Future Dental Journal

Volume 2 | Issue 2 Article 4

2016

Crestal bone loss of standard implant versus platform switch implant design using minimal invasive technique

Karim M. Ahmed
krystaldental@gmail.com

Salah Abd Elfatah

Mohamed Abd El-Mageed Katamish

Crestal bone loss of standard implant versus platform switch implant design using minimal invasive technique

Cover Page Footnote

Corresponding author. E-mail address: krystaldental@gmail.com (K.M. Ahmed). Peer review under responsibility of Faculty of Oral & Dental Medicine, Future University.

Future Dental Journal 2 (2016) 74–79

Contents lists available at ScienceDirect

Future Dental Journal

journal homepage: http://www.journals.elsevier.com/locate/fdj

Crestal bone loss of standard implant versus platform switch implant design using minimal invasive technique

Karim M. Ahmed [a, *], Salah Abd Elfatah [b], Mohamed Abd El-Mageed Katamish [b]

[a] *Oral and Maxillofacial Surgery Department, Faculty of Dentistry, Future University in Egypt, Egypt*
[b] *Oral & Maxillofacial Surgery Department, Faculty of Dentistry, Ain Shams University, Egypt*

ARTICLE INFO

Article history:
Received 5 June 2016
Accepted 1 September 2016
Available online 7 September 2016

ABSTRACT

The aim of the current study was to investigate the role of the type of abutment/implant connection on the marginal bone loss around dental implant. The present study was conducted on eleven patients, six males and five females with age range from 26 to 45 years. Twenty consecutive dental implants were inserted for implant – supported restoration in the maxillary premolar area. The diameter and length of dental implants of all subjects were the same in groups, 3.7 mm diameter and 11.5 mm length. At the time of prosthetic rehabilitation, 3.8 mm abutments were connected to the all inserted dental implants. Periodontal assessment (probing depth, bleeding index, plaque index) was performed 1, 3, 6, 12, months after implant insertion. Radiographic assessment of marginal bone was performed immediately at the time of implant insertion (baseline), 3, 6 and 12 months. Statistical analysis revealed that there was a significant difference between the control group and the test group as regard the total mean of marginal bone loss. In conclusion, platform-switching concept seems to have a role in minimizing the marginal bone loss around dental implant.

1. Introduction

Dental implants are one of the most exciting treatments in modern dentistry. Unlike crowns, bridges or veneers, which attach to existing teeth, dental implants replace lost or damaged teeth entirely by connecting a titanium “root” directly to the jawbone and attaching a fully-functional, cosmetically perfect ceramic tooth.

Since Brånemark found that osseointegration occurred between titanium and bone in the mid-1960s, dental implants were introduced for the replacement of missing teeth, and treatment options for the partially or fully edentulous patient have expanded exponentially [1].

The difference in the technology of the implants pushed them to be in the mainstream of the dental practice nowadays.

The healing following implant installation of various systems has been documented in a variety of clinical studies. The quality and stability of the soft tissue interface with implants and abutments together with crestal bone preservation are most likely of paramount importance for the short and long-term prognosis of oral implants [2].

Albrektsson et al. [3] found that the installation of two-piece implants healing in a submerged modality resulted in a crestal bone loss of 1.5–2.0 mm after 1 year of loading. Moreover, in experimental studies in dogs, a crestal bone remodeling with a resorption of 2 mm has been verified.

Clinicians, researchers, and implant companies have, thus, dedicated time to finding ways to control the crestal bone loss that occurs after abutment connection. One approach [4] has focused on controlling or decreasing the horizontal component of the bone loss by a technique known as platform switching; which refers to the use of a smaller diameter abutment on a larger diameter implant collar. Such a connection shifts the perimeter of the implant-abutment junction inward toward the central axis of the implant.

It has been suggested that this biologic process resulting in loss of crestal bone height may be altered when the outer edge of the implant–abutment interface is horizontally repositioned inwardly and away from the outer edge of the implant platform.

Canullo et al. [5] this prosthetic concept has been introduced as

* Corresponding author.
E-mail address: krystaldental@gmail.com (K.M. Ahmed).
Peer review under responsibility of Faculty of Oral & Dental Medicine, Future University.

http://dx.doi.org/10.1016/j.fdj.2016.09.001

'platform switching' and radiographic follow-up has demonstrated a smaller than expected vertical change in the crestal bone height around implants. Using three-dimensional finite-element models, Maeda et al. [6], examined the possible biomechanical advantage of platform switching in an in vitro study and suggested that by this configuration, the stress concentration would be shifted away from the cervical bone–implant interface.

The ability to reduce or eliminate crestal bone loss would be a major achievement in implant dentistry. Hürzeler et al. [7], Clinical benefits such as superior esthetics (particularly for adjacent implant sites), better bone to implant contact and improved primary stability, could be obtained. The purpose of this clinical trial was to show that the crestal bone height around dental implants could be influenced by using a platform switch protocol.

2. Materials and methods

2.1. Materials

2.1.1. Samples

The current study was conducted on eleven patients, six males and five females, with age range from 26 to 45 years. All patients had edentulous maxillary premolar region. Twenty consecutive dental implants in the eleven patients were inserted for implant-supported restorations in the premolar maxillary area. All patients were in general good health. They were followed for a period of 12 months implant insertion.

The exclusion criteria were:

- Sites with acute infection.
- Patients with aggressive periodontal disease
- Sites with narrow width of bone crest that mandate augmentation.
- Sites with interproximal or buccal bone defects.
- Smokers with >10 cigarettes/day.
- Patients with uncontrolled diabetes mellitus.
- Pregnant or lactating women.
- Patients with a history of bisphosphonate therapy.

2.1.2. Implants

The root shaped dental implant (ScrewPlant™ Implant, Implant Direct Company, USA) were used in this study presented with mini-threads start 1 mm below the crest of the bone and extend for 2–2.5 mm before transitioning into double-lead threads which extend into the apex of the implant and Soluble Blast Media of HA crystals textured surface extends over the entire endosseous portion of the. The dental implants of all subjects included in the study were assigned to one diameter which was 3.7 mm. One month post implant insertion the abutment is attached to the fixture. For the control group the abutment has internal bevel that hide the external bevel in the collar of the fixture, but in the study group there is no internal bevel in the abutment so it accentuate the bevel in the fixture creating plat-form switch design as in Fig. 1.

2.2. Methods

2.2.1. Surgical protocol

Pre-operative orthopantogram was performed to assess bone condition and available bone height. Study models were prepared and mounted for evaluation of the interocclusal distance, achievement of ridge mapping and construction of surgical stent. Before the surgical procedure, full-mouth professional prophylaxis appointments were scheduled and performed. All patients received 1 g amoxicillin/clavulanate (Glaxo SmithKline, England) 1 h before surgery and continued with 2 g/day for 5 days.

All dental implants were inserted according to the non-submerged surgical protocol. Tissue Punch was used performed after local anesthesia.

Sequential drilling to the desirable depth of the recipient bone under copious irrigation was done at the pre-planned sites. The osteotomy sites were enlarged to receive appropriate dental implant of suitable platform diameter according to the preplanned preoperative workup (Fig. 2).

All implants were inserted at the bone level.

Patients were instructed to have a soft diet and to avoid chewing in the treated area until the suture removal. Oral hygiene at the surgical site was limited to soft brushing for the first 2 weeks. Regular brushing in the rest of the mouth and rinse with 0.12% chlorhexidine were prescribed for 2 weeks.

Implants were allowed for a non-submerged healing. One month later, the extender was replaced with the final abutment and the comfort cap cover the abutment. Only uneventfully healed implants were accepted in this study. Four months after the surgical stage, coping transfer was used and an impression was taken. For restoration, in test and control groups, always a 3.8 abutment was used. All restorations were splinted single-unit crowns in order to protect implants from inhomogeneous loading and the crowns were cemented using provisional cement (Temp Bond, Kerr, WA, USA).

2.2.2. Radiographic and clinical assessment

For each patient, an individual customized digital film holder was fabricated to ensure a reproducible radiographic analysis. Furthermore, digital periapical standardized radiographs were taken at the time of implant placement as a baseline for marginal bone measurement. Every 6 months for 24 months after the final restoration, periapical standardized digital radiographs were taken in order to evaluate marginal bone level alterations. A computerized measuring technique was applied to digital periapical radiographs (Fig. 3). Evaluation of the marginal bone level around implants was performed using image analysis software Sidexis XG software, sirona, the dental company, USA. The image analysis software calculated bone remodeling at the mesial and distal

Fig. 1. Implant design for both groups.

Fig. 2. Steps in implant insertion.

aspects of the implants. Because each implant was inserted at the bone-level crest, the distance was measured from the mesial and distal margin of the implant apex to the most coronal point where the bone appeared to be in contact with the implant.

For each implant, mean values of mesial and distal records were used. All measurements were made and collected by the same two calibrated examiners, different from the implant surgeon. For each pair of measurements, mean values were used.

2.2.3. Statistical analysis

The collected data was revised, coded, tabulated and introduced to a PC using SPSS 17 (Statistical Package for Scientific Studies) for Windows.

Data was presented and suitable analysis was done according to the type of data obtained for each parameter.

Comparison between two quantitative variables was carried out by unpaired Student t-test for independent samples.

Mann Whitney *U* test (a non-parametric equivalent of Student's *t*-test) was used to compare bleeding and plaque index in the control and study groups. The significance of percent change by time was evaluated by Wilcoxon-signed rank test.

The different experimental times were compared using analysis of variance (ANOVA) test, followed by Tukey's post hoc test.

Results were expressed in the form p-values that were differentiated into:

* Non-significant when p-value >0.05
* Significant when p-value ≤0.05

3. Results

3.1. Clinical findings

Twenty implants were utilized in the current study with diameters 3.7 mm, 11.5 mm length. All patients showed uneventful healing after the surgical stage.

At the prosthetic stage, all implants were clinically osseointegrated and showed no signs of peri-implant infection or soft tissues inflammation. All implants were loaded at four months after insertion.

3.2. Radiographic results

Radiographic findings showed successful osseointegration with no peri-implant radiolucency.

Radiographic measurements revealed marginal bone loss for all inserted implants (Fig. 3). The mean of bone loss in control and both test groups along the mean crestal bone loss in the control and study groups along the whole study period. Whole study period were tabulated in Table 1.

3.3. Statistical analysis results

The data of the current study revealed that the total mean of bone loss during the whole follow up intervals was 1.2 mm (±0.2 SD) on the control group, 0.7 mm (±0.1 SD) on the test group A and 0.5 mm (±0.1 SD) on test group B (Fig. 4).

Both one way ANOVA and one way ANOVA Post.

Hoc tests were performed on the total mean bone loss during the whole study period. The one way ANOVA test revealed that there was a statistical significant difference between the control and both the test groups.

Furthermore, the one way ANOVA Post Hoc test revealed that there was a statistical significant difference between the control and test group A, as well as, between the control and test.

4. Discussion

In the current study, over a period of almost a year, it could be demonstrated that implants restored according to the platform-switching concept experienced significantly less marginal bone loss than implants with matching implant–abutment diameters (see Table 2).

The limitation of this study was that standardized radiographic evaluation only provided information about mesial and distal bone levels. Buccal and palatal bone levels were not evaluative. However, it has to be realized that this limitation was applied to several studies of Abrahamsson et al. (2009).

The etiology of bone remodeling, was believed to be dependant on the localized inflammation of the peri-implant soft tissue [8].

This view was been supported, especially in view of the micro

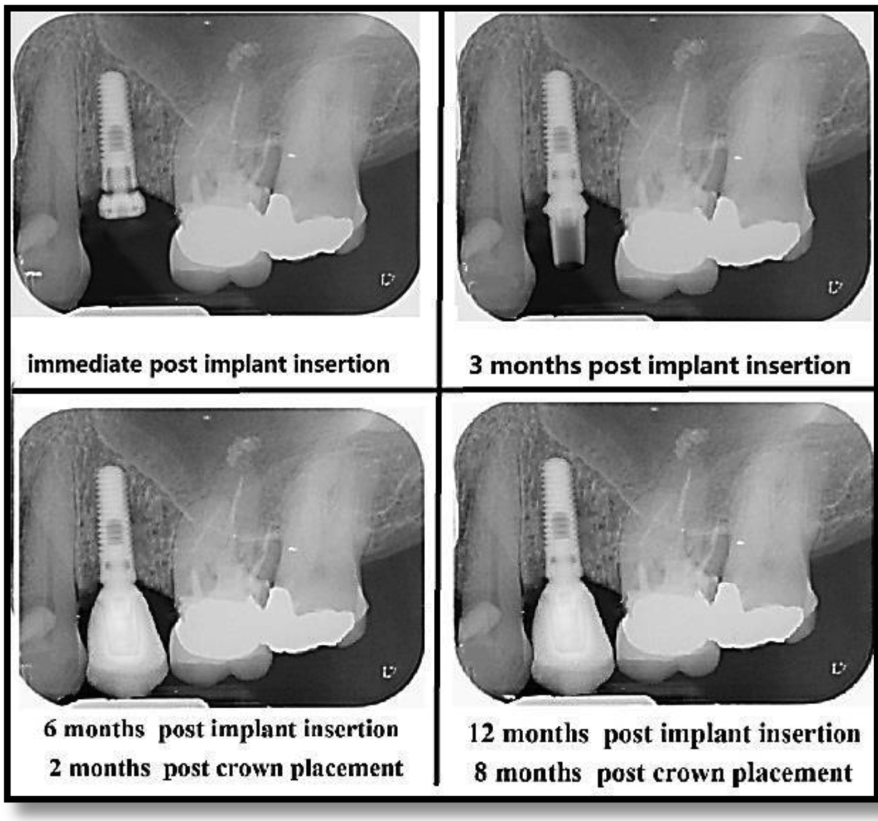

Fig. 3. Follow up series of standardized digital radiographs for case number 8 (study group).

Table 1
Showing the mean of crestal bone loss in the control and the study groups along the whole study period.

Side	Time	Group				P value
		Control		Study		
		Mean	SD	Mean	SD	
Mesial	Immediate	11.31	0.35	11.50	0	0.2131[ns]
	3 months	10.52	0.45	10.58	0.34	0.7997[ns]
	6 months	10.07	0.3	10.53	0.29	0.0223[a]
	12 months	9.82	0.29	10.38	0.42	0.0228[a]
Distal	Immediate	11.44	0.16	11.40	0.24	0.7411[ns]
	3 months	10.47	0.55	10.75	0.58	0.4110[ns]
	6 months	10.13	0.38	10.56	0.61	0.1735[ns]
	12 months	9.68	0.26	10.34	0.63	0.0391[a]

ns = non-significant.
[a] Statistically significant.

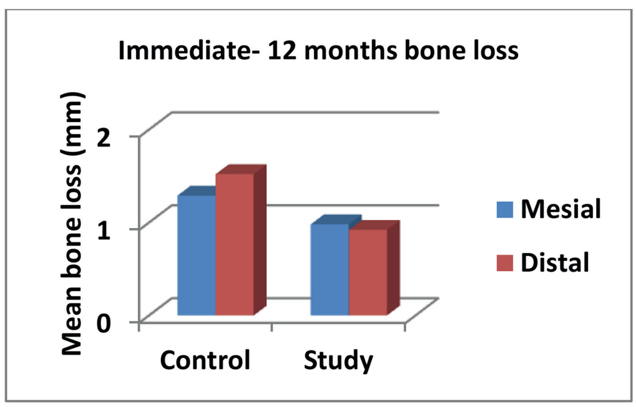

Fig. 4. Comparison between control and study groups regards total mean bone loss during 12 months of follow up in mesial and distal side.

gap at the implant abutment junction inflammatory cell infiltrate of the abutment, where it is always possible to detect bacterial infiltration, as reported by Jensen et al. (1997) [9]. This infiltrate was extended vertically for about 0.5–0.75 mm coronal to the IAJ and 0.5–0.75 apical to the IAJ. The ICT never ended in contact with the bone but was separated from it by an approximately 1 mm wide layer of healthy connective tissue.

The study of, Hermann et al. (1997) [10] observed radiographically that an initial bone loss of 1.5 occurred around implants, and the level then stabilized. These results indicate that biologic distances are established at the implant-gingival junction, which is accordance with other studies.

More recently, Warren et al. (2002) [11] reported that crestal bone resorption of 1.0–1.5 mm may occur almost immediately after implant loading. These findings are in accordance with the results of other authors Weng D et al. (2008) [12].

The platform switching concept is a recent approach which focused on controlling or decreasing the horizontal component of the bone loss; it refers to the use of a smaller diameter abutment on a larger diameter implant platform. Such a connection shifts the perimeter of the implant-abutment junction inward toward the central axis of the implant to preserve marginal bone from stress concentration. It is also believed that inward movement of IAJ shifts the inflammatory cell infiltration to the central axis of the implant and away from the adjacent crestal bone which is thought to restrict crestal bone resorption [13]. Moreover, crestal bone loss and soft tissue stability are influenced by the abutment collar

Table 2
Comparison between control and test groups regards total mean bone loss during 12 months in mesial and distal side.

Side	Time	Group				P value
		Control		Study		
		Mean	SD	Mean	SD	
Mesial	Immediate-12months	−1.29	0.33	−0.98	0.26	0.0034[a]
Distal	Immediate-12months	−1.52	0.28	−0.92	0.15	0.0028[a]

[a] Statistically significant.

length which controls the final crown margin location and the subsequent esthetic outcome.

Although most clinical studies have reported a positive impact of platform switching on crestal bone stability, yet the data have still been controversial and inconclusive & up to date the literature still lacks providing clinical evidence about the true influence of platform switching on preserving bone and soft tissue [14].

indeed, since the formation of an inflammatory-infiltrate extending vertically along the surface of the implant occurred with implants supported by abutments of the same diameter and aggravated the damaging effect on the bone, the ICT had to localize more inwardly with implants in which platform switching was performed, thereby reducing the range of exposure on the adjacent hard tissues.

Accordingly the current study was conducted to evaluate the influence of platform switching on variable biological outcome around upper premolar implants both clinically and radiographically when using minimal invasive surgery.

The study was conducted on medically free patients with standardized inclusion & exclusion criteria. The maxillary premolar area was selected.

Implants of all subjects included in the study were randomly assigned to the same treatment protocols to avoid bias among different treatment protocols.

Standardization of factors that can influence the results such as: age range, bone quality, implant type, surgical technique and loading periods were achieved throughout the study.

The results of the present study were coincident with the results of Lazzara and Poter in that, the periimplant bone resorption in the control group was 0.99 mm after 6 months of functional loading while the study cases showed a crestal bone loss of 0.52 mm.

The results of the present study showed that bone resorption around dental implants can be decreased by moving the micro gap at implant abutment junction inward. The use of narrower abutment can increase the distance between the implant abutment micro gap and the crestal bone, thus reducing bone resorption.

Sewerin (1990) [15] utilized several methods to standardize radiographic measurements around dental implant. The use of standardized radiographs has been proposed as a reliable approach to reduce measurement error when comparing measurements between radiographs taken at different points in time.

Lazzara and porter, measured in the present study, periodontal parameters in terms of PPD, BOP, PI and soft tissue condition for clinical monitoring of implant soft tissue health. The peri-implant soft tissue parameters that were reported in this study seem to be in agreement with the results [16].

When measuring the effect of the abutment design (platform switching versus non-platform switching) on the peri-implant tissues it was found that there was no statistically significant difference between groups regarding all periodontal parameters except for pocket probing depth. The lack of difference observed goes in accordance with previous studies by canullo et al. [17,18].

Canullo et al. [19] and Vela-Nebot et al. [20] revealed during the analysis of soft tissue esthetics including attached gingiva and papilla level a statistically significant difference between groups with PS abutments showing the best results. This better esthetic behavior seems to be strongly correlated to the lower bone loss that occurred in this group and the interproximal alveolar bone crest preservation.

One study reported that peri-implant probing around implant is a good prediction of crestal bone loss. Additionally, there is scientific evidence of correlation between the levels of the bone at the probing penetration Quirynen et al. 1992 [21] Bragger et al. 1996 [22]. Results observed in the present study seem to agree with the observations. There was a significant correlation between periodontal probing depth and crestal bone loss in our study. According to the results of this stud, implant with crestal bone loss displayed increasing periodontal pocket depth over time, while implant with no or little crestal bone resorption showed the opposite. Contrary finding have been presented by other authors Weber et al. 2000 [23].

Penarrocha et al. 2004 study design difference could explain the controversial finding, as the radiographic evaluation that was done using panoramic radiographs, which has been found to be less precise on the assessment of crestal bone loss [24].

This controversy in results of marginal bone loss among different studies may also be attributed to different implant designs, study populations and observation periods.

Limited number of patients, accurate observation of patient inclusion/exclusion criteria, conservative surgical technique, strict periodontal and prosthetic monitoring and short observation period, could be considered important co-factors for a high short-term successful rate observed in the test and control groups.

5. Conclusion

Within the limitations of this study, it was demonstrated that implants restored using the platform switching protocol seem to behave better than implants restored with platform matching restorations, regarding soft and hard tissue maintenance. It must be acknowledged that the horizontal mismatch configuration and the consequent placement of the implant–abutment gap away from peri-implant tissues together with the presence of a gingival collar are only among many other factors playing a role in crestal bone remodeling and soft tissue esthetics. Several other factors must be considered, such as the implant–abutment connection type, the implant macrogeometry at the cervical area (presence of threads), surface treatment, implantation time, loading schedules, and others.

Finally, although platform switching appears to be a promising tool in both soft and hard tissue preservation, yet, Because of controversy still existing regarding this concept, the present study can be considered as a part of a series of ongoing studies focusing on platform switching and more accurate long term studies of the potential differences among different implant platforms and abutment designs may increase our understanding in this field.

References

[1] Ismaiel Mohammed Diaa Z, Elhadry Amany A. Influence of platform switching concept on marginal bone alteration around dental implant. J Am Sci 2012;8(11):546–52.

[2] Abrahamsson I, Berglundh T. Effects of different implant surfaces and designs on marginal bonelevel alterations: a review. Clin Implant Dent Relat Res 2009;20:207–15.

[3] Albrektsson T, Zarb G, Worthington P, Eriksson AR. The long-term efficacy of currently used dental implants: a review and proposed criteria for success. Int J Oral Maxillofac Implants 1986;1:11–25.

[4] Lazzara Richard J, Porter Stephan S. Platform switching: a new concept in implant dentistry for controlling post restorative crestal bone levels. Int J

Periodontics Restor Dent 2006;26:9–17.
[5] Canullo L, Fedele GR, Iannello G, Jepsen S. Platform switching and marginal bone-level alterations: the results of a randomized-controlled trial. Clin Oral Implant Res 2010;21:115–21.
[6] Maeda Y, Miura J, Taki I, Sogo M. Biomechanical analysis on platform switching: is there any biomechanical rationale? Clin Oral Implant Res 2007;18:581–4.
[7] MarkusHürzeler, StefanFickl, OttoZuhr, Hannes C.Wachtel. Peri-implant bone level around implants with platform-switched abutments: preliminary data from a prospective study. J Oral Maxillofac Surg 65:33–39.
[8] Berglundh T, Lindhe J, Ericsson J, Mainello CP, Liljenberg B, Thomsen P. The soft tissue barrier at implants and teeth. Clin Oral Implant Res 1991;2:81–90.
[9] Jensen VK, Conrads G, Richter EJ. Microbial leakage and marginal fit of the implant abutment interface. Int J Oral Maxillofac Res 1992;3:99–103.
[10] Hermann JS, Cochran DL, Schenk RK, Higginbottom FL, Buser D. Biologic width around titanium implants. A histometric analysis of the implant-gingival junction around unloaded and loaded nonsubmerged implants in the canine mandible. J Periodontal 1997;68:180–98.
[11] Warren P, Chaffee N, Felton DA, Cooper LF. A retrospective radiographic analysis of bone loss following placement of Tio_2 gritblasted implants in the maxilla and mandible. Int J Oral Maxillofac Implant 2002;17:399–404.
[12] Weng D, Nagata MJH, Bell M, Bosco AF, De Melo LGN, Richter E-J. Influence of microgap location and configuration on the peri-implant bone morphology in submerged implants. An experimental study in dogs. Clin Oral Implant Res 2008;19:1141–7.
[13] Lazara Richard J, Porter Stephan S. Platform switching: a new concept in implant dentistry for controlling postoperative crestal bone level. Int J Periodontics Restor Dent 2006;26:9–17.
[14] Simion M, Jovanovic SA, Tinti C, Benfenati SP. Long-term evaluation of osseointegrated implants inserted at the time or after vertical ridge augmentation. Clin Oral Implant Res 2001;12(1):35–45.
[15] Sewerin IP. Errors in radiographic assessment of marginal bone height osseointegrated implants. Scand J Dent Res 1990;98:428–33.
[16] Lazzara RJ, Porter SS, Testori T, Galante J, Zetterqvist L. A prospective multicenter evaluation loading of Osseotite implants two months after placement: one-year results. J Esthet Dent 1998;10(6):280–9.
[17] Canullo L, Rasperini G. Preservation of peri-implant soft and hard tissues using platform switching of immediate extraction socket implants:a proof-of-concept study with 12–36 month follow-up. Int J Oral Maxillofac Implant 2007;49:995–1000.
[18] Canullo L, Iurlaro G, Iannello G. Double-blind randomized controlled trial study on post-extraction immediately restored implants using the switching platform concept: soft tissue response. Preliminary report Clin Oral Implant Res 2009;20:414–20.
[19] Canullo L, Fedele GR, Iannello G, Jepsen S. Platform switching and marginal bonelevel alterations: the results of a randomized-controlled trial. Clin Oral Implant Res 2010;21:115–21.
[20] Vela-Nebot X, Rodríguez-Ciurana X, Rodado- Alonso C, Segalà-Torres M. Benefits of an implant platform modification technique to reduce crestal bone resorption. Implant Dent 2006;15:313–20.
[21] Quirynen M, Naert I, van steenberghe D. Fixture design and overload influence marginal bone loss and fixture success in Branemark system. Clin Oral Implant Res 1992a;3:104–11.
[22] Bragger U, Hugel-Pisoni C, Brugin W, Buser D, Lang NP. Correlation between radiographic, clinical and mobility parameters after loading of oral implants with fixed partial dentures. A 2 year longitudinal study. Clin Oral Implant Res 1996;7:230–9.
[23] Meijer HJ, Steen WH, Bosman F. A comparison of methods to assess marginal bone height around endosseous implants. Clin Periodontol 1993 Apr;20(4):205–13.
[24] Penarrocha M, Palmor M, Sanchis JM, Guarinos J, Balaguer J. Radiographic study of marginal bone loss around 108 dental implants and its relationship to smoking, implant location and morphology. Int J Oral Maxillofac Implant 2004;19:861–7.