW system are required.

Keywords: Dentistry, platform-switching, dental implant-abutment design, dental abutments, dental implants, alveolar bone loss.

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INTRODUCTION

Implant treatment modalities offer standard, aesthetic, and functional approaches for cases of partial and complete edentulism.^{1,2}

The presence of osseointegration, which is the close relationship between the implant and the peri-implant bone, and the preservation of the marginal bone level are necessary aspects for success in dental implants.³ The bone resorption in the peri-implant region is the major cause of implant failures.^{4,5}

Soft tissue inflammation, which occurs in the implant-abutment connection area, passes through the mucosal barrier and spreads from the implant interface to the bone tissue over time, and creates a biological gap around the implant. Therefore, resorption begins in the bone around the implant.^{6,7} Stability of the bone loss, no or minimal resorption in the peri-implant marginal area during the loading phase and duration of oral use of implant-supported prosthetic restorations are important criteria for implant success.^{5,8}

In the last thirty years, there have been significant developments in the field of prosthetic dentistry, the characteristics of dental implants, surgical procedures, and prosthetic restorations.⁹

It has been expressed that within a one-year period following the prosthetic treatment by providing the implant-abutment connection for both maxillary and mandibular implant treatments, the radiological crestal bone loss should be between 1.2-1.5 mm and vertical bone loss should be <0.2 mm every year during the functioning of implants.^{3,10} New clinical techniques, various implant application techniques and designs have been developed.^{6,11}

Marginal bone losses start in the implant-abutment connection areas and at the first groove of the implant. It is necessary to reduce the bone loss in order to increase the clinical survival rates of implants.^{12,13} Factors affecting the marginal bone loss around the implant are presented in Table 1.¹⁴⁻¹⁶

Table 1. Factors effecting marginal bone loss around implants

Peri-implant marginal bone loss factors	Researcher/year
Occlusal overload; traumatic occlusion and combined with inflammation resulting in crater like bone defects lateral to the implants.	Hagiwara 2010, Misch 2009, Wu <i>et al.</i> 2016, Ferraz <i>et al.</i> 2012, Lindhe and Meyle 2008
Periimplantitis; was a site specific infection with microbial flora similar to chronic periodontitis.	Alvarez-Arenal <i>et al.</i> 2017, Lindhe and Meyle 2008, Lang and Berglundh 2011
Biomechanical factors	Hagiwara 2010
Implant design; macrodesign of the cervical area of the implant (i.e., platform-switching and platform-matching implants)	Freitas-Júnior <i>et al.</i> 2012, Strietzel <i>et al.</i> 2015
Implant diameter; using a small diameter implant may increase the stress and/or strain of bone around the implant neck	Wu <i>et al.</i> 2016, Baggi <i>et al.</i> 2008
Implant material properties	Freitas-Júnior <i>et al.</i> 2012
Implant surface configuration; surface topography of the implant neck	Wu <i>et al.</i> 2016, Hammerle <i>et al.</i> 1996
The width of the alveolar bone is insufficient	Freitas-Júnior <i>et al.</i> 2012
Concavity of the ridge is present (especially in the anterior regions of the jaws)	Wu <i>et al.</i> 2016
Implant-abutment micro-gap adversely affects the stability of the periimplant tissue. A microgap exists between the components of a 2-piece implant. This microgap may provide a place for bacterial colonization and food debris.	Hagiwara 2010, Singh <i>et al.</i> 2013
Implant crest module is the transosteal region of the implant- crestal stress during loading	Hagiwara 2010
Biologic width;	Hagiwara 2010, Singh <i>et al.</i> 2013, Lee <i>et al.</i> 2016
Surgical trauma; the heat generated during drilling may cause damage, inviting inflammatory and traumatic response.	Singh <i>et al.</i> 2013, Ferraz <i>et al.</i> 2012
Improving the interface between soft tissue and implant-abutment junction	Freitas-Júnior <i>et al.</i> 2012
Type of implant–abutment connection	Palaska <i>et al.</i> 2016
Repeated connection/disconnection of abutments	Abrahamsson <i>et al.</i> 1997
Interimplant distance	Rodriguez-Ciurana <i>et al.</i> 2009
Implant positioning relative to the alveolar crest	Hermann <i>et al.</i> 2000
Micromovements of the abutment (prosthetic components)	Duyck <i>et al.</i> 2006
Smoking status	Clementini <i>et al.</i> 2014

In order to take the marginal bone loss around the implant under control, there are methods such as placing implants by single-stage surgical procedures and performing the implant-abutment restoration as a whole. However, there has not been an ideal method found yet.^{8,17}

The platform-switching (PSW) implant configuration in dentistry was developed to prevent resorption in the cervical crestal bone by using an abutment with a diameter narrower than the implant diameter.^{18,19} There are many studies in the literature that have been conducted on this subject in the past decade.²⁰⁻²²

It has been reported that the peri-implant bone loss in PSW implants is between 0.05 and 1.4 mm in the first year following the prosthetic loading.^{5,23} PSW characteristics and application methods were first discovered in 1991. Wide implants 5 and 6 mm in diameter were produced by 3i implant system (Biomet) company in order to increase the bone connection surface and provide primary stability in implants. The marginal bone resorption was found to be lower in these implants with narrow platforms in clinical and radiological follow-ups of 1-5 years of restorations made using 4.1 mm diameter abutments compared to regular platform implants.^{9,24} Primarily by using narrow-diameter abutments, the bacterial invasion to the neck of the implant is prevented and the implant is preserved. The other reason is suggested as the soft tissue's creating a barrier for microorganisms with aesthetic and full formation.²⁵ The principles of PSW are the use of an abutment with a diameter narrower than the implant diameter, the absence of the shiny surface in the implant neck region, the use of internal screw implant systems, enabling the bone-level implant placement, the use of an implant with a diameter as large as possible, the selection of abutment with high

durability, immediate loading, and the resistance of peri-implant tissues to occlusal forces.⁵

However, some studies have stated that it is unclear whether the PSW configuration is better than platform-matching implants in terms of peri-implant bone stress distribution and peri-implant bone level changes.⁶ In other studies, it has been reported that it prevents the marginal bone loss and soft tissue loss at a low rate.²⁶⁻²⁹ However, there are more researchers who state the opposite.^{30,31}

As stated by the researchers, the soft tissue size was approximately 3.6 mm and it contained a barrier epithelium of 1.9 mm and a connective tissue portion of 1.7 mm.³² It is very important to maintain the crestal bone level to preserve soft tissue and therefore facilitate oral hygiene and sustain gingival esthetics. It has been suggested to place dental implants subcrestally in esthetic areas in order to acquire a perfect emergence profile for the prosthetic rehabilitation and to reduce the possibility of exposing the metal top of the implant or of the abutment margin.⁹

Therefore, the main objective of this review is to make a comprehensive literature assessment of the PSW concept and compare the advantages, disadvantages, and areas of use of the PSW implant concept with the marginal bone resorption, aesthetic and biomechanical characteristics of platform matching implants and to provide detailed information. Scientific data were compiled by examining controlled clinical prospective and retrospective studies, biomechanical analyses, systematic reviews, and results of meta-analyses conducted on this subject.

Advantages of PSW configuration: Table 2 contains information on the advantages of the PSW configuration in the substances below.

Disadvantages of PSW configuration: Table 3 contains information on the disadvantages of the PSW configuration in the substances below.

Table 2. Advantages of PSW configuration

	Researcher/year
Marginal bone is protected with platform switching concept	Wagenberg and Froum 2010
Reduces the stress at the bone-implant interface It provides a biomechanical advantage	Maeda <i>et al.</i> 2007
Have better periimplant bone stress distribution	Romanos <i>et al.</i> 2016, Liu <i>et al.</i> 2014
Lead to less periimplant bone level changes	Liu <i>et al.</i> 2014
Marginal bone loss decreases mesially and distally	Wagenberg and Froum 2010
Displacement of the intensity voltage of the implant-abutment	Freitas-Júnior <i>et al.</i> 2012
Implant-abutment combination is moved to the central axis of the implant	Tabata <i>et al.</i> 2010
The shift of the micro-gap between the implant and abutment	Freitas-Júnior <i>et al.</i> 2012
Force transmission is less than the standard implants from the crestal bone	Tabata <i>et al.</i> 2010
Clinical are preferred and the biologic and mechanical advantages	Wu <i>et al.</i> 2016, Cassetta <i>et al.</i> 2016
Crestal region of cortical bone by shifting the stress to cancellous bone during loading	Wu <i>et al.</i> 2016
Supported by several clinical and experimental studies	Freitas-Júnior <i>et al.</i> 2012
Platform switched implants had the least reduction in soft tissue	Barwacz <i>et al.</i> 2016, Liu <i>et al.</i> 2014
Can be applied together with immediate loading	Carinci <i>et al.</i> 2009
Maintenance of the gingival papilla are of importance in obtaining satisfactory esthetic results	Ferraz <i>et al.</i> 2012
PSW may keep away the micromotion between the implant and abutment from the bone.	Chrcanovic <i>et al.</i> 2015
PSW implants can increase the distance of inflammatory cells (micro-gap) from the bone margin, thereby maintaining bone tissue	Freitas-Júnior <i>et al.</i> 2012
Reverse conical implant neck	Carinci <i>et al.</i> 2009

Table 3. Disadvantages of PSW configuration

	Researcher/year
It may be associated with the infiltration of bacteria source platform switching	Gardner 2005, Baumgarten <i>et al.</i> 2005
It may increase the distance between marginal bone and implant	Gardner 2005, Baumgarten <i>et al.</i> 2005
Increasing stress intensity on the abutments screw	Tabata <i>et al.</i> 2010
Developing prosthetic failure due to a broken abutments screw	Maeda <i>et al.</i> 2007, Tabata <i>et al.</i> 2010, Canay and Akça 2009
Fixed and/or removable dentures in reconstruction challenges	Maeda <i>et al.</i> 2007, Tabata <i>et al.</i> 2010, Canay and Akça 2009
Patients economic losses due to screw breakage	Maeda <i>et al.</i> 2007, Tabata <i>et al.</i> 2010, Canay and Akça 2009
A greater risk of implant fracture may also be found	Maeda <i>et al.</i> 2007, Tabata <i>et al.</i> 2010, Canay and Akça 2009
Inconsistency between the implant and abutment platform in PSW systems may be between 0.3 mm versus 0.5 mm. Narrow abutment of neck to increase the risk of screw fracture produced consistent narrow screws	Maeda <i>et al.</i> 2007, Tabata <i>et al.</i> 2010, Canay and Akça 2009, Becker <i>et al.</i> 2007
It is increasing the stress density on the abutment screw and abutment	Maeda <i>et al.</i> 2007

Commercial platform switching systems

In recent years, many implant companies have been producing implants and abutments suitable

for PSW systems. The most commonly used implant systems and companies are presented in Table 4.

Table 4. Commercial trademarks PSW configuration

Commercial systems	Manufacturer	Researcher/year
Certain Prevail Implant	Biomet 3i, Implants Innovations Inc, Palm Beach gardens, FL, USA	Albrektsson <i>et al.</i> 1986
Osseotite Certain	Biomet 3i, Implants Innovations Inc, Palm Beach gardens, FL, USA	Albrektsson <i>et al.</i> 1986, Fickl <i>et al.</i> 2010, Sivolella <i>et al.</i> 2013
Global	Sweden & Martina	Crespi <i>et al.</i> 2009
Novel Active	Nobel Biocare	Wagenberg and Froum 2010
Ankylos Morse taper-type connections	Dentsply Friadent	Crespi <i>et al.</i> 2009
Camlog Screw-Line	Camlog Biotechnologies AG, Basel, Switzerland	Guerra <i>et al.</i> 2014
Promote plus surface	Inc. Palm Beach Gardens, FL	Desai and Patil 2013
3i, Implant Innovations	Osstem Implant Co., Seoul, Korea	Lindhe and Meyle 2008
Osstem GS III implant system	Nobel Biocare AG, Zürich, Switzerland	Lee <i>et al.</i> 2016
NobelReplace™Tapered Groovy	GTB Plan 1 Health Amaro, UD, Italy	Girolamo <i>et al.</i> 2016
BioPlatform, patent pending	São Paulo, SP, Brazil	Freitas-Júnior <i>et al.</i> 2012
SIN implants	Institut Straumann AG, Basel, Switzerland	Baggi <i>et al.</i> 2008
ITI Standard implants		

It has been reported that the use of internal hexagonal implant-abutment connections in PSW systems is more advantageous than external hexagonal connections from the biomechanical aspect.^{33,44} Moreover, it has been emphasized that Morse taper-type internal connection systems can be preferred since they cause less resorption and MBL (marginal bone loss), less bacterial contamination, and less bacterial invasion at the implant-abutment interface than butt-joint connection systems.⁵⁵

MATERIALS AND METHODS

The literature review was carried out electronically without a time limitation in PubMed/Medline, Web of Science, Cochrane Oral Health Group Trials Register, plus hand-searching and Google scholar until March 2018. The criteria for inclusion in the study were as follows: articles published in English. The keywords were selected as dentistry, dental implant, oral implant, platform switch, switched platform, platform mismatch, and dental implant-abutment design, platform-switching (PSW) implant concept, abutment, implant fixture, and platform matching (PM) implant. A total of 180 articles were reviewed. A total of 69 articles, including systematic reviews and meta-analyses, randomized retrospective and prospective clinical trials (at least 12 months of follow-up clinical studies in humans), and biomechanical in vitro studies, which were directly related to the subject, were included in the study. PSW implants were compared with platform matching implants (PMI), and evaluations were made. Information about commercial implant manufacturers, implants, and abutments suitable for the PSW method was evaluated in the light of the literature.

DISCUSSION

In-vitro studies of PSW configuration; finite element analysis and comparative analysis of platform matching implants and platform switching implants.

In a finite element analysis⁵ performed to determine the PSW and PM abutment-implant stress distribution, the PSW abutment was compared with the Ankylos implant and PM abutment Anthogyr implant. In PSW implants,

peri-implant bones were found to have lower stresses, and more uniform stress distribution was observed.

In a biomechanical analysis¹⁵ performed by placing PSW-compatible abutments in narrow-diameter (3.25 mm) implants, marginal bone stresses were found to be 74.9% lower than those of PM implants. When immediate loading was performed with the PSW abutment in small diameter implants, marginal bone stresses around the implant were less common.

In a study³³ in which internal and external hexagonal platform-switched implant-abutment connections were evaluated biomechanically, while high stresses were observed in external hexagon implants, reliable results were obtained in internal hexagon implants.

In a finite element analysis¹⁶ examining the effect of the PSW configuration on the stress distribution in angular abutments, it was found out that the PSW reduced stress in the cortical bone.

A regular implant (prosthetic platform of 4.1 mm) and a wide implant (prosthetic platform of 5.0 mm) were utilized for introducing PSW and PM implant systems in the studies in which they were compared with FEA.⁴⁷ The stress was determined over a broader area in the peri-implant bone tissue (159 MPa) and the implant (1610 MPa), while it was observed that the PSW reduced the stress distribution on bone tissue (34 MPa) and implant (649 MPa). It was found out that the PSW reduces stress distribution in the implant and bone by 80% and is biomechanically advantageous.

In a 3D-FEA analysis⁶⁴, in which the effects of the PSW on stress distribution were examined in long and short implants in the maxillary anterior region, it was observed that stresses were lower in long and PSW implants.

A 3D-FEA was performed for evaluating the load distribution and capability of various implant types to bear the same. Much greater cortical bone stress values (145% in tension and 290% in compression) were exhibited by the Nobel Biocare and ITI standard implants compared to the Ankylos system. As a result of the study, it was reported that PSW caused a decrease in overloading risk.³⁵

The impact of implant design (in terms of diameter, length, and thread shape), in-bone positioning depth, and bone post healing crestal morphology on the load transfer mechanisms of osseointegrated dental implants was examined in the study of Baggi *et al.*⁶⁶ on the basis of PSW. A 3D-FEA was conducted by simulating static loading. The implant diameter represents a more effective design parameter in comparison with the implant length, in addition to the fact that thread shape and thread details may have a considerable effect on stresses at the peri-implant bone, particularly for short implants.

The PSW procedure has an advantage from the biomechanical aspect since it shifts the stress concentration area away from the cervical bone-implant interface.

A 3D-FEA was carried out for assessing and comparing the stress distribution in the peri-implant bone of one single implant-supported crown with PSW and non-PSW. Models were formed with an implant (4, 9, 13 mm, platform 4.1 mm) in the jaw bone. The PM model was simulated in the computer environment by using a 4.1-mm diameter abutment, and the PSW model was simulated in the computer environment by using a 3.8 mm diameter abutment. The stress at the transitional cortical bone is reduced as a result of the PSW technique. In two models, as the load becomes more inclined, a gradual increase in the stress in question occurs. Lower stress values are observed in the transitional trabecular bone compared to the transitional cortical bone.⁸

According to the 3D-FEA results, the main concentration of the stress was at the bottom of the abutment and the top surface of the implant in two models. The von Mises stress values were determined to be considerably greater in the PSW model in a major part of the components, except for the bone. The highest von Mises values and stress distribution pattern of the bone were similar in the models.⁶⁷

Clinical studies of PSW configuration; Marginal bone resorption, clinical follow-up and implant survival rates

In clinical trials that have been carried out in recent years, PSW and PMI implant systems are compared. Accordingly, 5-year randomized

clinical trial one hundred subjects were chosen for the present study. The average MBL alterations for tissue-level implants restored with PMI were determined to be 0.26 mm at baseline to 1 year, 0.34 mm at 1 year to 5 years, and 0.61 mm at baseline to 5 years. The average MBL alterations for bone-level implants restored with PSW were determined to be -0.03 ± 0.74 mm at baseline to 1 year, -0.17 ± 0.67 mm at 1 year to 5 years, and -0.20 ± 0.75 mm at baseline to 5 years. The average difference between the two groups was found to be 0.31 mm at baseline to 1 year, 0.53 mm at 1 year to 5 years, 5 years: PSW; -0.20 ± 0.75 . Good and similar survival rates were exhibited by both implant systems: 98% for PMI, 96.1% for PSW.⁷

The impact of subcrestal implant placement in comparison with the equicrestal position on hard and soft tissues around PSW was systematically reviewed. The systematic review in question included 14 articles in total. The findings obtained from the meta-analyses have demonstrated that subcrestal implants, in comparison with equicrestally placed implants, presented fewer MBL alterations, in subcrestal implants with regard to the implant shoulder.⁹

The comparison of PSW and non-platform-switched implants was performed following 12 months of loading. The mean mesial and distal marginal bone loss of the control group was determined to be considerably higher than twice that of the test group. The findings indicate that the shorter the abutment height is, the more significant the marginal bone loss is.⁷⁵

In the current prospective study²⁴, it was aimed to assess the levels of the peri-implant bone crest in addition to soft tissue response, papilla height, and buccal mucosa recession, in bone-level implants that were restored with platform switching after 1-year and 5-year follow-ups. The average marginal bone level alterations were found to be as follows: -0.06 ± 0.32 mm from baseline to 1 year, -0.23 ± 0.38 mm from 1 to 5 years, and -0.28 ± 0.45 mm from baseline to 5 years. No statistically significant differences were determined in bone-level outcomes between baseline and 1 year, whereas statistically significant differences were determined in the

average differences between 1 and 5 years and baseline and 5 years.

The literature review⁵ covered 83 publications in total. The impacts of microgap and micromotion at the implant-abutment interface on marginal bone loss around the neck of the implant were summarized. It is necessary to choose appropriate Morse taper or hybrid connection implants and PSW abutments for the purpose of decreasing the corresponding detriment to the implant marginal bone.

In the study³, 60 dental implants were placed in 51 patients during a 1-year period. In case of platform switching, a bone gain of 0.93 mm was determined in the vertical gap and 0.50 mm in the horizontal gap. The decrease in the vertical gap from the baseline until 12 months was found to be 0.92 mm in PSW and 0.29 mm in PMI. PSW was found to have a greater effect on a better peri-implant alveolar bone vertical and horizontal gap reduction in 1 year.

In a systematic review and meta-analysis⁷⁶, 26 publications in total including 1,511 PS implants and 1,123 RP implants were assessed. In comparison with PMI, PSW implants exhibited a small increase in vertical MBL and pocket depth reduction (differences were found to be -0.23 mm and -0.20 mm, respectively). An average VMBL (vertical marginal bone loss) of 0.36 ± 0.15 mm was determined within the first year in PS implants. There may be an indirect protective impact of PSW on implant hard tissue outcomes.

1439 implants and 642 patients in total were selected. Smaller mean marginal bone loss around PSW implants was determined in more studies, and no differences with regard to implant failure rates were detected in any of them. A great impact of the PSW technique on preventing marginal bone resorption was confirmed as a result of the review.⁶³

Following an average loading time of 3 years, the implant survival rate was determined to be 98.74%. As indicated, the implants' stability is not impaired by the EML (early moderate loading) of implants.⁴⁶

52 implants were placed in twenty-four patients. Bone preservation or gain was presented in a total of 71.7% of all implants. No implant was

lost in 1 year, and 100% success rate was achieved. A high level of satisfaction was revealed as a result of the patient inquiry. A high rate of success and improvement or maintenance of marginal bone levels were determined following 1 year of loading in internal conical connection implants with PSW abutments.⁷⁷

108 patients with 228 implants, 180 implants 4.5 mm in diameter and 48 implants 5 mm in diameter, were included in the retrospective study. OsseoSpeedTM implants with the internal tapered conical connection MBL higher at 18 vs. 6 months, for short vs. long abutments, for grafted vs. pristine bone, and for implants with a diameter of 5.0 vs. 4.5 mm were placed in all patients. The MBL is not reduced by higher mismatching.⁷⁸

15 implants that were restored with platform switching PSW abutments and 15 implants that were restored with non-PSW (platform matched) abutments were selected. The placement of definitive abutments with conical connections was performed. After 12 months, it was determined that all implants remained osseointegrated at a 100% success rate. The marginal bone level alteration at 12 months was found to be 0.04 mm in the PSW group and 0.19 mm in the non-PSW (PMI) group.⁷⁹

In a one-year evaluation of 89 implants placed in 36 patients, while the bone loss in PSW implants was between 0.30-0.07 mm after a year following the placement of permanent prostheses, it was between 0.68-0.17 mm in platform-matching implants.⁵⁹

In a 5-year clinical trial⁵⁸, it was emphasized that PSW implants were stable for 5 years, had a total survival rate of 97.1%, and the marginal bone loss was low, being 0.08 mm. According to these results, it is stated that implant and abutment designs suitable for PSW configuration can be suggested.

In short-term clinical trials, it is reported that PSW implant systems reduce marginal bone loss and exhibit high survival rates, but it is emphasized that long-term studies are inadequate.^{5,27-29}

An 11-year radiological follow-up of 94 platform switching implants was performed in a retrospective study. During the mentioned period,

75% mesial and 71% distal no bone destruction was determined. Bone resorption less than 0.8 mm was observed in 84% of implants.⁴⁴

A meta-analysis⁵¹ of 28 articles was performed in approximately a 3-year clinical follow-up study. A total of 1216 PSW implants (16 failures; 1.32%) and 1157 PM implants (13 failures; 1.12%) were examined. A smaller marginal bone loss was determined in implants with PSW compared to implants with PM.

A meta-analysis⁸⁰ investigated twenty-two clinical follow-up studies as 8-15 months. Crestal bone levels can be maintained more in PSW compared to PM during the placement of implants. However, there is insufficient evidence for avoiding debates.

It was observed that as a result of a 12-month follow-up in maxillary and mandibular implants, while the marginal bone loss was between 0.95-0.32 mm in implants depending on the PSW configuration, it was between 1.67-0.37 mm in the control group.⁸¹

25 studies were examined in the meta-analysis; of which there were 17 randomized controlled trials and 8 prospective studies including 1098 patients and 2310 implants. 12-24-month clinical follow-ups were performed. Therefore, a lower crestal bone loss was found in PSW implants in comparison with PM implants.²⁰

A 24-month follow-up study was carried out in patients with and without type 2 diabetes mellitus. The study covered 45 male patients in total. However, no significant difference was detected in the peri-implant MBL in both groups.⁸²

In a 6-month follow-up, 80 PSW implants, in the maxillary anterior and mandibular posterior region, were positioned and restored after two-stage surgical and progressive loading protocols. MBL was found to be significantly higher in the anterior group (1.2 mm) compared to the posterior group (0.7 mm). A significantly greater bone loss amount was detected in the maxillary anterior region than in the mandibular posterior region.²⁵

The analysis⁸³ included 51 patients and 117 implants. Following 3 years of function, the PSW concept (0.33±0.19 mm) can cause a decrease in the marginal bone loss over time in comparison with the standardized one. PSW may be a

practicable prosthetic alternative to the implant treatment of partial edentulism.

The limitations of this study include the short and medium-term follow-up period and the absence of long-term follow-ups in clinically controlled studies. Secondly, they include difficulties in comparing the results obtained from the FEA with one another due to different implants and modeling.

CONCLUSIONS

According to studies performed on PSW implant supported prostheses, crestal bone loss is lower in this method. Furthermore, the clinical survival rates of prostheses increase by preventing soft tissue inflammation in the marginal zone. A lot of advantages will be ensured for patients as well as dentists as a result of the prolonged life of implants. Nevertheless, the narrower diameter of the abutment and abutment screw breakage occurring due to the usage of the abutment constitute the most significant complications and disadvantages.

Furthermore, according to the data obtained within the limitations of the study, it was concluded that the PSW system is a simple, functional treatment modality that preserves the crestal bone around the implant. It is obvious that more prospective studies and long-term controlled clinical observations on this issue are required. Therefore, it will become more safe and advantageous to use the PSW concept in question.

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CONFLICT OF INTEREST

There is no conflict of interest for this study

Platform Değişirtemeli Implantların Marjinal Kemik Seviyesi ve Yumuşak Doku Boyutlarına Etkisi **ÖZ**

Amaç: Bu çalışmanın amacı, implant diş hekimliğinde son zamanlarda ortaya çıkan platform-switch (değişirtemeli) implantlar (PSW) kavramının özelliklerini ve implant etrafındaki marjinal kemik kaybı (MKK) üzerindeki etkilerini platform-match (değişirtilmemiş) implantlarla (PMI) karşılaştırmaktır. **Veriler:** Çalışmada PSW implant-abutment bağlantı sistemi, MKK ve peri-implant sert ve yumuşak doku

değişiklikleri incelendi. Çalışmada kullanılan araştırma terimleri, dental implant, platform değiştirme konsepti, değiştirmeli platform, platform uyumsuzluğu, platform uyumlu implantlar ve dental implant-abutment tasarımıdır. **Kaynaklar:** Elektronik araştırmada dil İngilizce olarak seçildi ve Mart 2018'e kadar yapılan çalışmalar yıl sınırlaması olmadan araştırıldı. Elektronik araştırmalar National Library of Medicine, PubMed/Medline, Web of Science, Cochrane Oral Health Group Trials ve Cochrane Central Register of Controlled Trials'ı içermektedir. **Çalışma seçimi:** Araştırmalar, geriye dönük veya ileriye dönük klinik insan çalışmaları, randomize sistematik derleme ve meta-analizler ve sonlu elemanlar analizi çalışmaları incelenmiştir. Vaka raporları ve hayvan deneyleri çalışmaları inceleme dışında bırakıldı. **Sonuç:** Klinik çalışmaların kısa ve orta dönem takiplerden oluştuğu ve biyomekanik çalışmaların sınırlı olduğu görülmüştür. PSW implant sistemlerinin MKK' nin azaltulmasında pozitif sonuçlar elde ettiği ve PMI sistemlerine kıyasla yumuşak doku oluşumu açısından daha estetik olduğu ve son yıllarda PSW sistemine olan ilginin giderek arttığı gözlenmiştir. PSW sistemi için uzun vadeli klinik çalışmaların gerekli olduğu görülmüştür.

Anahtar Kelimeler: Diş hekimliği, dental implant-kaide tasarımı, diş dayanakları, diş implantları, alveoler kemik kaybı.

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