e-ISSN : 2455-5258

Research in Pharmacy and Health Sciences

Review Article

The Notion of Platform-Switching in Implants: A Review

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ABSTRACT

Platform switching implies to the mismatch in diameter of the abutment and that of the implant collar or in particular, use of the abutments with lesser diameter on a greater diameter implant collar. Platform switching was proposed as a process to improve long-term bone maintenance around implants. The clinical applications of platform switching are multiple, and all indicate better long-term predictability in implant therapy by allowing preservation of the peri-implant hard and soft tissue with time. In this review the influence of platform switching on various other factors affecting crestal bone loss around implants has been discussed.

Received: 03-03- 2018
Revised: 28-03-2018
Accepted: 07-05-2018
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Email:
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Funding: Nil
Competing Interests: None

Keywords: platform switching, implant abutment junction, inflammatory connective tissue zone, osseointegration

INTRODUCTION

Osseo-integrated implants have become a productive treatment option for single, partially edentulous, and completely edentulous spans in suitable patients. The rates for survival of implant-supported single- and multiple-tooth restorations are found comparable to those for implant-supported prostheses in completely edentulous patients. However, the goal of modern implant therapy is focused on more than just the successful osseo-integration (survival) of the implant. A successful result must also provide an esthetic and functional restoration surrounded by sound peri-implant tissues that are in harmony with the existing dentition. Stable level of peri-implant bone is one set parameter of implant success. As a process to improve long-term bone maintenance around implants, a new implant-to-abutment connection referred to as "platform switching" was proposed [1]. The resulting crestal bone levels around dental implants after the restoration has been a topic of discussion and used as a reference for evaluation of implant success for many years. The literature on implants contains numerous articles which describe the 1-year post-restorative bone levels around threaded dental implants. These articles report that crestal bone levels are almost always located approximately 1.5 to 2.0 mm below the implant-abutment junction (IAJ) at 1 year after implant restoration but are dependent upon the location of the IAJ relative to the bony crest. The radiographic observation that post-restorative "remodeled" crestal bone generally remains with the level of the first thread on most standard 3.75- and 4.0-mm implants has led some authors to suggest that when dental implants are placed into function, crestal bone remodeling occurs as a result of stress concentration at the coronal region of the implant. Other authors have suggested that post-restorative crestal bone remodeling is due to localized inflammation within the soft tissue located at the implant-abutment interface, and is a result of the soft tissue's attempt to maintain a mucosal barrier, i.e, biologic width (seal) around the top of the dental implant [2]. The bone resorption mechanism has been attempted to be explained by formation of the biologic width as it is in the case of the periodontal tissue around natural teeth or due to the mechanical stress on the bone–implant interface. Bone resorption at the implant neck region, however, is evitable because some clinical observations have shown that less bone resorption with bone preservation is possible when the narrower diameter of abutment is connected to the implant, so called platform switching [3].

An important factor in avoiding crestal bone loss related to platform switching may be that of the inflammatory connective tissue around the IAJ. If the ICT is responsible for bone remodeling, then moving the implant-abutment junction inward by means of platform switching can shift the ICT further from the alveolar crest, thereby reducing its deleterious effect on the crest [4]. Lazzara and Porter theorize that this occurred because shifting the IAJ inward also repositioned the inflammatory cell infiltrate and confined it within a 90° area that was not directly

adjacent to the crestal bone, thus reducing crestal bone resorption [5]. Few clinical, histological, and retrospective studies have shown that crestal bone loss around dental implants can be reduced by using platform switching. In a standard protocol, implants are fitted with abutments of the same diameter. Mechanical and biological principles of platform switching have been given to minimize the bone loss. First, with the greater surface area created by the exposed implant seating surface, the amount of crestal bone loss necessary to expose a minimum area of implant surface to which the soft tissue can attach is reduced. Second, and may be more important, by repositioning the micro-gap inward and away from the outer edge of the implant and adjacent bone, the overall effect of the abutment inflammatory cell infiltrate (ICT) on surrounding tissue may be decreased, thus decreasing the resorption of the crestal bone. As a consequence, the reduced exposure and confinement of the platform-switched abutment ICT may result in a decreased inflammation within surrounding soft tissue and crestal bone [6]. Success in tooth replacement is marked by the restoration of adequate function and esthetics without any negative effects on the adjacent hard and/or soft tissue structures. As there will be bone resorption at the implant platform following uncovering and loading, younger patients receiving restorations face a higher risk of future complications. That is why the selection of a better alternative to preserve healthy adjacent peri-implant structures seems important [7]. The interest created by this concept is demonstrated by the fact that all major dental implant manufacturers are providing at least one implant line with platform switching in their catalogs [8]. Furthermore, The distance between two implants has been reported to effect the inter proximal bone level and any forfeiture of interproximal bone will adversely affect the soft tissue between implants. It has been demonstrated that inter-implant bone crest moves apically when the horizontal inter-implant distance is decreased. It has been suggested that the vertical bone loss to the first thread with conventional platform– abutment interface may be due to a decrease in inter-implant distance less than 3 mm [9], so in the areas where inter implant distance cannot be maintained easily platform switching can help to maintain the mucosal barrier. The Platform switching can help to decrease the stress level at the implant-bone interface area. The reduction of the stress concentration at the implant-bone interface area is a favorable development to confirm the osseo-integration. Another possible explanation of the efficacy of the platform-switching configuration is the establishment of the implant abutment connection at the bone level [10].

2. Influence of Platform Switching on Various Factors affecting crestal bone loss around implants.

Effect on open and submerged healing of implants with platform switching: A study [11] evaluated the effect of platform switching on crestal bone loss at non submerged titanium implants in a dog model for 6 months, and it concluded that bone remodeling is not effected by platform switching in non submerged cases. Enkling et al did another study to evaluate the effect of healing mode (open or submerged) on marginal bone levels in platform switched implants and they found that the healing mode does not affect the marginal bone.

Effect of platform switching on inter implant distance:

Platform switching can aid in preserving the bone around the implant [12,13,14]and retain the inter implant bone peaks. This can be explained on the basis of the concept that platform switching shifts the IAJ towards the center of the implant and therefore provide biologic width modification so less resorption occurs. The placement of platform switched implant in proximity of natural tooth does not have any adverse effect on the natural tooth or the implant itself [15].

In an another study done by tabata et al [16] pellizer et al [17] cimen et al[18], stress distribution in peri implant bone tissue, implants, and prosthetic components of single implants in platform switching technique was measured, and they found that there was better stress distribution in peri implant bone tissue.

This can be explained by the fact that platform switching decreases the stress concentration on peri implant bone and tissues by shifting the implant abutment junction which leads to less micro damage in the bone, resulting in minimized crestal bone loss but higher stresses were evident for the retention of screw and prosthesis, concentration of stresses at the screw are mechanically harmful because it could clinically transfer into increased frequency of complications in implant supported prosthesis such as screw loosening and fracture or screw deformation[16] of the abutment if the stresses overcome the elastic limit.

Khurana et al[19], studied influence of fine threads and platform switching on crestal bone stress around implant and found that crestal bone stress is increased by the fine threads upon loading, fine threads increase the bone resistance to load by changing shear load to tensile or compressive load. Ana paula et al[20] evaluated stress in peri-implant bone with straight and angulated abutments. They concluded that angulated abutments produce more stress on peri implant bone when compared to straight abutments.

Effect of different platform width on crestal bone loss in platform switching concept:

Bone stability is an important factor in evaluation of longievity of osseointegrated implants, as extensive bone loss can cause peri-implantitis leading ultimately to implant failure. Resorption of bone in marginal areas can change the surrounding soft tissue profile which can

cause loss of inter-dental papilla leading to aesthetic, phonetic changes and food impaction. There are many factors responsible for influencing the marginal bone loss including the dental implant connection type.

According to Rodrigo et al [21] osseo integrated implants with internal connections showed less marginal bone loss as compared to external connection implants. This is mainly due to presence of platform switching present in internal connection implants. This is because in platform switching the implant abutment connection is far away from the margin, which causes decreased load concentration, decreased micromovements, and also the bacterial colonization takes place at a farther region of bone.

In a systematic review done by Maram et al[22] there can be presence of some confounding factors which can mask the real effect of platform switching which are:-

1. ***Apico coronal position of implants in relation to crestal bone.*** This review concluded that the more deeper the implant is placed the more bone loss will occur.
2. ***Presence of various implant microtextures***. The closer the micro threads were to the top of the implant the less is the marginal bone loss.
3. ***The degree of platform switch.*** The effect of degree of platform switching on marginal bone loss is inversely related i.e the greater the degree of platform switch the least is the maginal bone loss.
4. ***Reliability of examination methods***. A three dimensional examination method is more reliable as compared to a two dimensional peri apical radiograph.

Effect of platform switching on hard and soft tissues:

Platform switching demonstrates less vertical change in the crestal bone heights around implants than expected. There is a good soft tissue healing and maintenance of papillae and buccal margin levels were consistently observed [17,23]. PS implants behave better than NPS implants, regarding soft and hard tissue maintenance.

Two main reasons for the reduced bone loss around platform switched implants:

1. Shifting of the stress concentration area away from the cervical bone- implant surface to ensure less micro movement in the adjacent bone structure.
2. It shifts the inevitable microgap of the IAJ away from the outer edge of the implant and neighboring bone. The IAJ is always encircled by an inflammatory cell infiltrate (ICT) (0.75mm above and below IAJ, to protect the bone from this inflammatory infiltrate 1 mm of healthy connective tissue is needed to establish a biological seal. 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 the seal is established. An internal repositioning of the IAJ by platform switching may decrease the effect of ICT and as a result may decrease bone loss.

The effect of platform switching on marginal bone level seemed to be dose dependent, i.e the greatest platform abutment mismatch resulted in the least marginal bone loss. There is a strong tendency that around two or more adjacent platform switched implants peri implant bone is better preserved. The influence on inter implant distance on crestal bone loss in the platform switching designed internal connections was found to be -0.26mm with a mean error of 0.14mm even in the cases where inter implant distance is less than 3 mm[24].

Effect of platform switching on soft tissue:

The presence of the soft tissue above the bone is explained as a defense mechanism – a sort of barrier or protective seal capable of protecting the alveolar crest from the bacterial invasion of oral cavity.

This seal is merely the biologic width that is present on the natural tooth surface and in a similar way on implants exposed to oral cavity. The thickness of this mucosal seal is approx 3 mm. it has been hypothesized that the mismatching of implant/abutment is consequent to the reduction in inflammation within the soft tissue.

Inflammatory cells were detected in clinically healthy gingival and perimplant mucosa as well as peri implant mucositis and peri implantitis. In clinically healthy gingiva and peri implant tissues, mostly T lymphocytes were found in a narrow area of connective tissue lateral to JE. In the inflamed peri implant tissues B cells gradually increases. At the histological evaluation platform switching, it reduces the inflammatory infiltrate at the IAJ.

In healthy peri implant connective tissue, collagen fibers were well organized and generally are homogeneous. However in inflamed peri implant tissue the collagen fibers are loosely packed, thin fibrils, disorganized and not well arranged, impairing the structural resistance of soft tissue to bacterial penetration. Mismatching seems to lead to the establishment of a wider and more resistant zone of connective tissue at level of implant abutment connection [11].

The fibers that are perpendicular to the implant change their direction and arrange themselves in a circular way when they meet the implant surface. In PS implants this circular fiber formation takes place at IAJ while in NPS implants takes place at first thread, so in PS implants it

prevents bone loss as the switched Platform seems to stabilize the circular fibers.

The use of PS implants may help to minimize the perimplnat bone loss and consequently alterations on adjacent soft tissues, associated to the correct surgical and prosthetic planning ensuring excellent esthetics and function [25].

Specifically by coupling platform switching to abutment emergence profile modification, clinicians will create more space around implant abutment interface to allow for the development of additional soft tissue volume, better control of gingival margin and good oral hygiene maintenance .

Influence of Individual bone patterns on platform switching:

Canullo et al [26] conducted a study to determine whether individual bone markers might be associated with peri implant resorption around implants restored with platform switching concept. The clinical evidence has shown that post restorative peri implant bone resorption is not static but subject to interindividual variations from implant to implant and from patient to patient. This assumption was corroborated by data from the study of canullo et al. they found that bone resorption trends differed between patients. Individual local bone structure and quality seemed to be correlated to peri implant bone resorption.

Influence of Platform Switching on Stress distribution on Bone-Implant Biomechanical System:

Stress and strain fields around osseointegrated dental implants are effected by a number of biomechanical factors and platform switching is one of them. The stress/strain distribution in the bone also includes the length of bone implant interface. For a given implant, placement in maxillary and mandibular posterior region induces stress distributions that were dissimilar at bone implant interface as a consequence of different geometry and bone mechanical properties, resulting in higher compressive overloading risk in the maxillary segment. For a given implant, the compressive peaks and average stress at maxillary cortical bone were about 140% of the values for mandibular bone. Stress analysis of implants with similar diameters highlights that the risk of bone overloading in compact bone strongly increases when significant crestal bone loss occurs. When crestal bone geometry is modeled by platform switching configurations and subcrestal positioning, the best stress based performance for compact bone was obtained, together with acceptable stress values at cancellous interface [13].

Recent studies [27] have also shown that the biomechanical performance in platform switched implants is better as it changes the stress distribution from the abutment to the implant and from the implant to the bone when occlusal loading occurs. The von mises stresses in the abutment of platform switched models were lower [28] than the abutment of conventional models. The reduction of stresses in in the abutment with platform switching versus the conventional abutment was 36.91% at 15 degrees, 39.69% at 30 degrees and 40.07% at 45 degrees [29].

Stress Analysis by Photoelastic Method [6]:

Photoelasticity allows prediction of the mechanical response of photoelastic model when load is applied. The analysis resulted in a conclusion that in platform switched implants there is more centralization of stresses at the implant apex. This can be explained by the load concentration at IAJ, which transfers the stress to a more centralized position and the stress concentrations at cervical region are decreased**.**

Stress Analysis by Finite Element Method [13,28,30]

FE analysis revealed higher compressive and tensile stresses in conventional models than in platform switching models at the compact bone vicinity of the implant neck. However the value decreases by 41.7% for the first principal stress in compression. Apparent stress distribution in compact bone is reduced and stress concentration in cancellous bone was shifted along the entire surface of the thread in platform switched models. On comparing the stress distribution in different areas i.e. peri implant bone tissue, implant, prosthetic screw and prosthesis it was conclude that cortical bone exhibits higher stresses than trabecular bone. stress values are higher in the retention screws than in bone tissue, implant, and prosthesis. Platform switching decreases the stresses concentration in all the areas except for the retention screw. The influence of platform switching was more evident for cortical bone than for trabecular bone[31], but there is an improvement in peri implant bone preservation and better stress distribution and less stress transfer to the bone[32].

Effect of Immediate placement and Immediate loading:

According to canullo et al[17,24,27,33] the marginal bone around single, PLS implant placed immediately and restored immediately showed average bone resorption of 0.14 to 0.46 mm in a short span of 25 months, whereas the non PLS implants showed bone resorption of 0.84mm to 1.54 mm.

In an another study[12] the average bone loss in the PLS group was 0.45mm to 0.61mm in one year follow up period. They also examined hard and soft tissue changes in response to single PLS implants placed in anterior and posterior region following the immediate placement and

immediate restoration protocol and found that bone resorption around the implants was significantly lower than the expected reference value. They also concluded that PLS implants placed and loaded immediately can help in preservation of papilla by providing peri implant hard tissue stability. In a five year study by romanos et al[34] suggests that immediately functionally loaded PLS implants showed improved primary bone stability.

Delayed placement in healed sites:

The average bone loss in PL switched implants placed in healed sites is very less as compared to non pl switched implants [12]. The mean peri implant bone level alterations from base line to the 12 months follow up period were 0.12 ± 0.40mm in platform switched implants and
0.29 ± 0.34 mm in non platform switched implants.
The PLS reduces the crestal bone loss and increases the longievity of the implant therapy. In over all Platform switching is useful in decreasing the bone loss[35].

Prevalence of peri implant disease on platform switching implants [36]:

A longitudinal study was done in which 64 implants were placed in 25 patients was done. The prevalence of peri implantitis (i.e pockets $\geq$5mm with bleeding and bone loss$\geq$ 2mm was compared in between platform switched and conventional implants. The conclusion of the study was that there is lower prevalence of peri implantitis with platform switched implants.

Clinical and radiographic Assessment Of Bone Level Around Platform Switched Implants:

The effects of platform switching can be relevant both clinically and radiographically. Clinical relevance of platform switching is more important in situations where anatomic structures such as the sinus floor or alveolar nerve limit the residual bone height, the platform switching approach minimizes bone resorption and increases biomechanical support available to the implant. The radiographic evaluation revealed that the peri implant bone loss in platform switched implants after 1 year of function was 0.63mm to 1.27 mm while for non platform switched implants it was 1.30 mm to 2.24mm [24,36].

Loris et al [37] in their randomized prospective multicenter trial evaluated platform switching technique for prevention of post restorative crestal bone loss discussed that the platform switching technique, in comparison to conventional surgical protocols that restore non platform switched implants , resulted in significantly less crestal bone loss(p less than 0.001).

They further concluded two major points :

1. Implants with an enlarged platform that incorporates platform switching in their shape exhibited no little or no bone loss within first two years following the placement irrespective of surgical placement protocol (one stage or two stage).
2. 2 years after placement of implants with an enlarged platform and were placed with submerged procedure performed slightly better than the non submerged ones.

Vigolo et al [3] found that the mean marginal bone loss was 0.9mm for NPS implants while for PS implants it was 0.6mm. Platform switching has also shown less bone resorption radiographically in both vertical and horizontal direction when two implants are placed with an inter implant distance of less than 3 mm. According to crespi et al[4] the platform switched implants showed lesser mean bone loss as compared to the external hexagon implants although it was not significant.

Wagenberg et al [38]in their prospective study evaluated implant survival and crestal bone levels around platform switched implants for minimum of 11 years and found that 84% of mesial surfaces and 88 % of distal surfaces had 0.8mm or less bone loss. This was the longest follow up till that time and confirmed the conept of crestal bone preservation.

Radiological and micro CT analysis of peri implant bone around platform switched implants suggests that implants can be placed 2mm apart instead of 3 mm apart and 3 mm apart instead of 4 mm apart when platform switching is utilized [9]. Platform switched implants remained stable for 10 years as they showed minimal marginal bone loss radiographically i.e. 0.78mm to 1.24mm over a period of 10 year follow up and 0.21 mm to 0.77mm upto 1 year.

Conclusion:

Based on the obtained data and statistics the following conclusions can be drawn:

- Maximum and minimum principal stresses were reduced in the peri-implant bone tissue and implants when the platform switching concept was used. However stress distribution was influenced more by implant diameter than by the platform switching concept.
- There is a biomechanical advantage to platform switching in conditions of marginal bone resorption. However this advantage may decrease when bone resorption is dramatically increased.

- The combination of platform switching/straight abutment presented the best biologic behavior in stress distribution on the adjacent bone tissue.
- Platform switching decreases stress to a greater degree in implants having fine threads.
- A greater risk of implant abutment junction fracture than with conventional diameter implants. High strength abutments should be chosen to prevent fracture.
- Despite the obvious potential these facts convey, the platform switching procedure is a subject that needs extensive investigation. Further studies including modified 3D finite element models and longitudinal clinical observations.

References:

1. Lazzara RJ, Porter SS. Platform Switching: A New Concept In Implant Dentistry For Controlling Postrestorative Crestal Bone Levels. Int J Periodontics Restorative Dent 2006;26:9-17.
2. Ciurana XR, Nebot XV, Torres MS, Guirado JLC , Cambra J. The Effect Of Interimplant Distance On The Height Of The Interimplant Bone Crest When Using Platform-Switched Implants; Int J Periodontics Restorative Dent. 2009 ;29(2):141-151.
3. Vigolo P, Givani A; Platform-Switched Restorations On Wide-Diameter Implants: A 5-Year Clinical Prospective Study;Int J Oral Maxillofac Implants. 2009 ;24(1):103-109.
4. Crespi R, Cappare P, Gherlone E; Radiographic Evaluation Of Marginal Bone Levels Around Platform-Switched And Non-Platform-Switched Implants Used In An Immediate Loading Protocol; Int J Oral Maxillofac Implants. 2009;24(5):920-926.
5. Kalavathy N; Platformswitching: Serendipity; Indian J Dent Res. 2014;25(2):254-259
6. Pellizzer EP, De Carvalho PS, Santiago JF, De Moraes SL, De Carvalho BM; Photoelastic Analysis Of The Influence Of Platform Switching On Stress Distribution In Implants; J Oral Implantol. 2010;36(6):419-424.
7. Stanford C, Estafanous E, Huynh-Ba G, Oates T, Ellin Gsen JE; Thematic Abstract Review; International Journal Of Oral And Maxillofacial Implants.2011:26(2):119-125
8. De Almeida FD, Carvalho AC, Fontes M, Pedrosa A, Costa R, Noleto JW, Mourao CF; Radiographic Evaluation Of Marginal Bone Level Around Internal-Hex Implants With Switched Platform: A Clinical Case Report Series,Int J Oral Maxillofac Implants. 2011;26(3):587-592.
9. Elian N, Bloom M, Dard M, Cho SC, Trushkowsky RD, Tarnow D;Radiological And Micro-Computed Tomographyanalysis Of The Bone At Dental Implants Inserted 2, 3 And 4 Mm Apart In A Minipig Model With Platform Switching Incorporated; Clin Oral Implants Res. 2014;25(2):22-29.
10. Cimen H, Yengin E,Analyzing The Effects Of The Platform-Switchingprocedure On Stresses In The Bone And Implant-Abutment Complex By 3-Dimensional Fem Analysis,J Oral Implantol. 2012 ;38(1):21-26.
11. Becker J[1], Ferrari D, Mihatovic I, Sahm N, Schaer A, Schwarz F;Stability Of Crestalbonelevel At Platform-Switchednon-Submergedtitaniumimplants: A Histomorphometrical Study In Dogs, J Clin Periodontol. 2009;36(6):532-539.
12. Hagiwara Y;Does Platform Switching Really Prevent Crestal Bone Loss Around Implants. Japanese Dental Science Review. 2010;46(2):122-131.
13. Chang CL[1], Chen CS, Hsu ML; Biomechanical Effect Of Platform Switching In Implant Dentistry: A Three-Dimensional Finite Element Analysis;Int J Oral Maxillofac Implants. 2010;25(2):295-304.
14. Cocchetto R, Traini T, Caddeo F; Evaluation Of Hard Tissue response around widerplatform-Switchedimplants; Int J Periodontics Restorative Dent. 2010;30(2):163-171.
15. Urdaneta RA. A Retrospective Radiographic Study On The Effect Of Natural Tooth-Implant Proximity And An Introduction To The Concept Of A Bone-Loading Platform Switch;Int J Oral Maxillofac Implants. 2014;29(6):542-556.
16. Tabata LF, Rocha EP, Barão VA, Assunção WG.Platformswitching: Biomechanical evaluation Using Three-Dimensional finite Element Analysis. Int J Oral Maxillofac Implants. 2011;26(3):482-491.
17. Canullo L, Iurlaro G, Iannello G;Double-Blind randomized Controlled Trial study On Post-Extraction immediately restored Implants Using The Switching platform concept: Softtissue. Clin Oral Implants Res. 2009;20(4):414-20
18. Cimen H, Yengin E; Analyzing The Effects Of The Platform-Switching Procedure On Stresses In The Bone And Implant-Abutment Complex

By 3-Dimensional Fem Analysis. J Oral Implantol. 2012;38(1):21-6
19. Khurana P, Sharma A, Sodhi KK. Influence Of Fine Threads And Platform-Switching On Crestal Bone Stress Around Implant—A Three-Dimensional Finite Element Analysis. Journal Of Oral Implantology. 2013;39(6):559-565
20. Martini AP, Moreira Barros RL, Freitas Junior AC, Rocha EP, De Almeida EO, Ferraz AC, Pellegrin MCJ, Anchieta RB, Influence Of Platform And Abutment Angulation On Peri-Implant Bone: A Three-Dimensional Finite Element Stress analysis. Journal Of Oral Implantology.2013;39(6)
21. Duque AD, Aristizabal AG, Londoño S, Castro L, Alvarez LG. Prevalence Of Peri-Implant Disease On Platform Switching Implants: A Cross-Sectional Pilot Study. Braz Oral Res. 2016;30
22. Pozzi A, Mura P; Immediate Loading Of Conical connection implants: Up-To-2-Year retrospective clinical And Radiologic study;Int J Oral Maxillofac Implants. 2016;31(1):142-52
23. Glibert M, Bruyn HD, Ostman PO. Six-Year Radiographic, Clinical, And Soft Tissue Outcomes Of Immediately Loaded, Straight-Walled, Platform-Switched, Titanium-Alloy Implants With Nano-surface Topography. The International Journal Of Oral & Maxillofacial Implants 2016;167-171
24. Fickl S, Zuhr O, Stein JM, Hürzeler MB.Peri-Implant bone level around implants With Platform-Switched abutments. Int J Oral Maxillofac Implants. 2010;25(3):577-581.
25. Clavijo VB, Pinto FR, Ramos GG, Ciotti DL, Buso L. Switching Platform On Esthetic Area: Case Report. Dental Press Implantol. 2012; 6(4):93-103
26. Canullo L, Pellegrini G, Allievi C, Trombelli L, Annibali S, Dellavia C. Soft Tissues Around Long-Term Platform Switching Implant Restorations: A Histological Human Evaluation. Preliminary Results. J Clin Periodontol.2011;38(1):86-94
27. Hsu YT, Chan HL, Rudek I, Bashu Tski J, Oh WS, Wang HL, Oh TJ; Comparison Of Clinical And Radiographic Outcomes Of Platform-Switched Implants With Rough Collar And Platform-Matched Implants With Smooth Collar A: 1- Year Randomized Clinical Trial; Int J Oral Maxillo Fac Implants2015; 31:382-390.
28. Romanos GE. Malmstrom H, Carlo Ercoli CF. Immediately Loaded Platform Switched Implants In The Anterior Mandible With Fixed Prostheses: A Randomized, Split Mouth, Masked Prospective Trial. Clinical Implant Dentistry & Reasearch.2014;16(6):884-892
29. Singla S, Rathee M, Kumar L, Gupta M, Platform Switching: A Step Away From The Gap; European Journal Of Prosthodontics. 2015;3(1).
30. Gurgel-Juarez NC, Almeida EO, Rocha EP, Freitas Junior AC, Anchieta RB, Mercon De Vargas LC, Kina S Et Al, Regualar End Platform Switching : Bone Stress Analysis Varying implant Type. Journal Of Prosthodontics.2012;21:160-166
31. Zuiderveld EG,Hartog LD, Vissink A, Raghoevar GM, Meijer H JA. Significance Of Bucco Palatal Implant Position, Biotype, Platform Switching, And Preimplant Bone Augmentation On The Level Of Midbuccal Mucosa.Int J Prosthodont. 2014; 27:477-479.
32. Canullo L, Fedelle GR, Ianello G, Jepsen S. Platform Switching And Marginal Bone-Level Alterations: The Results Of A Randomized-Controlled Trial. Clin. Oral Impl. Res. 2010;21: 115–121.
33. Crespi R, Capparè P,Gherlone E. Radiographic Evaluation Of Marginal Bone Levels Around Platform-Switched And Non–Platform-Switched Implants Used In An Immediate Loading Protocol. INT J ORAL MAXILLOFAC IMPLANTS. 2009;24:920–926
34. Canullo L, Rosa JC, Pinto VS, Francischone CE. Inward-Inclined Implant Platform For The Amplified Platform-Switching Concept: 18-Month Follow-Up Report Of A Prospective Randomized Matched-Pair Controlled Trial. Int J Oral Maxillofac Implants. 2012;27:927–934.
35. Pozzi A, Tallarico M, Moy KP. Immediate Loading With A Novel Implant Feature By Variable Threaded-Geometr, Internal Conical Connection And Platform Shifting:3-Year Results From A Prospective Cohort Study. Eur J Oral Implantol.2015;(1);51-63.
36. Aradya A, Kumar K, Chowdhary R. Influence Of Different Abutment Diameters Of Implants On The Peri-Implant Stress In The Crestal Bone: A Three Dimensional Finite Element Analysis-In Vitro Study. Int J Dental Res. 2016:27(1).
37. Prosper L, Redaelli S, Pasi M. A Randomized Prospective Multi Centric Trial Evaluating The Platform-Switching Technique For The Prevention Of Post Restorative Crestal Bone Loss. Int J Oral & Maxillofac Implants.2009;24:299-308.
38. Wagenberg B, Froum SJ. Prospective Study Of 94 Platform Switched Implants Observed From 1992-2006. Int J Periodontics Restorative Dent. 2010;30:9-17.