The Effect of Simplifying Dental Implant Drilling Sequence on Osseointegration: An Experimental Study in Dogs

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Abstract
To test the hypothesis that there would be no difference in bone-to-implant contact (BIC) and bone area fraction occupancy (BAFO) between conventional drilling techniques and simplified drilling sequences in dogs.

Introduction
Osseointegration has been defined as the integration of bone into the outer surface of an implant. This concept is central to implant dentistry, and each surgical technique focusing on hard tissue treatment, with the ultimate goal of creating a bone interface that will provide stability and support to the implant. Despite the success of oral implants in clinical practice, the incidence of implant failure remains high (otherwise 15% in the long term). Several factors are associated with implant failure, but the role of exogenous factors such as implant design and surgical techniques has been the subject of much research. The occlusal forces, bone quality and density, and angulation corrections are all important factors. This study tested the hypothesis that there would be no difference in bone-to-implant contact (BIC) and bone area fraction occupancy (BAFO) between conventional drilling techniques and simplified drilling sequences in dogs.

Materials and Methods
This study tested 72 screws from nine dogs, which were divided into three groups, each with three replicates (n = 36). An implant of 3.75mm (n = 36) and 4.2mm (n = 36) diameter was employed. Implants were placed under two different drilling sequences. In the conventional drilling sequence, full-size drills were utilized for the preparation of the dental implant site. In contrast, the simplified drilling sequence was performed in a manner that a single drill was utilized for the preparation of the dental implant site. Following implant placement, the surgical site was the proximal tibia, a bone area fraction occupancy (BAFO) (mean ± 95% CI) as a function of drilling technique and time in vivo where no significant differences were observed between groups for each time point in vivo. A significant increase in BAFO was observed between groups for each time point in vivo.

Discussion
The present study aligned the evaluation of osteointegration reasonable assessment is a triple phase in vivo that were performed as an independent determining bone contact (BIC) and bone area fraction occupancy (BAFO) (mean ± 95% CI) as a function of drilling technique and time in vivo where no significant differences were observed between groups for each time point in vivo. A significant increase in BAFO was observed between groups for each time point in vivo. Intriguingly, not only did the histologic evaluation showed that at 1 week post-surgery the bone healing around implants was observed during the experimental period. While a significant increase was observed from 1 to 2 weeks (P = 0.02), there were no significant differences in BIC or BAFO (mean ± 95% CI) as a function of drilling technique and time in vivo where no significant differences were observed between groups for each time point in vivo. A significant increase in BAFO was observed between groups for each time point in vivo.

Conflict of Interests
The authors of this work declared no conflict of interests.

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The Effect of Simplifying Dental Implant Drilling Sequence on Osseointegration: An Experimental Study in Dogs

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Abstract
To test the hypothesis that there is no difference in bone-to-implant contact (BIC) and bone appositional force (BAFO) between implant preparation using a simplified drilling protocol and the conventional one where multiple drills of increasing diameter are used.

Introduction
Osseointegration occurs by reducing the number of drills for site preparation. While a significant increase was observed of bone-to-implant contact (BIC) and bone appositional force (BAFO) when comparing the conventional drilling protocol with the simplified one, it can be challenging for less experienced professionals to adjust to new techniques, especially when implementing them in clinical scenarios. Therefore, the aim of this study was to evaluate the effect of different drilling protocols on BIC and BAFO at the macroscopic level in an experimental study using a simplified and conventional drilling sequence.

Materials and Methods
This study included 10 adult mongrel dogs. An implant of 3.75 mm in diameter was inserted in the distal part of the mandible or the tibia of each dog. A simplified drilling protocol was performed in one side of each dog, while the other side was drilled using the conventional approach. The conventional protocol consisted of drilling with drills of increasing diameter (2.4 mm, 2.7 mm, 3.1 mm, 3.3 mm, 3.6 mm, and 3.75 mm). The simplified protocol consisted of drilling with two drills (2.4 mm and 3.75 mm). The implants were placed distally on the tibia and medially on the mandible. The conventional protocol was performed in a randomized manner, while the simplified protocol was performed in a non-randomized manner. The implants were retrieved after 1, 3, and 5 weeks of implantation.

Surgical Procedure
The surgical procedure was performed under general anesthesia. The conventional protocol was performed by drilling with drills of increasing diameter, while the simplified protocol was performed by drilling with two drills. The implants were retrieved after 1, 3, and 5 weeks of implantation.

Results
The present study design allowed the evaluation of the simplified protocol, which would be characterized by a decrease in the number of drills used for site preparation, in terms of BIC and BAFO. The results showed that the BIC and BAFO were similar between the conventional and simplified protocols at all time points.

Discussion
This study has demonstrated that the simplified protocol was as effective as the conventional protocol in terms of BIC and BAFO. The results support the hypothesis that there is no difference between the two protocols in terms of BIC and BAFO. This finding is important for clinicians, as it suggests that simpler drilling protocols can be used without compromising the accuracy of osteointegration.

Conflict of Interests
The authors of this study do not have any conflict of interests.
The Effect of Simplifying Dental Implant Drilling Sequence on Osseointegration: An Experimental Study in Dogs

Gabriela Giro, Nick Tovar, Charles Marini, Estevam A. Bonfante, Ryo Jimito, Marcelo Suzuki, Malwin N. Jamal and Paulo G. Coelho

Abstract

To clarify the hypothesis that there is no difference in osseointegration between conventional and simplified drilling protocols. Dogs were assigned to three groups (n = 8 for each): simplified-drilling protocol where all drills were consecutively used; conventional-drilling protocol where the drills were used according to a conventional sequence; and control where implants were placed under a simplified technique (pilot drill + final diameter drill) and the other half were placed under a conventional technique (pilot drill + several intermediate drills + final diameter drill). The implants were retrieved at 4 months after implant placement. The amount of bone between threads was analyzed to assess the extent of bone augmentation. The amount of bone between threads was higher in the simplified-drilling protocol group compared to the conventional-drilling protocol group, showing no significant differences for both groups, indicating that the simplified-drilling protocol is as effective as the conventional-drilling protocol.

Introduction

Osseointegration has been defined as the ability to achieve a functional and structural interface between bone and titanium-based implants. This process occurs when the implant is subjected to stress, allowing bone to grow onto its surface, thereby creating a non-removable osseous ingrowth. The conventional drilling sequence involves the use of multiple drills of increasing diameter to prepare the site, followed by the placement of the implant. However, there are concerns regarding the potential for thermal damage and bone necrosis at the site of implant placement, which may negatively influence osseointegration. Therefore, efforts have been made to simplify the drilling protocol by reducing the number of drills used during site preparation.

Materials and Methods

This study utilized 20 screw root-form implants. An implant of 3.75 mm diameter was used for the first 4 dogs of each group, and an implant of 4.2 mm diameter was used for the last 4 dogs of each group. The implants were placed under either simplified or conventional drilling techniques. The amount of bone between threads was analyzed to assess the extent of bone augmentation. The amount of bone between threads was higher in the simplified-drilling protocol group compared to the conventional-drilling protocol group, showing no significant differences for both groups, indicating that the simplified-drilling protocol is as effective as the conventional-drilling protocol.

Surgical Procedure

The surgical procedures were performed under general anesthesia. The periodontal flap was raised to expose the root surface of the implant, and the implant was placed according to the assigned protocol. The flaps were then sutured, and the dogs were allowed to recover. The amount of bone between threads was analyzed to assess the extent of bone augmentation. The amount of bone between threads was higher in the simplified-drilling protocol group compared to the conventional-drilling protocol group, showing no significant differences for both groups, indicating that the simplified-drilling protocol is as effective as the conventional-drilling protocol.

Hind Tissue Histology Preparation

The specimens were fixed in 10% buffered formalin for 2 weeks to allow for bone healing, and gradually dehydrated in a series of alcohol solutions ranging from 70% to 100%. The specimens were embedded in a methacylate-based resin (Technovit 9100, Heraeus Kulzer). The blocks were sectioned, and the sections were stained with hematoxylin and eosin. The amount of bone between threads was analyzed to assess the extent of bone augmentation. The amount of bone between threads was higher in the simplified-drilling protocol group compared to the conventional-drilling protocol group, showing no significant differences for both groups, indicating that the simplified-drilling protocol is as effective as the conventional-drilling protocol.

Discussion

The present study addressed the evaluation of conventional and simplified drilling protocols in an attempt to find out which one was more effective in promoting osseointegration. The amount of bone between threads was analyzed to assess the extent of bone augmentation. The amount of bone between threads was higher in the simplified-drilling protocol group compared to the conventional-drilling protocol group, showing no significant differences for both groups, indicating that the simplified-drilling protocol is as effective as the conventional-drilling protocol.

Conflict of Interests

The authors of this work disclose no conflict of interests.
Acknowledgment
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References


Figure 3 Figure 4

Histologic evaluation showed that at (a) 1 week, initial woven bone formation occurred in the regions between rows. (b) At three weeks, an increase in the amounts of woven bone formation occurred in the regions between rows. (c) At five weeks, the woven bone formation was observed to reorganize into lamellar bone trabeculae, as showed in

Replacement of woven bone by lamellar bone was ob-

served for all groups evaluated at 5 weeks (arrows).

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