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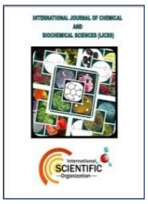

Simplified Approach for Implant Placement Using Trephine Bur: A Mini-Review

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Abstract

Contemporary implantology emphasizes the importance of achieving an optimal three-dimensional implant position, as prosthetically driven placement is a critical determinant of long-term therapeutic success. Computer-assisted implant surgery facilitates precise implant positioning through preoperative virtual planning using advanced interactive software and the fabrication of static surgical guides. Various drilling protocols are employed during guided osteotomy preparation, including conventional sequential drilling, pilot-guided techniques, and the recently introduced trephination-based approach. Trephination-based guided implant placement represents an innovative, partially guided protocol for osteotomy preparation. This two-step technique involves the initial use of a trephine drill through a sleeveless surgical guide, followed by the application of the final drill from the conventional drilling kit corresponding to the selected implant system. The guided trephination protocol is designed to streamline the osteotomy process, reduce operative duration, and potentially mitigate postoperative morbidity. Therefore, trephination-based guided implant placement could be a valid alternative to conventional guided surgery.

Keywords: Guided surgery, Guided trephination, Surgical guide, Trephine drill, Computer-guided implant surgery

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1. Introduction

1.1. Prosthetic-driven implant placement

Modifications have been made over the years to address dental implant success. The development of lifelong implant restorations with healthy, natural-looking peri-implant soft tissues has taken priority over implant survival [1]. Proper implant positioning provides long-term tissue stability, optimal occlusion, prosthetic benefits, and simplicity of oral hygiene maintenance. Ideal placement can prevent surgical complications like nerve injury, sinus perforation, and prosthetic difficulties [2].

1.2. Computer-guided implant surgery

Computer-assisted implant planning (CAIP) and computer-guided implant placement (CGIP) protocols enable integration of three-dimensional (3D) computed tomography data into software programs for more accurate implant planning. The planned implant position is then transferred to the patient using individually fabricated surgical guides [3]. In the field of implant dentistry, the term "guided surgery" refers to a digital workflow that starts with the collection of information about the patient's future prosthesis, continues with its digital processing through virtual planning software, and concludes with the creation of a surgical guide [4]. The use of guided implant surgery helps surgeons to carry out quicker, more accurate, and minimally invasive procedures while placing implants precisely in the preplanned ideal position. Furthermore, it has many benefits, including facilitated surgical procedures, reduced surgical intervention time, facilitated immediate loading protocol, treatment of medically compromised or anxious patients, and reduced postoperative morbidity and discomfort [5].

1.3. Drilling techniques

Implant drilling is a critical phase in the surgical technique. It is advised to use a minimally invasive technique to ensure a predictable osseointegration and aesthetically pleasing natural implant restoration. Furthermore, it is well known that the sequence of drilling has an impact on the success rate of dental implants. The crucial step in the surgical protocol of implant placement is the drilling process. Furthermore, it is well known that the sequence of drilling has an impact on the success of dental implant therapy. Sequential drilling is a well-established technique for the implant site preparation that involves using a sequence of drills with increasing diameter. A small diameter pilot drill is used to prepare osteotomy at first, and then it is subsequently widened with a series of bigger drills [6]. The sequential drilling technique with increasing drill diameters has been the most widely used the drilling method for implant osteotomy preparation [7]. The use of several drills allows for the angle adjustment if needed; however, this sequence increases length of the procedure, risk of infection and postoperative pain [8].

Therefore, it has been suggested to simplify the drilling procedure for the benefit of both the patient and the surgeon [9]. Simplified drilling techniques allow for simpler and faster osteotomy preparation by lowering the number of drills utilized during implant preparation procedure. A simplified single-step drilling protocol has been evaluated in several studies, the technique utilizes only one drill, the final diameter drill, for the entire drilling process [7-11]. Another method of simplifying the drilling process is a two-step simplified drilling technique, which consists of two drills: pilot drill and final diameter drill. This technique suggested that implant site preparation could be easier and simpler, which would save time and effort [12]. Since fewer steps in drilling technique does not have a detrimental effect on success, simplifying site preparation might be advantageous for both professionals and patients [8-13]. The most common limitation of simplified technique is that there is no chance for angle correction, which may demand a steeper learning curve [12]. To overcome such limitations, a study conducted in 2018 recommended using simplified protocols with the assistance of guided surgery [14].

2. Review of Literature

Trephine drills are widely used in implant dentistry for osteotomy preparation, offering improved stability, positive long-term outcomes, time-saving benefits, bone preservation, minimal trauma, and ease of use compared to conventional drills [15]. A hollow, cylinder-shaped tool with a serrated cutting end that forms a cylinder of bone in the osseous site is called a trephine drill [16]. The trephine drills are mainly used for bone harvesting and biopsy due to their hollow design [17] Figure 2. In the context of implant dentistry, trephine drills are routinely employed for the explantation of osseointegrated fixtures. These instruments, characterized by their hollow cylindrical design and an internal diameter marginally exceeding that of the implant, are particularly indicated in scenarios involving fractured implants or abutments, as well as cases where removal torque surpasses 200 Ncm, Figure 1. Although trephine-based osteotomies are inherently more invasive and often necessitate mucoperiosteal flap elevation, the technique remains relatively straightforward.

Moreover, it offers a cost-effective alternative by obviating the need for specialized implant retrieval kits [18-19], Table 2. Emerging evidence supports the clinical viability of trephine drills for implant site preparation, demonstrating non-inferiority to conventional sequential drilling protocols. A prospective in vivo study reported no statistically significant differences in peri-implant bone loss, gingival inflammation, implant stability, or masticatory impairment at one year post-placement when comparing trephine-based osteotomies to traditional drilling techniques [20]. Complementing these findings, an in vitro investigation was conducted to quantify bone loss within cortical and medullary compartments during osteotomy preparation using standard versus trephine drills. Cone Beam Computed Tomography (CBCT) was employed to assess volumetric bone removal at the osteotomy sites. The results indicated that trephine drills were associated with reduced bone loss relative to standard drills. This phenomenon was attributed to accumulation of dense cortical bone within the trephine lumen, which effectively blunted cutting edge following cortical penetration [21].

Consequently, the trephine functioned more as a cylindrical compactor, inducing lateral condensation of marrow rather than active removal, thereby preserving medullary architecture [21].

Nowadays, in the era of computer-guided surgery, a new technique that utilizes the trephine drill with a surgical guide has been developed. The guided trephination protocol was described at first as an approach for computer-guided implant removal. Osseointegrated implants need to be removed if the screw is broken or the implant is misplaced. For precise implant removal, trephination and computer-aided planning using a 3D-printed guide can be used. This technique may obviate the necessity for flap elevation, reduce osseous tissue resection and permit the immediate replacement of the failed implant [22]. To overcome the limitations of sequential drilling procedures in guided implant surgery, a novel method of guided osteotomy preparation involving trephination was developed. The trephination-guided approach was designed to minimize the number of drills utilized, control the angulation and width of the trephination osteotomy, and enable the cross-utilization of different implant systems [23], Table 1.

Figure 1: Trephine Bur of 2.8 mm diameter

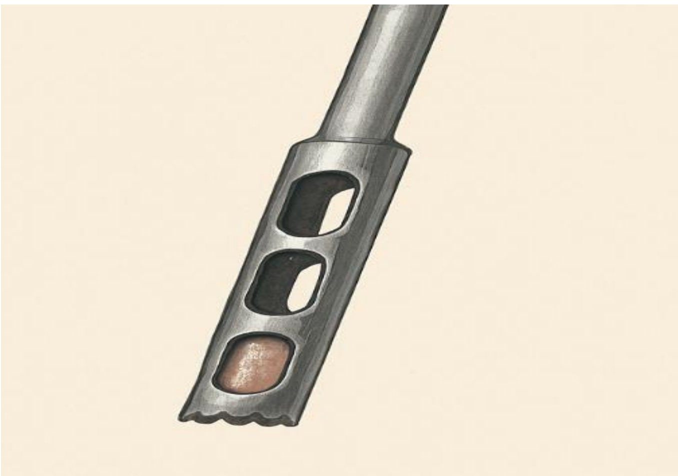

Figure 2: illustration showing trephine bur with autogenous bone

Table 1: Advantages of simplified approach using Trephine Bur

1	Simplify the drilling sequence
2	Reduce the surgical time and post-operative discomfort
3	Allow cross-utilization of different implant systems
4	Reduce the cost
5	Simultaneous autogenous bone harvesting

Table 2: Literature Review (studies on the utilization of trephine bur for implant placement)

	Study type	Title
1 [15]	Clinical	Utility of Trephine Drills in Implant Dentistry
2 [21]	In vitro	Comparative study to evaluate bone loss during osteotomy using standard drill, bone trephine, and alveolar expanders for implant placement
3 [23]	Clinical	Trephination-based, guided surgical implant placement: A clinical study.
4 [26]	In vitro	In Vitro Comparison of Time and Accuracy of Implant Placement Using Trephine and Conventional Drilling Techniques Under Dynamic Navigation

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3. Conclusions

Implant placement utilizing guided trephine bur represents a clinically viable and technically simplified alternative to conventional guided surgery protocols. This approach enables accurate implant positioning with minimal deviation across vertical and horizontal dimensions. The use of trephine drills demonstrated comparable precision. Importantly, the protocol facilitates cross-compatibility with multiple implant systems and accommodates anatomical constraints such as limited vertical access or restricted mouth opening.

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