Does Implant-Abutment Interface affect Marginal Bone Levels around Implants?

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Abstract

Objective The use of dental implants with different types of surface roughness and implant-abutment interface has brought about a situation of marginal bone loss. Therefore, the aim of this study was to analyze and compare marginal bone levels of different types of osseointegrated dental implants with platform switch (Group A: Ankylos, Mannheim, Germany) and platform match (Group B: Dentsply Xive, Mannheim, Germany, and Group C: MIS Implant Technologies, Karmiel, Israel).

Materials and Methods One hundred and seven patients (52 men and 55 women) with a mean age of 54.79 (standard deviation ± 12.35) years and a total of 321 dental implants (Group A, n = 198; Group B, n = 58; and Group C, n = 65) placed in a private practice between April 2006 and May 2015 were retrospectively analyzed. In addition to demographic information and implant characteristics, marginal bone levels were evaluated by Image J (Wayne Rasband, National Institute of Health, Maryland) program.

Results The mean age of all patients was 54.79 ± 12.35 years, and 51.5% of them were women. Implants supporting fixed bridge were most commonly used in all groups (65%), whereas only 20% were restored with a single crown and 15% with overdentures. In total, 47.5% of all implants showed no marginal bone loss. Mean bone loss in Group A was significantly lower (0.81 ± 1.60 mm) as compared to Group B (1.58 ± 1.59 mm) and Group C (1.18 ± 1.36) ($p < 0.005$).

Conclusion Among different types of dental implants, platform switch seems to preserve marginal bone levels and increase the long-term success of dental implants.

Keywords
- implant
- marginal bone loss
- platform match
- platform switch

Introduction

Dental implants have been a part of our lives since 1965 due to studies commenced by Branemark. They have gradually become the most preferred treatment and are widely placed for the rehabilitation of missing teeth. Today, there are more than 1,300 different types of dental implant systems in the market.[1] Osseointegration is to be able to increase implant to bone contact while reducing failures, and for this purpose, many different studies have undergone which include implants with different platform designs, surface properties, and coatings.[2,3]

To understand osseointegration and allow clinicians for better implant selection, studies about the surface properties and osseointegration of dental implants have been published over the years.[4–6] As increased osseointegration means decreased treatment time needed, surface properties have been modified by manufacturers physically and chemically which yielded different results regarding bone to implant contact and marginal bone levels around implants.[7,8]

After the completion of the osseointegration process, marginal bone levels may also be affected by bacterial biofilm formation around dental implants over time.[9] In addition to the clinical inflammation, when exposed to the oral environment, it was found that rough-surface implants were more prone to have marginal bone loss as compared to others.[10] Biofilm may occur on all implant surfaces; however, surfaceproperties do affect the amount and composition of it.[10]

Being superior to no one,[4] widespread use of different types of dental implants has brought alone a gradually increasing situation in the name of "marginal bone loss." In

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addition to microbial biofilm, some of the factors that can influence marginal bone levels around implants are implant design (bone/tissue level), implant-abutment connection, overhanging prosthetic restoration margins, and excessive occlusal forces. Type of surgical approach (one stage/two stage) may also be considered a factor having an effect on marginal bone levels. However, studies showed that there is no significant difference between the two approaches in terms of marginal bone loss.[11,12]

The influence of implant-abutment connection on marginal bone levels has been investigated in several studies.[13–15] When the diameter of abutment and implant neck are equal, it is called "platform match." Platform switching is a method that can help prevent marginal bone loss around dental implants and it refers to the placement of an abutment that is narrower than the implant diameter.[16] Platform insertion depth is also an important factor when placing dental implants. As a result of subcrestal placement with platform switching, horizontal and vertical distances between the implant-abutment interface and marginal bone crest are increased, and the inflammatory infiltrate is displaced away from the crestal bone, resulting in a reduction or elimination of bone loss.[17,18]

The aim of this study was to analyze and compare the marginal bone loss of different types of osseointegrated dental implants with platform switch and platform match.

Materials and Methods

One hundred and eleven patients having 330 dental implants were analyzed in this retrospective study. Implants placed in private practice between April 2006 and May 2015 and those in function at least for 1 year were included. Patients who had dental implants in function for <1 year and those who had radiographs that were difficult to read and implants treated with one-stage surgical approach and needed regenerative treatment due to surgical trauma were excluded from the study. Furthermore, failed implants diagnosed according to the criteria of Misch et al[19] were excluded. Therefore, the final study population comprised 107 patients (52 men and 55 women) with a mean age of 54.79 (standard deviation [SD] ± 12.35) years and a total of 321 dental implants. The mean follow-up time of the implants was 5.3 ± 1.7 years.

The demographic information of patients was collected from the database. Regarding the implant characteristics, anatomic location, implant diameter and width, type of prosthetic reconstruction, and marginal bone loss were analyzed.

All patients were treated by two experienced surgeons (J.D. and A.U.), using platform-switch (Dentsply Ankylos, Mannheim, Germany) and platform-match dental implants (Dentsply Xive, Mannheim, Germany; MIS, Implant Technologies, Karmiel, Israel). Implant diameter was chosen by the operator according to the width of the patient's residual jaw. Following local anesthesia, full-thickness flaps were elevated buccally and lingually; implants were placed either with one-stage or two-stage surgical approaches. Sutures were removed 1 week after the treatment. During this period, patients were instructed to rinse twice daily with 0.12% chlorhexidine digluconate (Kloroben, Drogsan, Ankara, Turkey) and used naproxen Sodium (Aprol Fort tablets, Bilim Ilac, Kocaeli, Turkey) twice a day for 5 days.

The time of the prosthetic loading was considered as baseline. In panoramic radiographs, the distance between implant platform level and the most coronal bone in contact with the implant was evaluated both on the mesial and distal sites (►**Fig. 1**). The site with the most pronounced bone loss was chosen to represent the marginal bone loss around each implant.[20,21] The Image J (Wayne Rasband, National Institute of Health, Maryland, United States) program was used for the evaluation of marginal bone levels. All of the radiographs were analyzed by the same examiner (E.E.).

The statistical analysis (SPSS v.15.0; SPSS, Chicago, IL, United States) included descriptive statistics (mean ± SD), Kruskal–Wallis test, and Mann–Whitney U nonparametric test for clinical and radiographic parameters. The level of significance was set at $p < 0.005$.

Results

A total of 321 dental implants that were placed in 107 patients with a mean function time of 5.3 ± 1.7 years were evaluated in this study. The patient and implant characteristics were homogenously distributed in all groups (Group A: Ankylos, Group B: Xive, and Group C: MIS) (►**Table 1**). The mean age of all patients was 54.79 ± 12.35 years and 51.5% of them were female. Overall, implants included in this study were placed slightly more in mandible in all groups. The location of implants placed within the jaw was also similar among groups and in total 30% in incisor region, 32% in premolar region, and 38% in the molar region.

The distribution of the number of implants according to the diameter and length is shown in ►**Table 2**. The majority of the implants were 11 mm in length (40.8%) and 3.5 mm in width (54.2%). Dental implants restored with fixed bridge were most commonly used in all groups corresponding to a total of 65%, whereas only 20% were restored with a single crown and 15% with overdentures (►**Table 3**).

The distribution of marginal bone loss among different groups was also assessed (►**Table 4**). In total, 47.5% of all implants showed no bone loss. In Group A, out of 198 implants, 138 (70%) of them showed no bone loss. Taking

Fig. 1 Marginal bone-level measurement by ImageJ program.

into account different levels of bone loss, Group B and Group C showed a marked difference as compared to Group A.

Mean function time and bone loss in all groups are presented in ►**Table 5**. Regarding clinical and radiological evaluations, mean function time of implants in Group A and Group B was found higher (>5 years) than that of Group C ($p < 0.001$) (►**Fig. 2**). Mean bone loss in Group A was significantly lower (0.81 ± 1.60 mm) as compared to Group B (1.58 ± 1.59 mm) and Group C (1.18 ± 1.36) ($p < 0.005$) (►**Fig. 3**).

Table 1 Patient and implant characteristics by implant group

Patients implants	Group A (64) (198)	Group B (17) (58)	Group C (26) (65)	Total (107) (321)
Mean age (years) ± SD	52.61 ± 11.82	60.31 ± 7.85	56.52 ± 15.23	54.79 ± 12.35
Women (%)	32 (50)	7 (41)	16 (61.5)	55 (51.5)
Jaw (%)				
Maxilla	93 (47)	27 (46.5)	26 (40)	146 (45.5)
Mandible	105 (53)	31 (53.5)	39 (60)	175 (54.5)
Anatomic location (%)				
Incisor	66 (33)	13 (22)	17 (26)	96 (30)
Premolar	56 (28)	23 (40)	23 (35)	102 (32)
Molar	76 (39)	22 (38)	25 (39)	123 (38)

Abbreviation: SD, Standard deviation.
Note: Group A: Ankylos, Group B: Xive, Group C: MIS.

Table 2 Distribution of implant diameter and implant length

Diameter (mm)	Width								Total (%) (*n* = 321)
	3.3 mm (*n* = 2)	3.4 mm (*n* = 21)	3.5 mm (*n* = 174)	3.75 mm (*n* = 28)	3.8 mm (*n* = 24)	4.2 mm (*n* = 32)	4.5 mm (*n* = 37)	5 mm (*n* = 3)	
8	–	–	6	2	–	1	4	–	4
9.5	–	5	41	–	4	–	12	–	19.1
10	–	–	–	8	–	7	–	–	4.6
11	2	12	83	–	17	–	17	–	40.8
11.5	–	–	–	13	–	17	–	–	9.3
13	–	4	4	5	3	7	2	3	8.7
14	–	–	37	–	–	–	2	–	12
17	–	–	5	–	–	–	–	–	1.5

Table 3 Distribution of implants supporting different types of prosthetic restorations

	Group A (*n* = 198)	Group B (*n* = 58)	Group C (*n* = 65)	Total (*n* = 321)
Single crown (%)	45 (23)	5 (9)	15 (23)	65 (20)
Fixed bridge (%)	124 (63)	43 (74)	43 (66)	210 (65)
Overdenture (%)	29 (14)	10 (17)	7 (11)	46 (15)

Note: Group A: Ankylos, Group B: Xive, Group C: MIS.

Table 4 Distribution of marginal bone loss among groups

	Group A (*n* = 198)	Group B (*n* = 58)	Group C (*n* = 65)	Total (*n* = 321)
Implants with no bone loss (%)	138 (70)	21 (36)	30 (46)	152 (47.5)
Implants with bone loss (%), mm				
> 0.5	60 (30)	36 (62)	35 (54)	131 (45.5)
> 1	54 (27)	33 (57)	32 (49)	119 (37)
> 2	34 (17)	20 (35)	18 (27)	72 (22.5)

Note: Group A: Ankylos, Group B: Xive, Group C: MIS.

Table 5 Clinical and radiographic evaluations of implant groups

	Group A (*n* = 198)	Group B (*n* = 58)	Group C (*n* = 65)	*p* *
Mean function time (months) ± SD	62.99 ± 20.43	60.93 ± 13.67	40.74 ± 12.20	0.000
Mean bone loss (mm) ± SD	0.81 ± 1.60	1.58 ± 1.59	1.18 ± 1.36	0.000

Abbreviation: SD: standard deviation.
Note: Group A: Ankylos, Group B: Xive, Group C: MIS.
*Kruskal–Wallis test, $p < 0.001$.

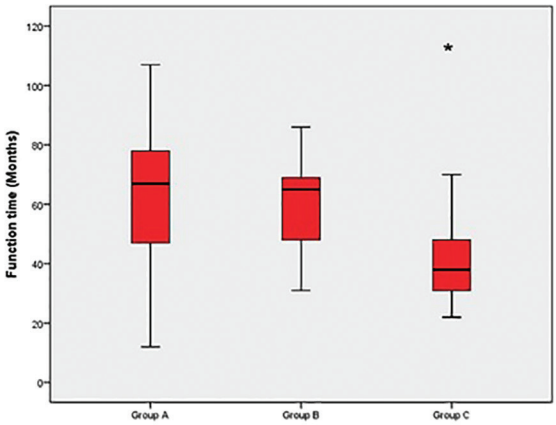

Fig. 2 Comparison of function time among implant groups. *Mann–Whitney U test as compared to Group A and B, $p < 0.001$.

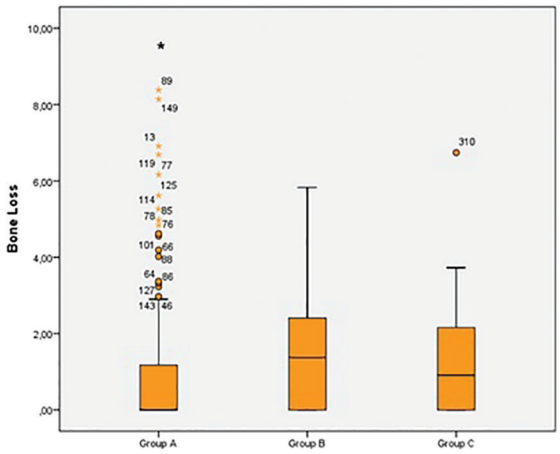

Fig. 3 Comparison of marginal bone loss among implant groups. *Mann–Whitney U test as compared to Group B and C, $p < 0.005$.

Discussion

Treatment of partially or completely edentulous patients presented a significant change in favor of placing dental implants over the past few decades. By the increase in knowledge and experience of clinicians in this field, patient profile has shifted more from fully edentulous to partially edentulous.[22] In a retrospective analysis of 1817 dental implants by Bornstein et al,[22] only 9.4% of all implants were placed in the edentulous jaws. Similar to these findings, 15% of the implants were placed in completely edentulous jaws in our study which support the high rates of dental implant placement in partially edentulous patients.

Eckert and Wollan[23] in their study analyzed 1,170 dental implants and location of implants was shown to have no effect on implant survival. Weber et al[24] evaluated changes in marginal bone levels around implants located in different jaw areas, and no statistically significant changes were found in any of the jaw locations between the first and second year evaluations. On the other hand, Peñarrocha et al[25] observed more marginal bone loss around implants placed in the maxilla after 1 year. Similar to these results, location of the implants (higher in the maxillary posterior region) was found to have an effect on peri-implant marginal bone levels at implants with a 6-year follow-up.[26] In our study, the location of the implants analyzed was homogenously distributed. According to the conflicting results in the literature, more studies with large sample groups and long-term follow-ups are needed.

In a retrospective study by Mijiritsky et al,[27] implant length and diameter were not found to be significant factors affecting implant survival. Ivanoff et al[28] also observed no relationship between marginal bone loss and implant diameter. Our findings were also parallel to previously published studies having no association between implant diameter and marginal bone loss. In this study, no short implants (< 8 mm) were present and only two implants were with narrow diameter (3.3 mm) that yielded no further analysis and no results could be drawn.

Lekholm et al,[29] in a 5-year prospective study of 521 implants supporting fixed prosthetic restorations, observed marginal bone loss <1 mm. In a study by Wyatt and Zarb,[30] fixed prostheses supported by 230 implants with a mean function time of 5.4 years were analyzed and implant success rate was 94%. Sixty-five percent of implants (n = 210) evaluated in this study were found to support fixed prostheses. Mean function time for these implants was 4.6 years and mean bone loss was 1.17 mm, which is in accordance with the previously published studies showing long-term success of implants supporting fixed prostheses.

Rammelsberg et al[31] evaluated the effect of prosthetic restoration on the survival of implants. They included 1,569 dental implants with an observation period ranged between 9 months and 11 years and concluded that the type of prosthetic support had a small but significant effect on implant prognosis. In our study, 65% of the implants were restored fixed prostheses, 20% with a single crown, and 15% with overdenture. There was no significant

difference in terms of marginal bone loss around implants supporting different types of prosthetic restorations. This can be explained by the heterogenicity of the distribution of prosthetic restoration type in our study.

Platform switching is a method used to preserve marginal bone levels around dental implants by the inward shifting of the implant-abutment junction. Marginal bone levels are better maintained at implants restored according to the platform-switching concept.[32] This concept has also the biomechanical advantage of shifting the stress concentration area away from the cervical bone–implant interface.[33] In a systematic review by Atieh et al,[34] it was concluded that platform-switching concept helps maintain marginal bone levels around dental implants. Baggi et al[35] also reported that Ankylos implant based on the platform-switching concept and subcrestal positioning demonstrated lower risk of marginal bone loss. In a prospective study by Cappiello et al,[36] mean marginal bone loss was found 0.95 mm around implants with platform switch, whereas the corresponding value was 1.67 mm for platform match implants. In this study, a total of 321 dental implants were evaluated and 61.7% were with platform switch. Among those implants, 70% had no bone loss after a mean observation period of >5 years. Similar to the results of Cappiello et al,[36] mean marginal bone loss was significantly lower (0.81 mm) around platform switch implants as compared to two different platform match implants (1.58 mm and 1.18 mm, respectively) ($p < 0.005$).

Today, treatment of partially edentulous patients is performed mostly by dental implants. Among the different types of implants, platform switching seems to preserve marginal bone levels and increases the long-term success of dental implants.

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Conflicts of Interest
None.

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