Evaluation of Short-Term Success Rate of Pterygoid Implants Placed With or Without Surgical Guide

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ABSTRACT

Background and Objectives: Pterygoid implants represent an alternative approach for rehabilitation of posterior maxilla, and it challenges the standard procedures such as sinus lifting which has high morbidity and long healing time. There is limited data in the literature regarding the use of surgical guide to increase the success rate of pterygoid implants. Therefore, this study compared the results of pterygoid implants placed with or without surgical guide. In addition, evaluation of the effect of smoking on the success rate of pterygoid implants was a secondary aim.

Methods: A prospective interventional study in which patients receiving free-hand (without surgical guide) pterygoid implants, designated as control group (12 participants, 19 implants) was compared to patients receiving guided pterygoid implants (9 participants, 11 implants). In both groups, standard two-piece implants were used. Osteointegration was tested clinically by reverse torqueing at 25 N/cm after 3 months from surgery.

Results: In the free-hand group,18 implants osseointegrated with 1 implant failed, and in the guided group, 9 implants osseointegrated with 2 implants failed. There was no statistically significant difference regarding implant success rate between the two groups. In addition, smoking did not show statistically significant correlation with implant success.

Conclusion: Both groups showed high but similar success rate. As surgical guide did not increase the success rate of pterygoid implants, surgeons need to consider cost/benefit analysis of guided surgery in pterygoid implants. In addition, smoking did not result in increase of pterygoid implant failure, making its use within these patients recommended.

Keywords: Pterygoid, Dental Implant, Posterior Maxilla, Guided Implant Surgery, Rehabilitation, Smoking.

INTRODUCTION

Prosthetic rehabilitation of edentulous posterior maxilla using dental implants presents a challenging clinical scenario because of deficient alveolar bone quality and quantity in this region. Posterior maxilla usually has lower bone density [1], and alveolar bone resorption with maxillary sinus pneumatization after tooth extraction reduces the bone volume significantly. Consequently, Implants placed in the posterior maxilla generally have a lower success rate compared to other sites [2].

Standard rehabilitation techniques to manage atrophic posterior maxilla use three different approaches either individually or in combination: prosthetic compromises, implant site development, and short implants. However, each of these options present several disadvantages:

Prosthetic compromises include; short prosthetic bridge and hybrid bridge which decrease the masticatory force on the anteriorly placed implants but are less functional and have lower esthetics. Alternatively, posterior cantilever provides more function and esthetics but increases the force on the anteriorly placed implants [3]. Implant site development using bone grafts and sinus lift procedures increases patient morbidity, increases healing time, requires greater cost, and are generally technique sensitive which require long learning curve. Short implants are presented as an alternative option to the above procedures, but their survival rate show higher variability and lower predictability as compared to longer implants [4]. Additionally, long term prosthetic and biological complications are to be expected if the above procedures are not adequately performed.

Implants anchored outside maxilla such as pterygoid implants present an alternative approach to overcome the limitations of posterior maxilla (figure 1). Pterygoid implants are placed through the maxillary tuberosity to engage the dense cortical bone formed by the pyramidal process of the palatine bone and the pterygoid process of the sphenoid bone (figure 2) as described by Tulasne [5]. In addition, Pterygoid implants have a 94.87% survival rate [6] and low complication rate, with implant displacement been the most serious one [7].

Individualized CBCT treatment planning of pterygoid implants is necessary for the following two reasons; first, angle of implant placement anteroposteriorly and buccopalatally is variable as pterygomaxillary region shows difference of the morphology of bone corroider created between maxillary tuberosity, pyramidal process and pterygoid process [8], and the degree of maxillary sinus pneumatization affects this morphology as well. Second, variation in bone density is

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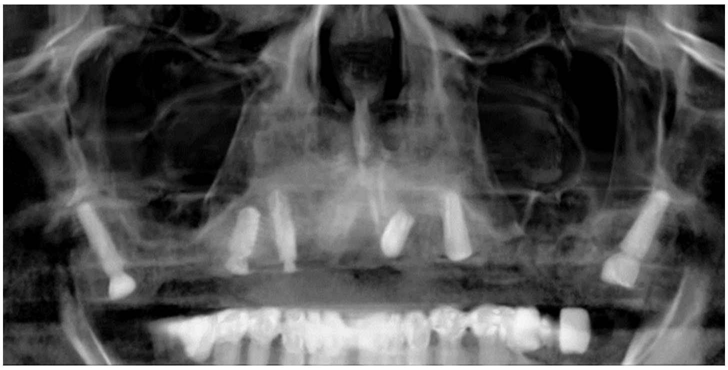

Figure 1: Shows Pterygoid implants to overcome the limitations of bone quality and quantity of posterior Maxilla

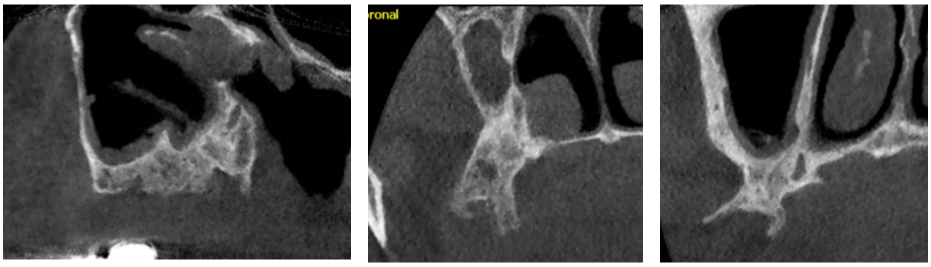

Figure 2: CBCT shows the anatomy of the maxillary tuberosity with the dense cortical bone formed by the pyramidal process of the palatine bone and the pterygoid process of the sphenoid bone

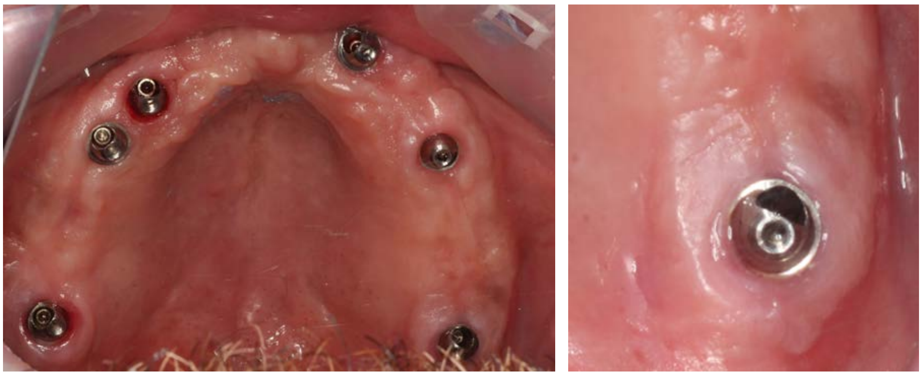

Figure 3: Clinical emergence of pterygoid implants in the third molar position

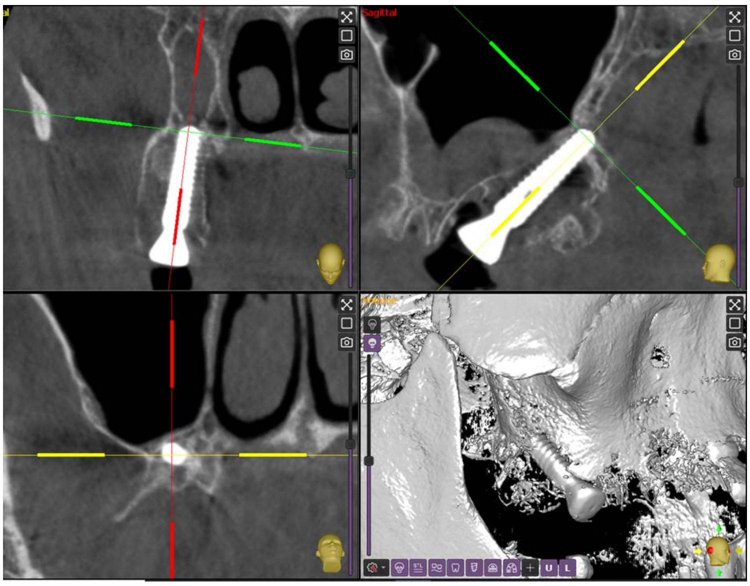

Figure 4: CBCT shows the technique of pterygoid implant placement in this study

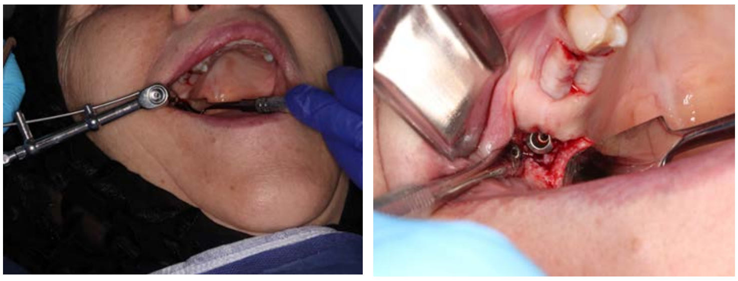

Figure 5 : Free-Hand Placement of Pterygoid Implant with 80 N/cm torque achieved

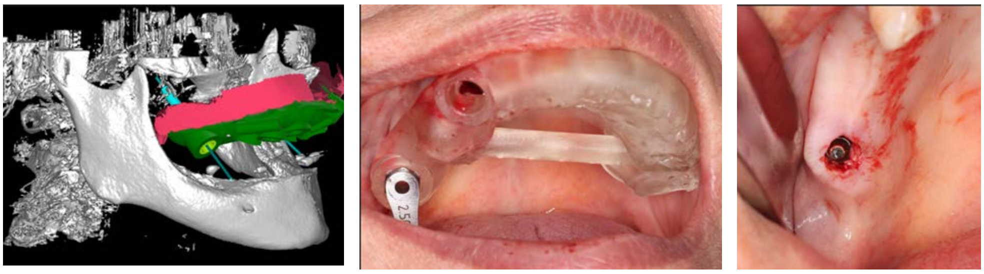

Figure 6: The use of surgical guide to place pterygoid implant

present according to age, gender, and dental status [9], which may alter the treatment plan.

The correct 3D positioning of implants within the preplanned bony contour significantly increases the success rate of osseointegrated implants [10]. Guided implant surgery through the fabrication of surgical guides aims to achieves this purpose. However, Guided surgery needs to be strictly controlled as many steps are involved in its fabrication, and inaccuracies can result in poor outcome.

There are limited number of researches in the literature regarding the use of surgical guides in pterygoid implant placement [11] and the effect of smoking on the success rate of pterygoid implants. As such, the aim of this study was to evaluate the short-term success rate of pterygoid implants when placed free handed (without surgical guide) or placed using a surgical guide. In addition, the effect of smoking on the implant success rate was a secondary aim.

METHODOLOGY

This research protocol was reviewed and approved by the Scientific Ethics Committee of the Kurdistan Higher Council for Medical Specialties (approval number 1995, date 2/11/2022).

This study included 21 patients with a total of 30 pterygoid implants placed. The patients were divided into two groups. In group A, Pterygoid implants were placed in a free-hand approach (without surgical guide), and it included 12 patients (8 females, 4 males) with a total of 19 implants placed. In group B, Pterygoid implants were placed with a surgical guide, and it included 9 patients (5 females, 4 males) with a total of 11 implants placed. The mean age of the participants was 51 years. The patients included were completely edentulous or partially edentulous, and a unilateral or bilateral pterygoid implant where used as part of over all treatment plan. Patients were informed about the study and put into either group A or group B based on their preference. In addition, consent was taken from all the participants. Patients who were smokers were advised to decrease or stop smoking but none of them changed their smoking habits.

Patients were excluded if they did not have enough bone to place an implant, uncontrolled systemic diseases, received chemo or radiotherapy to the area. In addition, intraoperatively implants achieving torque of less than 25 N/cm where not included in the study.

Clinical examination performed and preoperative CBCT was taken for all the patients, based on which ideal pterygoid implant placement was planned using the ImplaStation software by (ProDigiDent, USA). The planed placement was mostly for the implant to emerge from the third molar position (figure 3), and to engage the dense pillar of bone formed by the pyramidal process and pterygoid process of sphenoid bone (figure 4). Implant placement in the free-hand group was done based on the clinical correlation with the CBCT planed implant (figure 5). In group B, surgical guide was fabricated which were either soft tissue or teeth supported using Implastation Software (figure 6).

In both groups, Local anesthesia (2% lidocaine with adrenaline 1:100000) was infiltrated subperiosteally in the buccal vestibular mucosa in the third molar apex position, and supra periosteal in the palatal mucosa near the greater palatine foramina. A flap was raised in group A but flapless approach was used in group B. An initial pilot drill of 1.5 mm (or 2 mm in guided group) was used until the resistance from the dense cortical bone was reached, then a further 3 mm drilling was done. The pilot drilling was done at 700 RPM and 35 N/cm torque with copious irrigation. After that subsequent drills were used but the osteotomies were under drilled by two drill sizes to provide high primary stability. BT SAFE Bone Level Implant (BTK, Vicenza, Italy) where used either 4.1 mm or 4.8 mm diameter, and Implant length ranged from 12 mm to 18 mm.

A gingival former torqued to 25 were attached to the implants, and none of the implants where immediately loaded. After a healing period 3 months, the implants where clinically tested for osteointegration by torqueing and revers torqueing the implants at 25 N/cm. Where the implant succeeded only the gingival former was removed, but where the implant failed both the gingival former and implant come out together.

RESULTS

A total of 21 patients participated in this study, 13 females and 8 males. The patients age ranged between 40 to 75 years, and 9 patients were smokers. The distribution of gender, age, and smoking habit across the two groups is shown in Table 1.

In group A, a total of 19 implants placed, 18 implants successfully osseointegrated and 1 implant failed. in group B, 9 implants successfully osseointegrated and 2 implants failed. The failed implants occurred in three female patients, nonsmokers, aged 40, 50, and 72. Table 1. One implant in the free-hand group and two implants in the guided group could not be placed due to lack of primary stability, and were excluded from the study.

Table 1. Distribution of gender, age, and smoking across the two groups with number of implants placed and the success rate.

Patients characteristics		Free-Hand	Guided
Gender	Male	4	4
	Female	8	5
	Total	12	9
Age mean		51	51
Age range		40 to 75	44 to 72
-Smoking	Non-Smoker	7	4
	Smoker	5	5
Number of implants placed		19	11
Number of implants osseointegrated		18	9

Statistical analysis was done using IBM SPCC Statistics version 29.0 (IBM, SPSS Inc, Chicago, USA). A P-value < 0.05 was considered statistically significant. There was no statistically significant difference regarding implant success rate between the free hand group and guided group using Mann–Whitney U test. Smoking did not show statistically significant correlation with implant success rate. Furthermore, gender, age, implant length, and diameter did not show statistically significant correlation with implant success rate.

DISCUSSION

Placement of pterygoid implants is a challenging procedure because of the difficult anatomy of this region with decreased surgical access in the posterior area of the oral cavity. Guided surgery has been shown to increase implant success rate owing to a more precise implant placement with the preplanned bony contour [10]. Therefore, the aim of this study was to examine whether guided surgery will increase the success rate of pterygoid implants as well. However, the results showed that there was no significant difference in short term success rate when pterygoid implant placement was done in a free-hand approach or with guided surgery. These results are similar to previous study comparing free-hand to guided pterygoid implants placement [11]. Guided surgery requires multiple steps in its fabrication which must

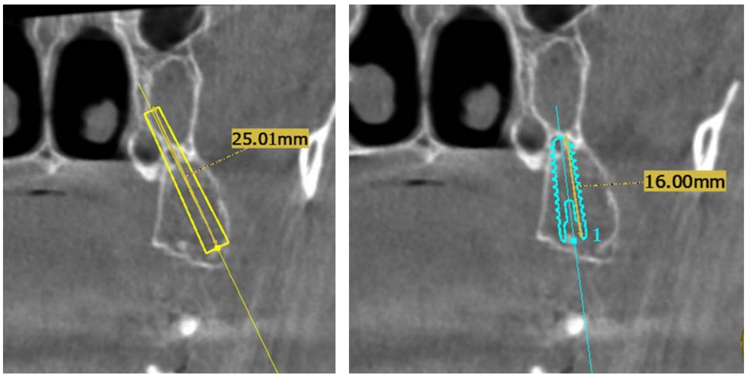

Figure 7: Shows the use of long implants to engage the medial pterygoid plate could lead to complications such as trauma to the muscles, and the implant could emerge in unfavorable position biologically and prosthetically, as opposed to a shorter implant engaging only the Pterygoid apophysis.

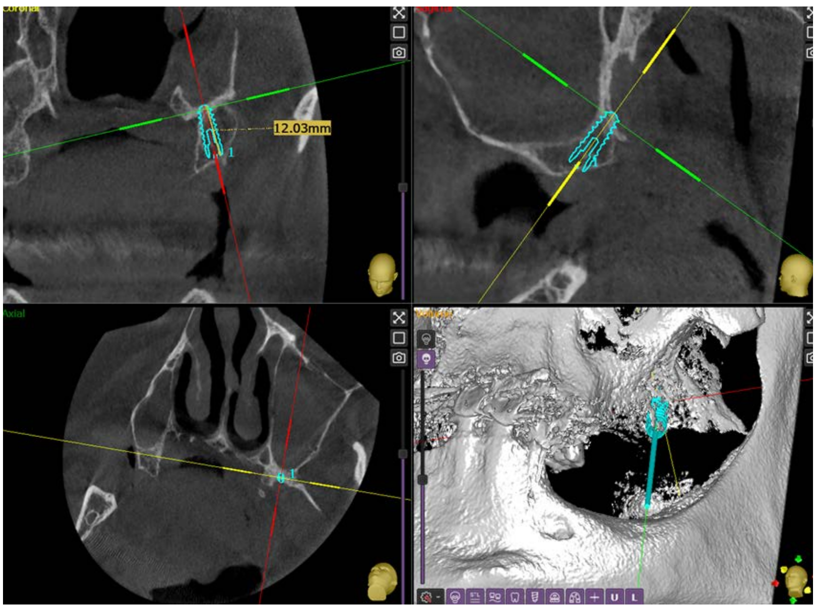

Figure 8: Shows A 12 mm implant to be sufficient to engage the dense cortical bone in this patient. Therefore, the use of a 13 mm implant that would end in muscle space just to be designated as Pterygoid implant, would be unadvisable.

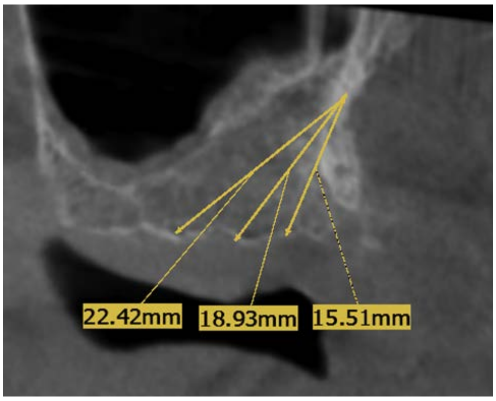

Figure 7: shows the implant emergence crestally dictates the implant length

be strictly controlled otherwise a poor outcome is to be expected. In addition, access becomes more challenging due to the bulk of the guide and the use of longer drills to reach the cortical bone. These two factors might be the reason for the results of the surgical guide group. As such, surgical guide could have a role for initial surgical localization of the implant position, and for prosthetically driven implant placement but the success rate will not be different compared with free hand placement.

The decision to use standard two-piece implants rather than newer pterygoid implant designs was for the following reasons: most research articles on pterygoid implants uses standard two-piece implants with high survival rates [6], and there is a lack of research comparing the success rate of these two implant types. In addition, a standard two-piece implant is lower in cost, making it more applicable clinically for most patients.

The technique of implant placement with engaging only 3 mm of the dense cortical bone as used in this study has the following advantages; it decreases the rate of complications such as bleeding, trauma to muscle, and implant displacement because the drilling is confined within the bony contour. Second, it makes the implant placement as simpler procedure while achieving high degree of primary stability (figure 5). Third, implants could emerge in a more favorable position biologically and prosthetically. Therefore, practitioners using very long implants in the range of 22 to 25 mm needs to provide CBCT evidence of how their implants is positioned (Figure 7).

Some clinicians advocate that the minimum length of pterygoid implant to be no less than 13 mm to engage the dense cortical bone [6 12]. However, this needs further research as the patient's individual anatomy based on CBCT and clinical decision of the operator should guide the properties of the implant. For example, a 12 mm implant may be sufficient to engage the denes cortical bone (figure 8). This point has been substantiated by virtual and clinical pterygoid implant studies [13 11]. In addition, the degree of submergence of the implant is decided by the clinician. For example, a 12 mm implant submerged 2 mm has the same reach as a 13 mm implant submerged 1 mm. Moreover, where the implant emerges crestally dictates the implant length (figure 8). Therefore, the 13 mm minimum implant length might not be accurate and further research is needed to investigate this point.

Smoking has been shown to negatively affect implant success rate especially in the long term [14]. However, the results of this study showed that smoking does not have a negative effect on the short-term success rate, and follow up of the patients who smoke within this study up to 1 year (results not reported within this study) showed no implant complications within these patients. These results could be due to the thick keratinized mucosa in the tuberosity area counteracting the negative effect of smoking.

CONCLUSION

The result of this study showed that the use of surgical guide did not increase the short-term success rate of pterygoid implants as compared to free-hand placement. Therefore, surgeons need to consider cost/benefit analysis of guided surgery in pterygoid implants. In addition, smoking did not result in increase of pterygoid implant failure, making its use within these patients recommended.

Authorship Contribution: RSA and SAH developed the project idea. RSA performed the surgeries under the supervision of SAH. The work has been read and approved by all authors.

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Availability of data and materials: The datasets used and analyzed during the current study are available from the corresponding author upon reasonable request.

Potential Conflicts of Interest: None

Competing Interest: None

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