Radiographic Evaluation of Marginal Bone Level Around Internal-Hex Implants with Switched Platform: A Clinical Case Report Series

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Purpose: *The purpose of this retrospective investigation was to evaluate the influence on the adjacent cervical bone of moving the implant-abutment microgap inward from the outer edge of an internal-hex implant platform (ie, a platform-switched configuration).* ***Materials and Methods:*** *A convenience sample of 26 patients received 42 Frialit-2 (Dentsply-Friadent) implants for single tooth replacement and were divided into two groups. One group followed the original protocol (control group), and the other (study group) received narrower replaceable components. Follow-up time varied between 6 and 60 months (mean, 33.45 months).* ***Results:*** *The control group showed noticeable bone remodeling (mean bone loss = 2.30 mm), and all the remodeled crests were apical to the implant platform. In contrast, all patients in the study (platform-switched) group showed stable levels (mean bone loss = 0.27) of the peri-implant crestal bone, coronal to the implant platform.* ***Conclusion:*** *The relocation of the implant-abutment microgap through platform switching with Frialit-2 System implants seems to be an effective means to minimize marginal bone loss in all circumstances employed.* Int J Oral Maxillofac Implants 2011;26:587–592

Key words: *marginal bone level, peri-implant bone loss, platform switching*

The use of two-piece dental implant systems has been well established. Such implants are restored, with few exceptions, with prosthetic components that locate the interface between the implant and the prosthetic component at the outer edge of the implant platform.

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The original criteria established for assessing implant success and survival identified marginal bone levels as an important indicator for measuring the response of the peri-implant tissues to functional loading.[1,2] Histologic and radiographic observations suggest that a biologic dimension of hard and soft tissues exists around dental implants and extends apically from the implant-abutment interface.[1–4] Radiographic evidence of the development of the biologic dimension can be demonstrated by the vertical repositioning of crestal bone and the subsequent soft tissue attachment to the implant that occurs when an implant is uncovered and exposed to the oral environment after matching-diameter restorative components are attached.[5,6]

Success in tooth replacement is characterized by the restoration of adequate function and esthetics without negative effects on the adjacent hard and/or soft tissue structures. Because there will be bone loss at the implant platform following uncovering and loading, younger patients receiving tooth replacements face a higher risk of future complications.[7] For this reason, the selection of an appropriate alternative to preserve healthy adjacent peri-implant structures

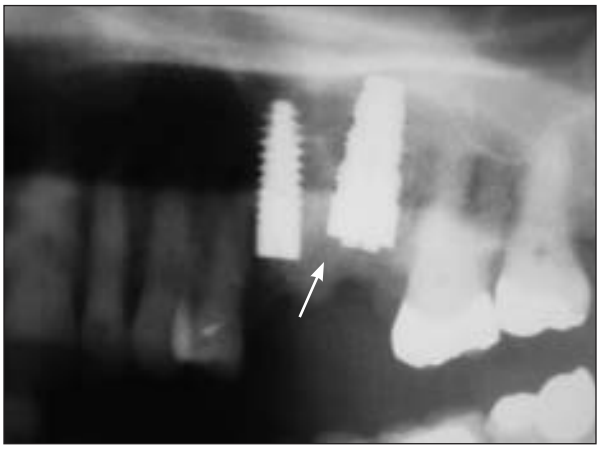


Fig 1 Replacement of the matching-diameter cover screw with a smaller one.

seems rational. With adequate consideration of these requirements, the use of single-tooth implants for rehabilitation of edentulous areas has gained significant importance.[8–12]

The results of several studies have confirmed a high rate of success for single-tooth implants. Most publications that have reported on survival rates of implants and attached prosthetic components are based on studies of Brånemark-type implants.[6,13–16] Results reported by Scholander[13] and Scheller and associates[17] have confirmed these findings, with success rates of 98.5% and 95.9%, respectively. Long-term results for other implant systems have also documented the successful use of implants for single-tooth replacement.[18–21]

The Ankylos implant system, developed by Nentwig and Moser,[22] first established the concept of platform switching combined with an absence of the microgap and has been in clinical use since 1987. In 1991, Implant Innovations (Biomet 3i) introduced wide-diameter implants with wide-diameter platforms.[4] At that time, however, matching-diameter prosthetic components were not yet available; therefore, many of the early 5.0- and 6.0-mm-wide implants received "standard"-diameter (4.1-mm) healing abutments and were restored with "standard"-diameter (4.1-mm) prosthetic components. Long-term radiographic follow-up of these "platform-switched" wide-diameter dental implants demonstrated a smaller than expected vertical change in the crestal bone height around these implants than is typically observed around implants restored conventionally with prosthetic components of matching diameters. This radiographic observation suggests that the postrestorative biologic process resulting in the loss of crestal bone height is altered when the outer edge of the implant-abutment interface is horizontally repositioned inwardly and away from the outer edge of the implant platform. Lazzara and Porter contributed to a better biologic understanding of the observed radiographic findings and clinical rationale for this technique.[4] However, independent evaluation of Frialit-2 implants (Dentsply Friadent) for single-tooth replacement under the concept of platform switching has not yet been done. The present study, therefore, reports on the influence of this protocol on peri-implant cervical bone levels.

MATERIALS AND METHODS

The study was based on retrospectively collected data from a convenience sample of 26 patients treated with internal-hex implants (Frialit-2 System, Dentsply Friadent). The same surgeon in the same clinic placed all implants.

The inclusion criteria were as listed:

- Sufficient bone height and width to allow infrabony placement
- Minimum interval of 6 months after tooth loss, or after bone grafting, to avoid the need for simultaneous procedures
- Good health

Forty-two stepped-screw internal-hex implants (Frialit-2, Dentsply Friadent) of varying lengths and diameters were used as late implantation (healed sites). Fifteen were restored under the original (platform-matched) protocol (control group) and twenty-seven following the platform-switching concept (study group). In the latter group, all implants were restored with switched-diameter components. At the time of implant placement, the first step for the platform-switching protocol was the replacement of the original cover screw with a smaller one (Fig 1). The 5.5-mm-diameter implants received a cover screw of 3.8 mm in diameter (difference of 1.7 mm). All 6.5-mm-wide implants received 4.5-mm-diameter healing abutments and were restored with 4.5-mm prosthetic components. At the time of uncovering, a smaller-diameter healing screw or a smaller-diameter abutment (in case of direct provisionalization) was used. Loading was initiated 30 to 180 days after implant placement, depending on the bone type and insertion torque. Control group implants were restored with matching-diameter components.

The follow-up time varied between 6 and 60 months (mean, 33.45 months).

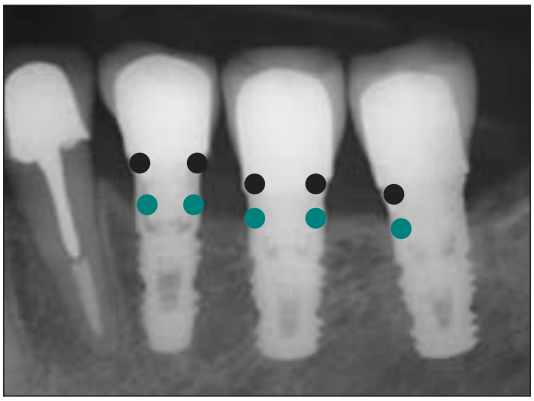


Fig 2a Control group radiographs. Following the original protocol, all the remodeled crests *(green dots)* were apical to the implant platform *(black dots)*.

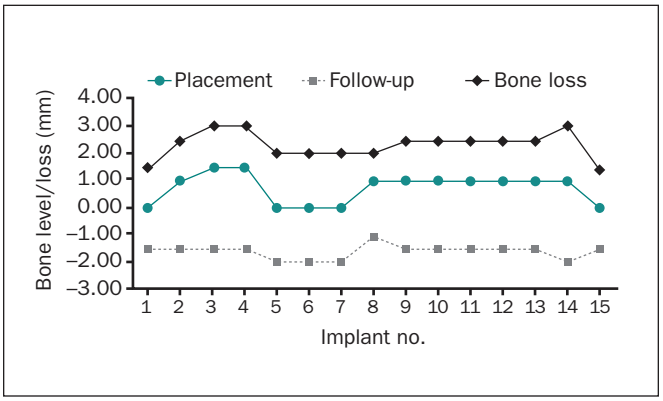


Fig 2b Chart showing bone levels in the control group. The implants were placed at the bone crest (0.00 mm) or subcrestally (0.50 mm to a maximum of 1.50 mm). Positive numbers indicate crestal bone at or coronal to the implant platform. Negative numbers indicate that the crestal bone was apical to the implant platform. Green line = bone level at placement; gray dotted line = bone level at the most recent evaluation; black line = total bone loss.

All included patients took part in a regular recall program; during the first year they were evaluated at 3-month intervals, and thereafter the patients were examined every 6 months. At the follow-up appointments, bone resorption was assessed radiographically using the method of Gomez-Roman and associates[16]; radiographic evaluation was performed on periapical radiographs based on the paralleling technique. For the purpose of this study, immediate postoperative radiographs were compared with the most recent ones.

Most implants (36 of 42) were placed subcrestally. The control group had a mean subcrestal placement of 0.7 mm, and the study group had a mean subcrestal placement of 1.76 mm. The bone level with respect to the implant platform was compared on the radiographs taken immediately postoperative and at the most recent appointment. The difference between these measurements was considered the total bone loss during the time frame for each implant.

RESULTS

The present reported data provide detailed information about the outcomes following single-tooth replacement with Frialit-2 implants under a platform-switched protocol. The patients' ages ranged from 25 to 70 years (mean age, 41 years).

In the control group, 15 implants were placed in 10 patients and were restored following the original prosthetic protocol. Bone remodeling was noticeable (Fig 2), and all the remodeled crests were apical to the implant platform. Ten of the 15 implants were placed subcrestally. The follow-up ranged from 18 to 60 months in the control group (mean follow-up, 39 months).

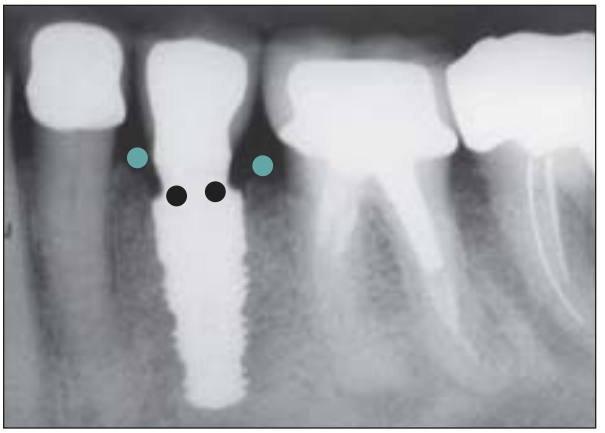
The test group comprised 27 implants in 16 patients, which showed maintenance of the interproximal crestal bone level coronal to the implant platform (Fig 3). Only one of these 27 implants was placed at the bone crest. The follow-up period ranged from 6 to 60 months (mean follow-up, was 30.3 months).

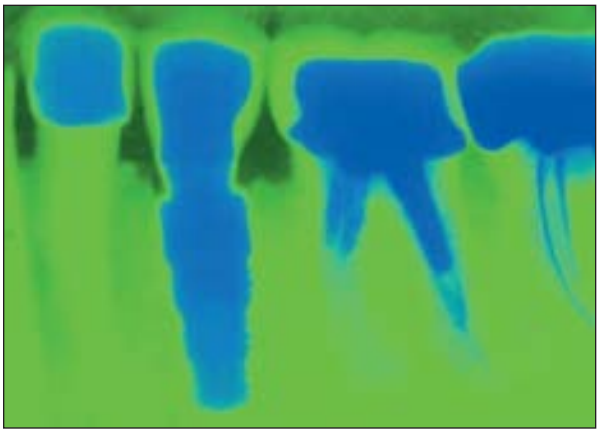
The mean marginal bone resorption in the control group was 2.3 mm, while for the study group it was 0.27 mm.

DISCUSSION

In the present study, the main indication for implantation was various endodontic failures and their consequences, including root fracture. This is consistent with the investigations of Priest[3] and Kemppainen et al[23] but is in obvious contrast to the findings of Ekfeldt et al,[10] Engquist et al,[11] and Scheller et al,[17] who described trauma and aplasia as primary indications.

Strietzel et al,[24] in a retrospective longitudinal study, evaluated the success of implant-prosthetic rehabilitation with the Frialit-2 implant system. In 2002 Krennmair et al[7] reported, in a study of the same system, marginal bone resorption up to 2.5 mm (mean bone loss, 1.3 ± 0.8 mm). A general follow-up of Gomez-Roman and coworkers[16] included a subgroup of 290 single-tooth implants out of a total of 696 Frialit-2 implants. De Wijs and Cune[25] reported on 68 Frialit-2 single-tooth implants, but these had been restored exclusively under the standard (ie, matching-diameter)





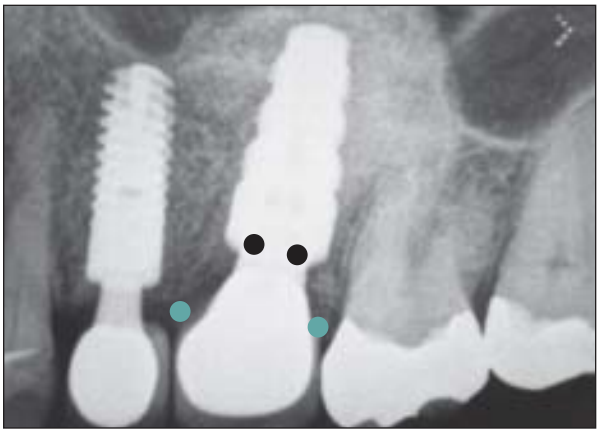


Fig 3a *(Top left)* Study group radiograph showing maintenance of the interproximal crestal bone *(green dots)* coronal to the implant platform *(black dots)*.

Fig 3b *(Above)* Figure 3a shown with density gradient.

Fig 3c *(Left)* Platform-switched Frialit-2 implant adjacent to an Ankylos implant. Black dots = implant platform; green dots = bone crest.

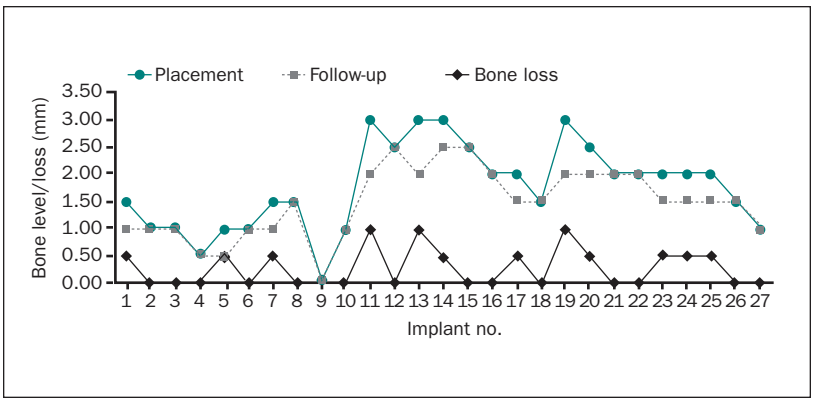


Fig 3d Bone levels in the study (platform-switched) group. All implants were placed at the bone crest (0.00 mm) or subcrestally (0.50 mm to a maximum of 3.00 mm). Green line = bone level at placement; gray dotted line = bone level at the most recent evaluation; black line = total bone loss.

protocol. Despite these reported successful outcomes, one of the major concerns when using Frialit-2 is the marginal bone remodeling that has been observed in all other two-piece matching-diameter implant systems. With the development of the Ankylos implant system in 1985, Nentwig and Moser[22] introduced the concept of platform switching combined with the absence of a microgap.

There are established and well-accepted data regarding the "biologic width" involving the height of the interproximal crestal bone and the presence or absence of the interdental papillae. The present retrospective radiographic follow-up of platform-switched dental implants demonstrated a smaller-than-expected vertical loss of crestal bone around these implants than is typically observed around implants restored

with prosthetic components of matching diameters. This radiographic observation suggests that the postrestorative biologic process resulting in the loss of crestal bone height is altered when the outer edge of the implant-abutment interface is horizontally repositioned inwardly and away from the outer edge of the implant platform. In 2006, Lazzara and Porter[4] published a study about controlling postrestorative crestal bone levels and the biologic understanding of the observed radiographic findings and clinical rationale for this technique.

The reduction in the diameter of the replaceable prosthetic parts of the Frialit-2 System seemed to create a horizontal biologic width, allowing the peri-implant bone to remain coronal to the platform, much like the results obtained with the Ankylos implants, which are shown side by side in Fig 3c. It must be emphasized that in the control group, two thirds of the implants were placed subcrestally (mean bone loss = 2.6 mm, with a mean subcrestal placement of 1.1 mm), and one third were placed at the bone crest, with a mean bone loss of 1.8 mm. The original protocol for Frialit-2 implants recommends that they be placed at the bone level. Nevertheless, in comparison with the results in the study group, where all but one of the 27 implants were placed below bone level (mean subcrestal placement of 1.76 mm), the 0.27-mm mean bone loss is a consistent result. This study was focused only on biologic width and did not consider the biomechanical aspect of platform switching.

The introduction of an additional step into the platform-switching protocol should be considered relevant. At the time of implant insertion, the original cover screw was replaced with a smaller one (Fig 1). The reason for this was to eliminate the peripheral microgap that is present even during the covered healing phase. The authors have observed that microgap-related bone changes frequently take place even before implant uncovering surgery, and after this, platform-switched components will not reverse the remodeling process.

CONCLUSIONS

Within the limitations of this study of single-tooth replacement with Frialit-2 implants under conventional and platform-switched protocols, the following were found.

- The control (conventional) group had a mean subcrestal implant placement of 0.7 mm and showed a mean bone loss of 2.3 mm.
- The study (platform-switched) group had a mean subcrestal implant placement of 1.76 mm and showed a mean bone loss of 0.27 mm.

Within the limits of this study, the evidence points to an alternative approach to minimize bone loss around Frialit-2 dental implants.

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DISCLAIMER

This study was not supported by any sponsor and was not influenced on study design, collection, analysis, or interpretation of data. The writing of the report and the decision to submit this paper was indepaendent.

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