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Comparative Evaluation of Implant Placement with Conventional and Digital Surgical Guide Techniques: Two Case Reports

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Abstract

Background: Implant placement using a conventional surgical guide and digital surgical guide techniques is well documented in the literature. The most frequently reported disadvantages of conventional surgical guide placement are lack of accuracy in implant placement when compared to three-dimensional assessment in digital technique. Other factors listed are longer time duration and the need for impression techniques. In this case report, the authors present a comparison between the two techniques and the time taken between both cases one done conventionally and another case by digital technique. **Case Presentation:** For the digital surgical guide, a 44-year-old, male reported with the chief complaint of missing teeth needing replacement was considered. For the conventional technique, a female patient aged fifty-seven who had gone through various dentists with an existing bridge was considered. This patient wanted a good outcome at a reasonable cost. In both cases, molars were missing and needed replacement. The steps for digital flow for a surgical guide and step-by-step conventional methods are both highlighted in this article. **Conclusion:** Hence the digital technique saved time and was accurate when compared to the conventional in our experience.

Keywords

Implant Surgical Guide, Digital Workflow, Accuracy, Implant Placement

1. Introduction

Failures in implant-retained prostheses can be due to the inaccuracy of implant placement technique apart from biological, mechanical, and other patient factors. Developments in digital techniques with the use of intraoral scanning and complete digital workflow made work easier. The clinical practice of dentistry has changed significantly in the past 10 years due to the advances in digital technology. These changes not only have influenced changes in restorative dentistry but also have changed how things are done in surgical practice. A patient may present with multiple missing teeth and dental problems requiring treatment. By utilizing digital imaging and CAD/CAM, treatment options can be more easily evaluated to determine the one that will optimize results.

Many studies have reported the superiority of digital techniques over traditional techniques. De Almeida *et al.* [1] did a study on maxillary molar implant placement with two groups. One group did the guide using the digital technique and the other group placed implants by the traditional guide technique. They observed that the group then used the digital guide which had reduced clinical and operative time. The screw access deviation was also less compared to the other group. Hence the digital procedure had improved efficiency.

In our study, we compared the implant placement between the traditional and digital guide by the same operator to avoid any differences in procedure or time consumption based on individual parameters.

2. Case Report One

In the traditional guide placement technique, a 57-year-old, female patient who had visited many previous dentists for bridge placement wanted a solution to her food entrapment under the bridge thus seeking an implant placement. She wanted a cost-effective treatment with a good outcome. Implant placement was the option, and a traditional surgical guide was planned. Treatment was explained to her, and the consent form was signed by the patient.

Steps Followed in Traditional Technique of Fabricating the Surgical Guide

1) Missing teeth are set up on wax on the primary casts using a tooth replacement template "**Figure 1**".

2) An acrylic resin plate is fabricated by duplication of the waxed-up model "**Figure 1**".

3) The fabricated guide is then checked on the primary edentulous cast, with locating implant pilot drill position "**Figure 2**".

4) Gutta-percha was used as the opaque material to fill the access hole "**Figure 3**".

5) The fabricated guide is evaluated in the patient's mouth for accuracy in fit "**Figure 4**".

6) The implant placement procedure is completed using the acrylic guide

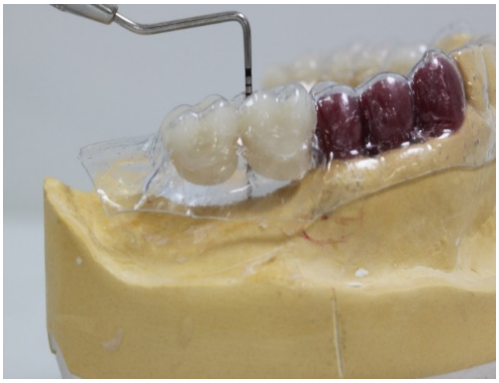


Figure 1. Tooth replacement template.

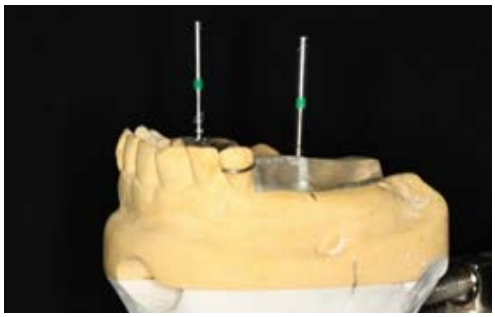


Figure 2. Locating the pilot drill position.

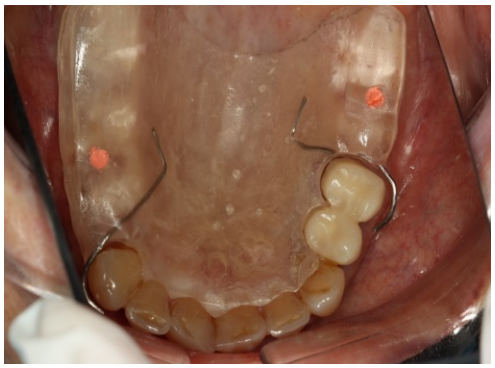


Figure 3. Gutta-percha filling access hole.

Figure 4. Fabricated implant positioning guide.

"Figure 5".

The disadvantages of the traditional techniques include cumbersome lab work requiring skill in the accuracy of fit and technique employed. If during any of the lab procedures the technique was compromised then the accuracy of the surgical procedure is in jeopardy. The conventional technique also depends on the skill of the operator and lab personnel in delivering a good impression to techniques in the fabrication of an accurate surgical guide.

3. Case Report 2 (Digital Technique for Fabricating Surgical Guide)

A 44-year-old male patient reported wanting an implant placed. He had multiple visits with a previous dentist, and he preferred a treatment requiring no impressions as he had a severe gag reflex. He wanted a procedure that avoided multiple dental visits too. Considering all his requests a digital flow for implant prosthesis placement was planned with CEREC Omnicam, Galileos imaging unit, and MCXL milling unit. Consent form was obtained explaining all the treatment options and procedure to be done.

The digital flow consists of the following steps "Figure 6".

3.1. Data Capturing and Treatment Planning

Plan for implant placement, a blueprint is obtained following the principles of "prosthetically driven" implant planning. During the implant planning process,

Figure 5. Implant placement completed.

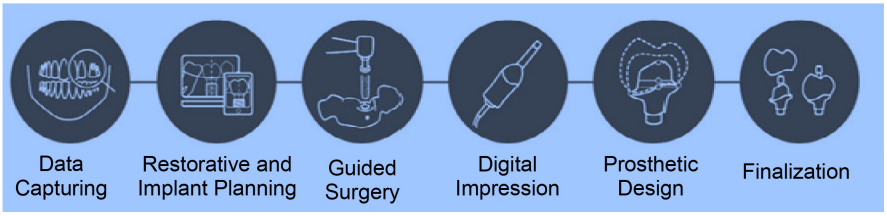
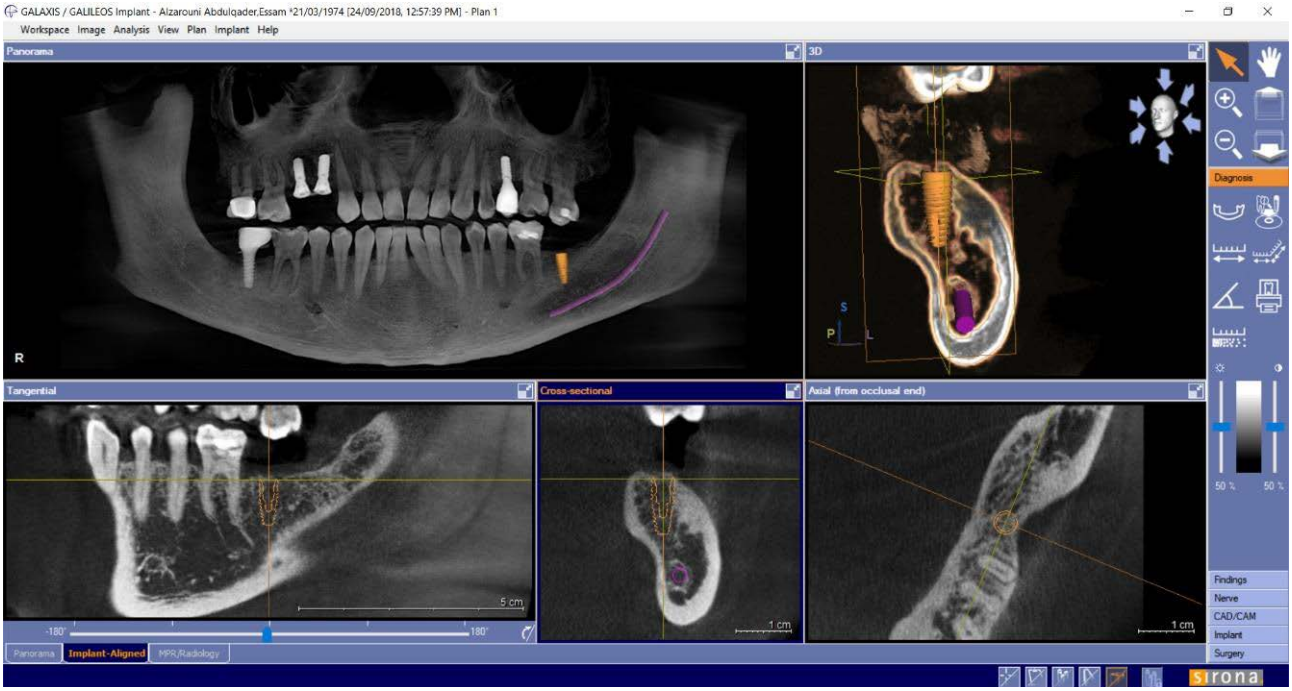
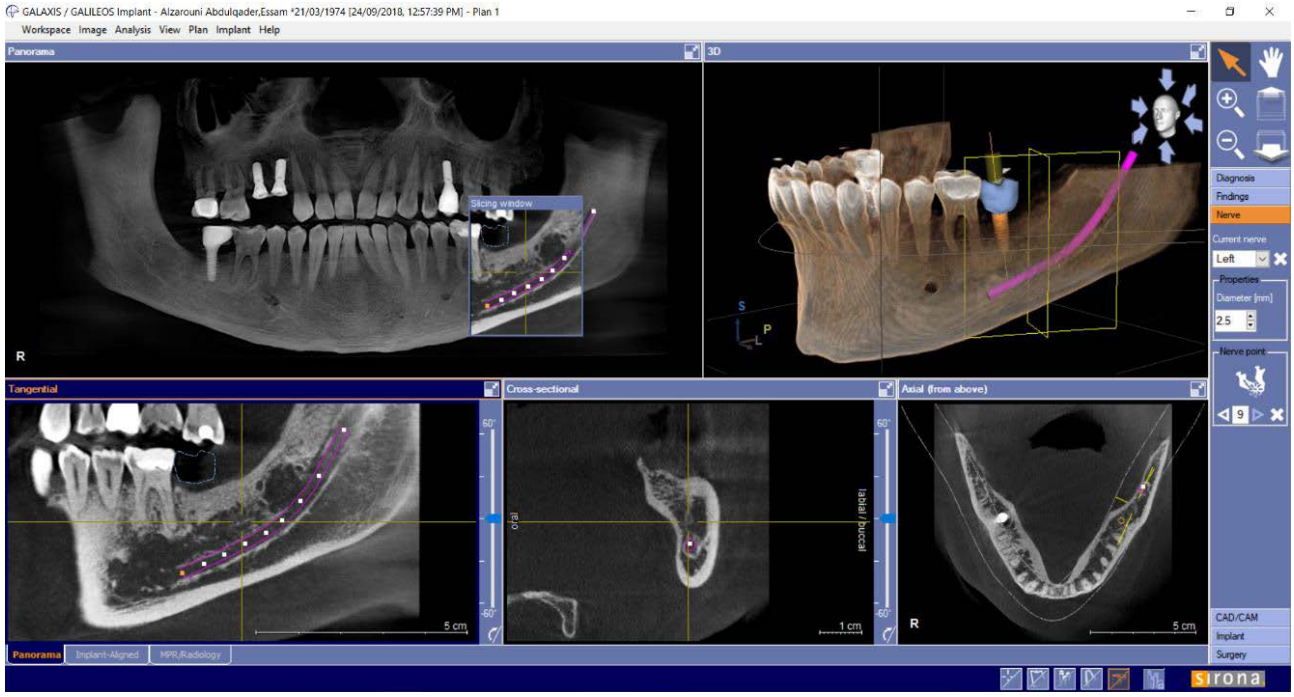


Figure 6. Treatment planning (Digital flow).

the ideal implant fixture position is determined. Digital planning also allows the final prosthesis design to be previewed. The advantages of digital planning include the assessment of bony and soft tissue anatomy, and if there is a need for augmentation or modification, it is determined at the planning stages, rather than during surgery. In conventional techniques when a plan is being developed to replace a missing tooth, the arch form of the adjacent teeth can be used as a reference to design the ideal final prosthesis. In this case, the adjacent lower left first molar is used to determine the arch form to replace the missing lower left second molar in the correct position "**Figure 7(a)** and **Figure 7(b)**".



(a)



(b)

Figure 7. (a): Digital planning for implant placement and Cross-sectional view with proposed implant site. (b) Digital planning for prosthesis design (Future crown proposal in consideration to provide the preferred occlusion).

3.2. Surgical Guide Fabrication

The replica of the tooth to be replaced by the implant is scanned and the design sequence of prosthetically driven restoration to the surgical guide fabrication is planned "**Figures 8(a)-(f)**". The designing stage of the surgical guide is done with CEREC software 4.5. Depending on the case, the guide may be milled or 3D-printed. Critical to the success of this guide is a channel into which a metal guide sleeve, or tube, is inserted. The guide tube is specific to the implant system being used. For implant systems that are fully guided, a specific drilling system is used. This sleeve-in-a-sleeve technique allows for precise control of the position, angulation, and depth of each osteotomy and the implant placed.

CERE Guide block is used in the CEREC MCXL milling unit to fabricate the completed surgical guide. After the designing and making of the surgical guide, the implant-guided surgery steps are planned. The steps are depicted in "**Figure 9**". The planning report is generated using Galileos implant software. This software shows the planned implant placement replacing teeth #3-7 based on the prosthetic plan. Half of the apical dimension of the fixture would be in solid alveolar bone, allowing for good primary mechanical stabilization. In GALILEOS® Implant software (Dentsply Sirona), the optical impression and proposal were imported and then superimposed over the cone beam CT image. Using the digitally proposed final restoration as the blueprint for the final prosthetic result, the ideal position, angulation, and depth for the implant fixture were determined.

Using the digitally planned surgical guide takes very less time compared to the

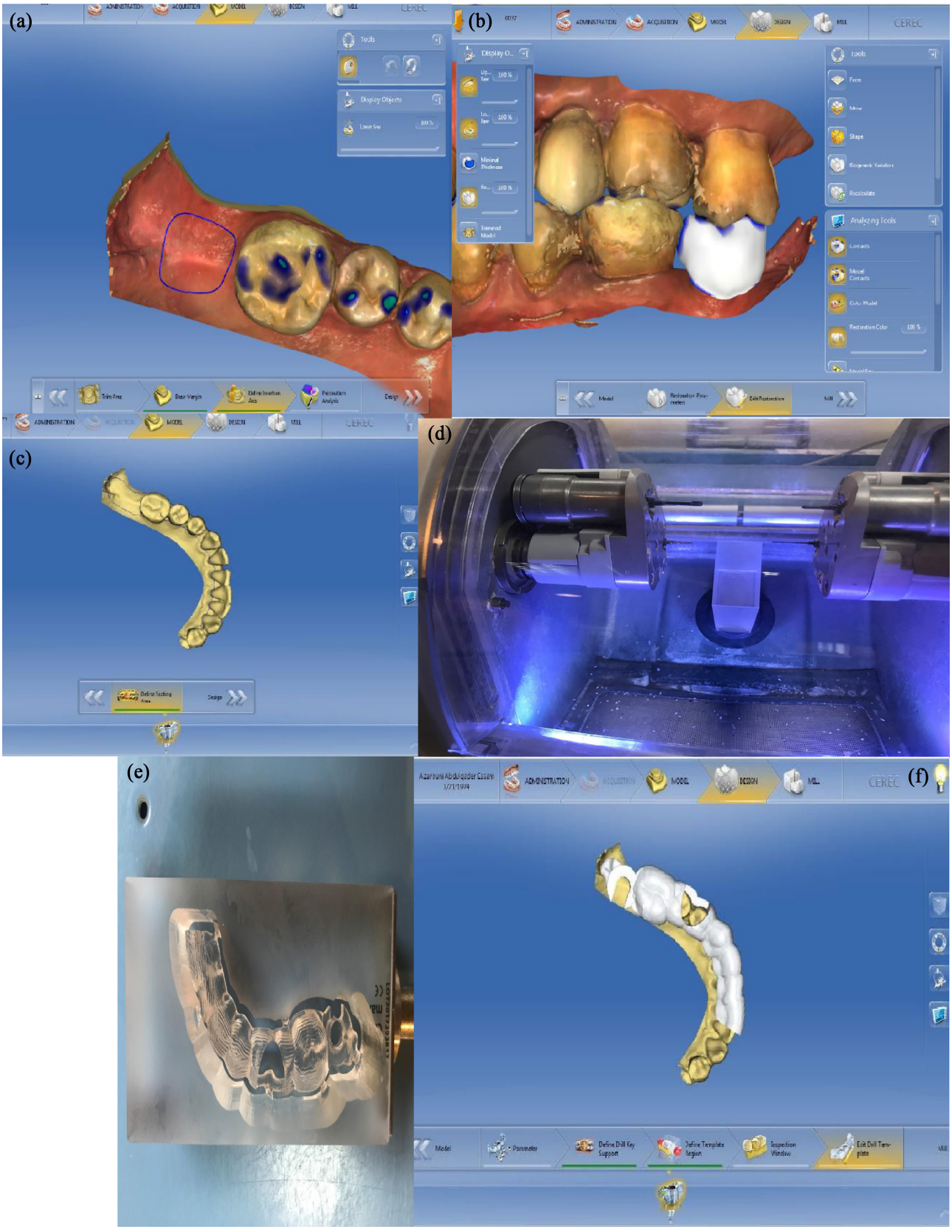


Figure 8. (a): Digital Impression, (b): Tentative prosthesis design. (c): Digital model, (d): Milling of surgical guide (CEREC), (e): Milled surgical guide (inner surface), (f): Final digital surgical guide.

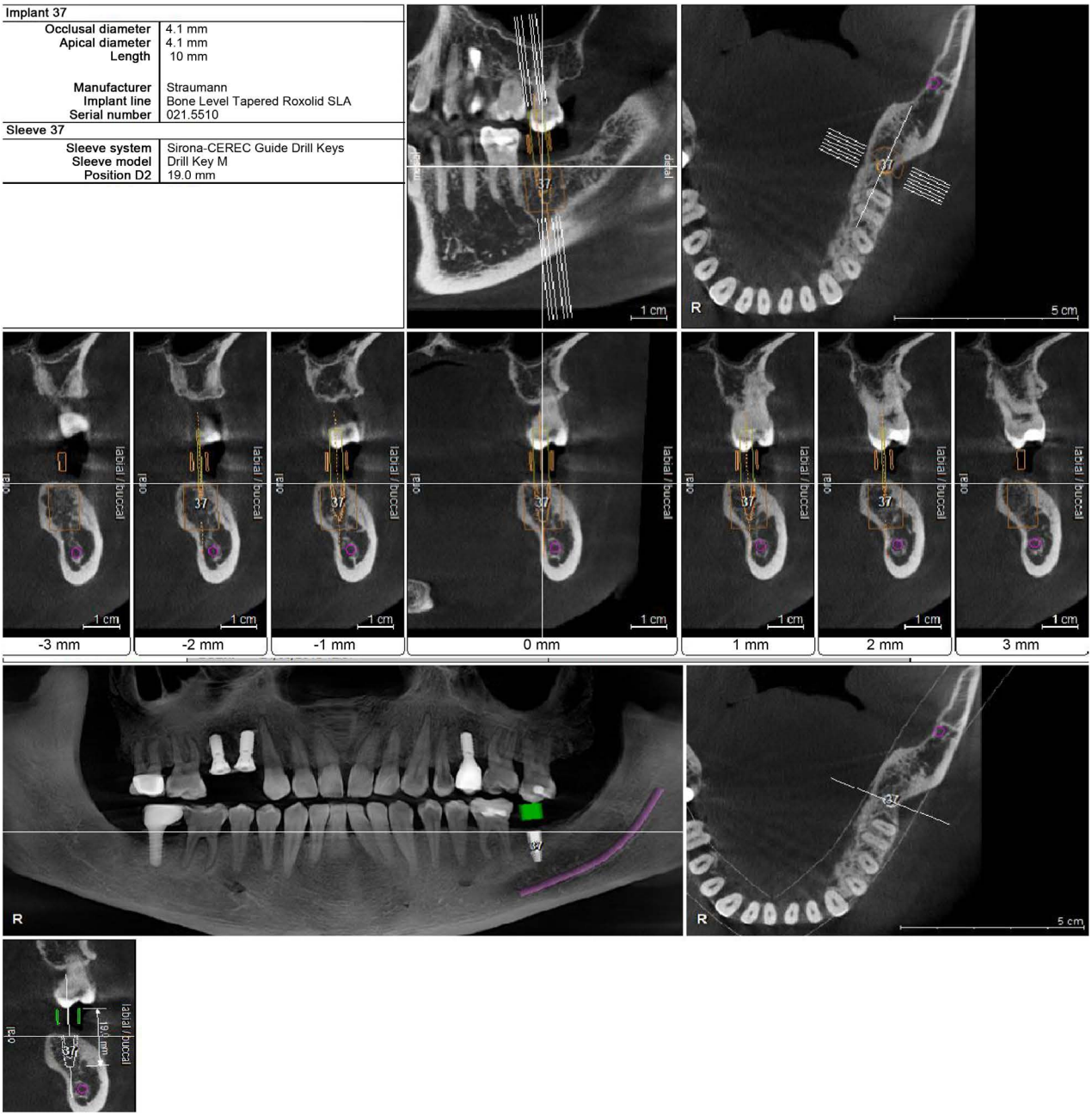


Figure 9. Guided surgery planning steps.

cumbersome conventional surgical guides.

3.3. Surgical Guide and Implant Placement

The fabricated digital guide is placed in the patients mouth to check adaptation and fit "Figure 10".

3.4. Steps in Implant Surgery

The digital surgical guide was used "Figure 10" the surface was smoothed and polished, and the guide drill was inserted, making the guide ready to use.

The least invasive tissue punch flapless technique was used. In this case, Straumann Implant System™ EV 3.6 mm × 15 mm was employed. The guided surgery system uses a sleeve, which fits directly on the drill (sleeve-on-drill), thus eliminating the need to use a drill key (aka handle, drill guide, spoon) Following the consultation appointment, the treatment plan, based on the final prosthetic result, was finalized, and the treatment plan and optical scan were uploaded to SICAT (Dentsply Sirona; Bonn, Germany).

After the implant placement, a postoperative panoramic radiograph was taken in addition to periapical images. The implant placement was as planned and well-positioned "Figure 11".

Figure 10. Digitally made surgical guide in patients' mouths.

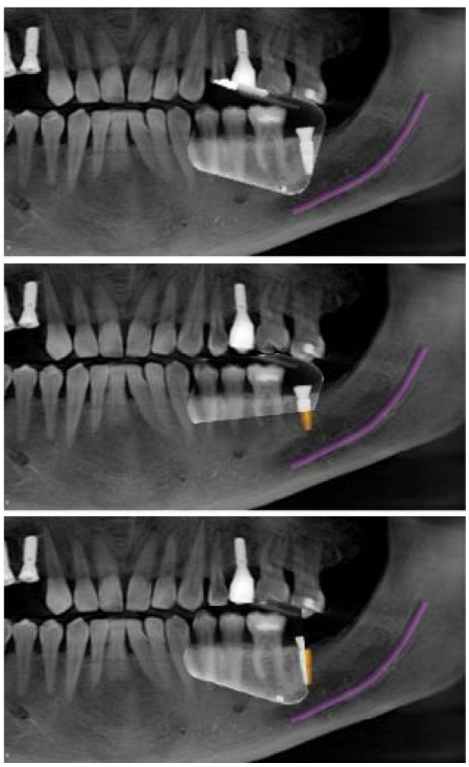


Figure 11. Postoperative image of implant position.

After implant placement, a transgingival healing abutment was placed. As the patient had severe gag reflex further prosthetic treatments for crown placement were also planned digitally with an intraoral scanner for impressions CEREC® Omnicam (Dentsply Sirona).

Followed by the milled crown on the same day.

4. Discussion

An implant placement needs proper planning of the site, location, and functional and aesthetic restorative outcomes. The advantage of digital planning is a preview of the outcome is generated digitally. A potential complication to vital surrounding structures can also be digitally assessed [2]. On the contrary, the free-hand technique is economic, and with no digital technique involved with only cone beam CT a static guide can be made. In the case of digital guided immediate prosthesis placement is possible and authors have reported requiring fewer bone augmentation procedures [3]. Many authors compared the free hand procedure with the pilot drill guide procedure and the fully guided procedure. Ramadhan *et al.* concluded in their study that the gold standard for implant placement in terms of accuracy, safety, and good outcomes is fully guided implant surgery [4]. Gargallo-Albiol *et al.* [5] compared free-handed and half guided and fully guided and they observed the deviations in the coronal, apical, vertical, and horizontal deviations along with apical angle changes, and the total time taken for each procedure was studied. They concluded that comparing all the parameters of deviation and apical angle along with total time the best was static fully guided followed by static half guided and the least accurate was the free hand placement.

In our case report, the same operator did the procedure to standardize the working speed and time and to finally evaluate the ease of placement and procedure.

5. Conclusions

1) Treatment planning management was more effective with the digital approach.

2) 3D planning allowed more accurate positioning of surgical implants phase as well as restorative implant-supported crown.

3) Fewer chances of error in positioning the implant.

4) Least invasive as with digital planning we did not require opening a surgical flap.

5) Treatment time was much less utilizing a digital planned guide rather than conventional.

Learning Points

- Without a surgical guide, no implants should be placed.
- The final success of an implant depends on the accuracy of its placement with

safety to surrounding structures.

- Based on the comfort, fewer appointments needed, and precision fully guided implant placements are the gold standards as per evidence.
- A digital dental implant utilizing the prosthetically driven approach is overall a faster treatment compared to conventional dental implants. This is due to the level of accuracy attained by the 3D Simulation and planning that is done before the clinical treatment.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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