Original Article - Evaluative Study

Drill Bit Guiding System for Implant Placement

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Abstract

Introduction: The implant angulation plays a very important role in the outcome of prosthetic and functional outcome. The conventional surgical stents uses a ring system to drill the pilot drill, only the CAD printed stents provides a guide sleeves for the sequential drill for implant placement. **The Purpose of this Study:** The purpose of the study was to fabricate a drill bit guide for the stent to transfer the angulation and implant placement planned using conventional method in prescribed drilling sequence. **Material and Methods:** A surgical stent with a threaded guide ring system was fabricated with internal drill bit guiding system. The interchangeable sequential drilling allows the drill bit to be in predetermined position throughout the procedure. **Results:** The surgical stent with the drill bit guiding system provided less than 1% error with a mean deviation of 0.48%. **Conclusion:** The drill bit guide fabricated has a complete limiting system and transfers the angulation and placement as desired with very minimal or no alteration, which enables the predetermined prosthetic outcome.

Keywords: Drill bit, implant, stent

Introduction

The implant angulation plays a very important role in the outcome of prosthetic and functional outcome. A surgical stent is a template which not only assists in diagnosis and treatment planning but also facilitates in proper positioning and angulation of the implant in the bone.[1,2] A dual-purpose stent is a template that carries both clinical and radiographic information of the fixture angulation and location, and transferring the information from the surgical template or stent leading to successful implant placement.[3] The conventional surgical stents use a ring system to guide the pilot drill; only the computer-aided design (CAD) printed stents provide the guide sleeves for the sequential drill for implant placement. The disadvantage of CAD splints is two-handed operation. Transferring the angulations for implant placement is important for the selection of abutment and the determination of bone grafting procedures and cost for patient. There are various types of splints fabricated in laboratory with guide sleeves, which allow the operator to have a limited utilization in transferring the planned angulations and the prosthetic procedures. The laboratory modified guide rings allow proper transfer of angulations planned with less error during surgical implant placement which allows the surgeon, periodontist, and prosthodontist to plan for immediate prosthetic replacement utilizing CAD-CAM guided navigation surgery. The aim of this study was to evaluate the drill bit guide ring use in transferring the specific angulation determined on splint and to study the clinical applications of extended treading.

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Materials and Methods

The drill bit guiding system

The guide tube ring system has an outer two core ring (6 and 7 mm diameter) with a length of 5 mm, which has a polished outer surface and a 1 mm threaded internal surface [Figure 1]. The inner tube rings have a sequential system as the drill bit diameter which has an inner smooth surface and threaded outer surface. The inner surface of the tube has 2.1, 2.7, 3.6, and 4.4 mm diameter holes, [Figure 2] which allows the drill bit to pass on. The inner guide tube has a split slot on the upper surface which allows the screwdriver to tread the ring into the outer tube ring. The inner tubes are available in 5 mm, 8 mm, and 10 mm length [Figure 3]

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Figure 1: Surgical stent guide outer ring

Figure 3: Drill bit guide of different lengths (6, 8, and 10 mm)

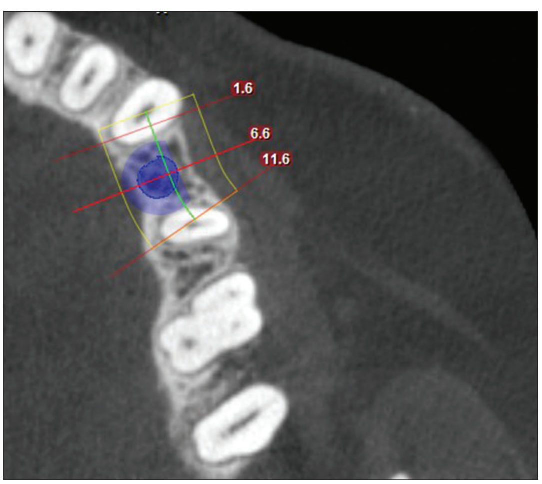

Figure 5: Entry point of implant planning on cone beam computed tomography

which allows the operator to adjust the length from the outer surface of the guide ring to the bone. The inner drill bit guide tube can be adjusted up to 1–8 mm away from the guide ring in the splint. All the components are made of medical grade stainless steel which allows them to be sterilized and be used again.

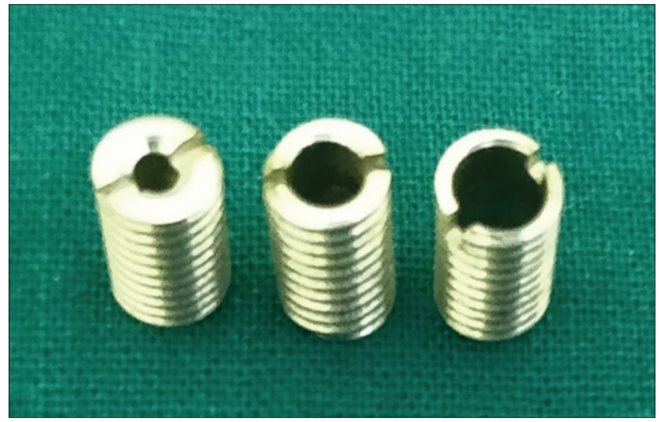

Figure 2: Drill bit guide with different internal diameters (2.1, 3.6, and 4.4 mm) of inner rings

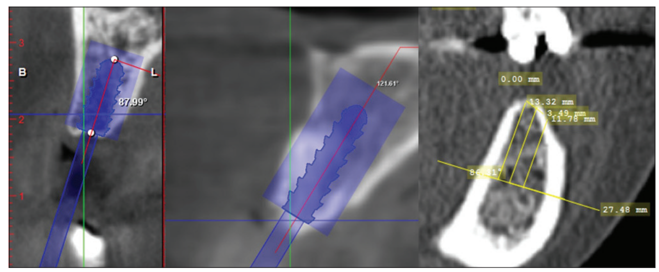

Figure 4: Implant angulation planning in cone beam computed tomography and computed tomography

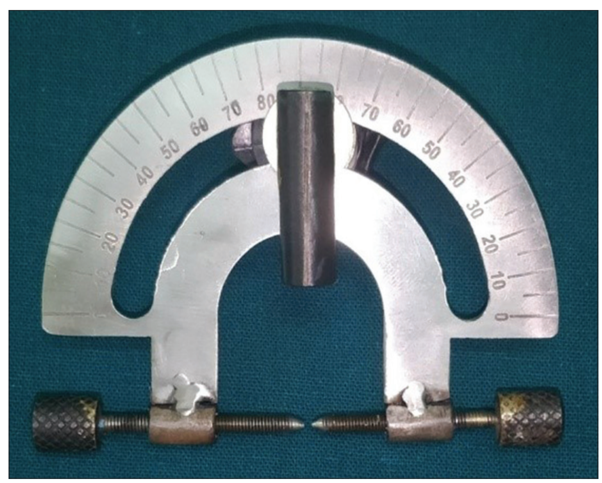

Figure 6: Angulation transfer device

In our study, the predetermined *in vivo* and *in vitro* placement of implants was studied for transferring the cone beam computed tomography (CBCT) planned angulation to the dental models. Clinical evaluation and radiographic analysis using CBCT was done to determine the angulation [Figure 4] and placement of implant [Figure 5]. The angulations planned on the CBCT was transferred to model using SRDC-dental implant surgical guide (DISG) a patent pending design (design no: 201741044809) [Figure 6], and a thermo press surgical splint [Figure 7] was fabricated with the drill pin guide system. The drill pin guide

Figure 7: Surgical splint with drill guide pin

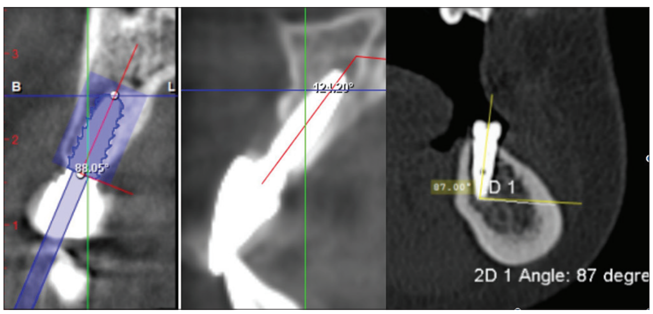

Figure 9: Measuring angulation of implant placed

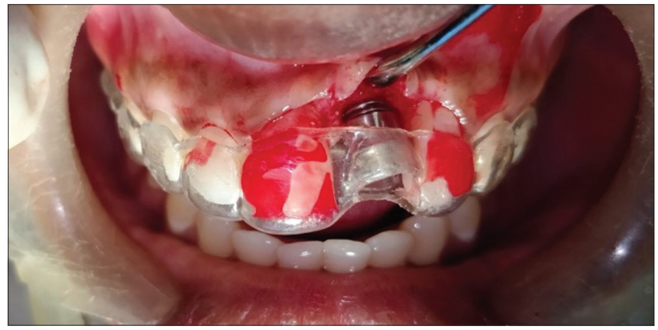

Figure 8: Drill guide pin extended during surgery

Figure 10: Entry point evaluation after implant placement

was used to transfer the measurements by extending the thread up to the osteotomy site [Figure 8] for accurate placement of implants at the planned osteotomy site [Figures 9 and 10]. The drill bit guiding system was used as an accessory to achieve the results. The study was performed in partially edentulous alloplastic models using 10 dummy implants followed by three clinical patients in maxillary anterior, maxillary premolar, and mandibular molar area to evaluate transferring accuracy of the planned implant angulation with the drill bit guiding system.

Results

The results of the placed implants in the model were analyzed using Student *t*-test, which showed a mean deviation of 0.48%, which was <1% error [Tables 1 and 2]. Clinically, three implants were planned with 86.81°, 121.61°, and 87.99° angulation and we achieved 87°, 121.20°, and 88.05° angulation, respectively.

Table 1: Determined and achieved angulations

Tooth number	Determined	Achieved	Percentage error
26	103.04	103	0.038
15	80	80	0
16	70	70	0
35	98.88	97.86	1.03
36	90	90	0
32	102.06	102.94	−0.086
36-I	96.47	96.40	0.072
34-I	110.02	110.65	−0.57
32-I	111.46	111.45	0
41-I	117.43	117.43	0
Average	97.94	97.97	0.048

Discussion

Achieving the planned angulation and predetermined prosthetic outcome has always been a tough play with conventional placement of implants. There are various methods used to transfer the determined angulations for transfer from clinical and radiograph using devices such as surveyor, modified surveyor table, and positioner perforation guide[4-6] in which the positioner perforation guides have less error transfer.[7]

The common method followed for determining the distance and position of the implant is by transferring the buccal and gingival intersection of the radiopaque tooth measurements and the buccolingual inclination of the implant by sectioning of cast.[6]

In our study, we used a SRDC-DISG to transfer the angulations determined by CBCT. The accuracy of the implant placement for the determined angulation was 0.048% with a standard deviation of 0.391. The CAD/CAM stent[8-10] evaluated implant placement accuracy for angulations using a laser probe and showed a mean mesiodistal angle deviation of 0.7 (±5.02)

Table 2: Mean, standard deviations of mean values of determined and achieved angulations and mean percentage difference in errors

	n	Minimum	Maximum	Mean	SD
Determined	10	70	117	97.94	14.606
Achieved	10	70	117	97.97	14.691
Percentage difference	10	−0.57	1.03	0.0484	0.39107

SD=Standard deviation

degree and buccolingual angle deviation of 0.46 (±4.43) degree. The entrance point variation was 0.2 (±0.72) in which 85% implants were within <1 mm from the planned position with a <7 degree deviation on buccolingual and mesiodistal angulation in 88% and 91% placed implants, respectively.[11]

The drill bit guide system can be incorporated in all the basic guide stents categorized as follows: (1) fully edentulous, (2) partially edentulous, and (3) partially edentulous tooth supported design.[12,13] The surgical guide templates are classified based on the amount of surgical restriction as, (1) nonlimiting design, (2) partially limiting design, and (3) completely limiting design. Our drill bit guide system adapts the completely limiting design splint.[14-16] The completely limiting designs are of two designs – cast-based guided surgical guide and CAD/CAM-based surgical guide – which allows limited or no alteration of the planned angulation, and implant placement is based on the radiographic and software transfer.[14,17]

The stent fabricated using the drill bit guide ring in this study is of completely limiting design, which can be adapted to any denture design. It restricts the movements of the operator completely, till the final osteotomy. In a study conducted by Park *et al*.,[17] the drill guides were placed 4 mm, 6 mm, and 8 mm away from the model; the 4 mm occlusogingival height guide allowed accurate placement when compared to 6 mm and 8 mm height guides. Our design of drill bit guide can be screwed down from 1 to 8 mm from the guide ring by the 6, 8, 10 mm threaded sleeves, reducing the occlusal-gingival height. These drill guides reach up to the osteotomy site and nullify the angulations and placement errors of the drill bits. The inner sleeves are changed for each drill bit by a hand-held screwdriver and allow the operator to use a single hand comparing the CAD-based surgical splints which need two-handed operations.

The presence of drill bit guide ring in the stent allows the drill bits to follow the predetermined angulation. An inner drill bit guide, which is threaded to the guide ring, also helps to extend the drill sleeve up to the bone after flap reflection or punch. This helps the drill to start from the planned osteotomy site to maintain the position and angulation.

The advantages of the drill bit guide rings are as follows: straightforward design, economical, can be used in flap or flapless technique, can be modified for any drill system, all parameters can be controlled by the operator, and less time-consuming for implant positioning. The disadvantages are that each guide pin has to be screwed and unscrewed.

Limitation of our study is that we have evaluated the system on a limited number of implants and edentulous situations with good results. The same must be evaluated in different edentulous situations.

Conclusion

The drill guided system can be incorporated in all designs of denture surgical stents. They aid in angulation achievement for implant placement including, determining the primary grafting procedures. Prosthetic rehabilitation can be achieved in a single stage just as in CAD-CAM navigation guided surgery. The advantage of the drill guide system is easy adaptation to any system, economical availability of interchangeable components, sterilization and reusability.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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