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Pre-surgical Soft Tissue Biotype Simulation Model for Immediate Implant Surgical Planning

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Abstract

Background - The pre-surgical evaluation is vital to the success of immediate implant placement (IIP) and helps in the prevention of complications at the time of surgery. The aim of this technique is to simulate the pre-operative conditions for immediate implant placement in anterior region.

Materials and methods – Step by step procedure for the fabrication of the tooth wax pattern, its placement in the impression, pouring of the cast, removal and further placement of the implant have been explained in detail.

Results and conclusion - The aforementioned novel pre-operative simulation technique provides information on the tissue biotype, surgical procedure, increased accuracy and predictability of implant placement, and sensitize the operator about complication during the procedure.

Key word: Implant simulation; Immediate implant placement; tissue biotype; Presurgical mock-up;

INTRODUCTION

One of the challenges an implantologist confronts is the placement of an implant in esthetic zone, particularly in the maxillary anterior region immediately following extraction. Immediate implant placement (IIP) has been shown to be effective, as it has decreased surgical appointments, improved recovery time, decreased bone resorption post-extraction and has psychological benefits.¹

It can be a challenging situation specifically in the anterior region when associated with significant bone resorption or loss of the cortical buccal plate either due to infections or trauma. Therefore, proper assessment and evaluation of the proposed implant site is necessary which can be carried out by thorough clinical examination, palpation and using different radiographic modalities ranging from conventional to three dimensional imaging,²⁻³ which helps in providing accurate amount of bone available and overall treatment planning. IIP treatment protocol also has several disadvantages, such as achieving implant stability, increased risk of implant failure, difficulty in predicting soft and hard tissue levels, and bone grafts requirements.⁴ Thickness of the cortical bone is a crucial factor in IIP, in esthetic zone only in 13%,⁵ one mm or more width of labial wall is present, supposedly narrowing for indications for IIP and demands for bone augmentation procedures to attain sufficient contours.

Therefore, there is a need of analog simulation technique for trainees, which helps them in simulating the surgical procedure and sensitize them before placement of an immediate implant in anterior region. Thus, this article describes an alternative simulation technique for beginners in immediate implant placement procedures, to evaluate the hard and soft tissue (HST) around the

tooth with pre-surgical mock up procedure on working model and fabrication of a surgical stent accordingly for the accurate visualization of the IIP and provisionalization.

TECHNIQUE

1. Make an elastomeric impression of arch before extraction of concerned tooth.
2. Using software in CBCT, remove the virtual tooth to be extracted and export the .stl file and print it in the table top 3d printer.
3. Insert the 3D printed tooth pattern at the desired site into the elastomeric impression as seen in figure 1.
4. Apply a thin layer of silicone separator to the impression (Divorce, Anaxdent USA).
5. Next, syringe the soft tissue silicone (Gingitech, Ivoclar Vivadent), covering the area of soft tissue around the tooth pattern (tooth to be extracted) as in figure 2.
6. Pour the impression with die stone and obtain the working cast.
7. The working cast obtained will mimic soft tissue profile and bone around the implant site after removal of 3d printed pattern as seen in figure 3.
8. Select a dummy implant and abutment of the appropriate size for the socket. As per the socket available and the profile desired of the final restoration, place the implant in the simulated extraction socket of the working model as seen in figure 4.
9. Approve the angulation of implant and the abutment for aesthetic restoration of the crown from the lateral aspect and fabricate provisional crown as seen in figure 5.
10. Implant placement should be done in patients oral cavity as the simulated position and angulation as of the working model.

DISCUSSION

IIP in the maxillary anterior region is technique sensitive and challenging. Sufficient time must be allotted to treatment planning before the actual procedure of IIP begins. Askary,⁶ stated that the evaluation of the peri-implant soft tissue before IIP is important for planning of desired restoration. The literature suggests for functional and aesthetic restoration, a correct diagnosis is more primordial than the implant design.⁷ Thus, Levine⁸ stated pre-surgical evaluation of the implant sites, the smile line, gingival biotype, and radiographic examinations before surgery. Romanoset al⁹ demonstrated the importance of soft-tissue health and specified peri-implant soft tissues as critical factor for aesthetic appearance.

Computed Tomography combined with Digital Implant Planning softwares provide the amount of bone and soft tissue present at the surgical site. It also helps in the overall treatment planning of the IIP and fabrication of surgical stent and provisional restoration. However, these digital softwares do not reflect the pre-surgical mock up of the surgical procedures.

Our novel technique supports the literature mentioned and helps to fabricate a working model which simulates the extraction socket with the surrounding soft and hard tissue during the planning of IIP. The collective soft and hard tissue thickness can be evaluated on the mock up working model and accordingly the need for soft or hard tissue augmentation can be decided. Dummy implant along with the abutment can be placed within the prepared mock up osteotomy as seen in figure-4. Furthermore if required, a mockup osteotomy can be modified up to the desired depth, position and angulations. Surgical stent can be fabricated according to the final position and angulation and subsequently provisional crowns can be fabricated prior to the surgery fulfilling the aesthetic and functional needs. As suggested by Wöhrle¹⁰ immediate

temporization is crucial to covering an immediate implant, as it may help with soft tissue issues while flap closing.

In the present case scenario, the mockup model showed presence of very thin soft tissue and near to complete absence of labial cortical bone. This helped in decision making regarding the HST augmentation prior to surgery. This novel method is thus simple, economical and helps the practitioner to understand and visualize the surgical scenario that they might encounter during the surgery. Another advantage of this technique is the evaluation of the amount of bone present around the tooth undergoing IIP, which helps in assessment regarding HST augmentation. With this technique, the most critical element in preserving working cast accuracy, is seating of the 3D printed tooth pattern in the impression.

SUMMARY

IIP in the esthetic zone necessitates rigorous planning and execution in the correct sequence. Each of the important steps covered in this article has its own significance and is according to the current scientific knowledge in order to obtain predictable and consistent therapeutic outcomes. This technique shows preparation of the working model, helps in pre-operative evaluation of HST at the implant site, and direct the positioning of dummy implants in the working model. The implants may then be positioned according to the planned optimal location of the final prothesis. This leads to new therapeutic strategies to improve pre-surgical simulation model for teaching and learning procedure for trainees and to sensitize the operator about the complexity involved during the procedure.

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Authors' contributions :

Santosh Nelogi : Conception or design of the work; the acquisition, analysis for the work; and drafting the work or revising it critically for important intellectual content

Amit Porwal : conception or design of the work; the acquisition, analysis for the work; and drafting the work or revising it critically for important intellectual content.

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FIGURE LEGENDS

Figure 1: Impression with the silicone gingival mask material around the tooth pattern.

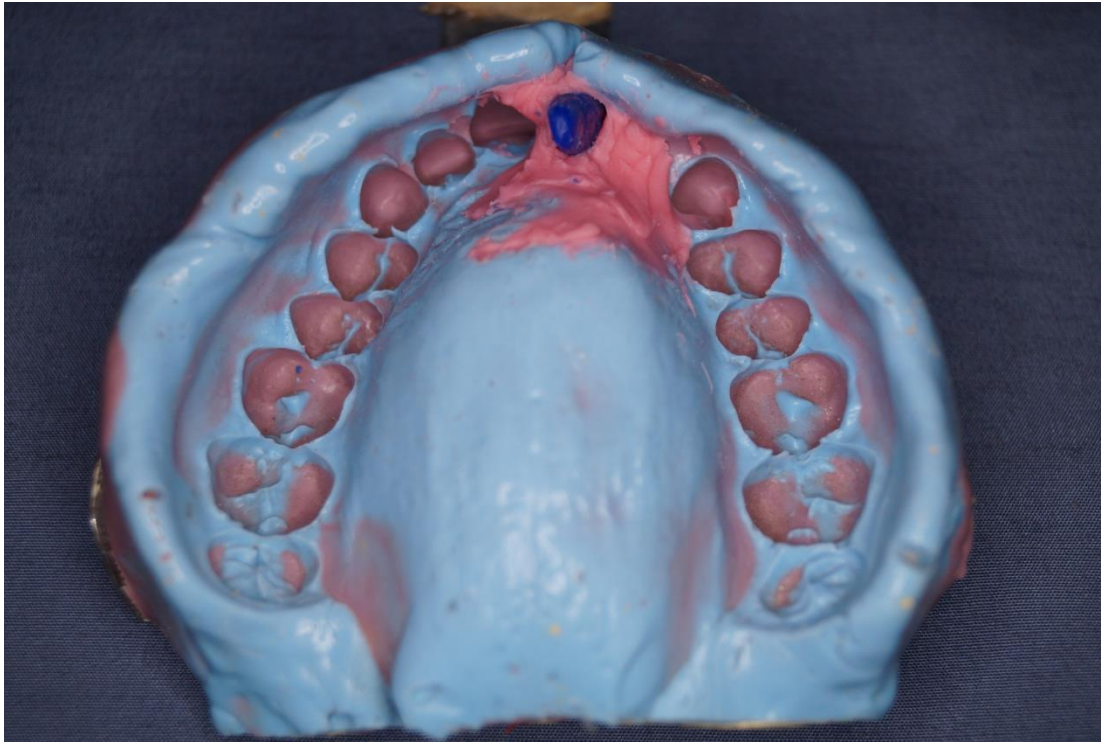


Figure 2: Simulating model with soft tissue profile and tooth pattern in position.

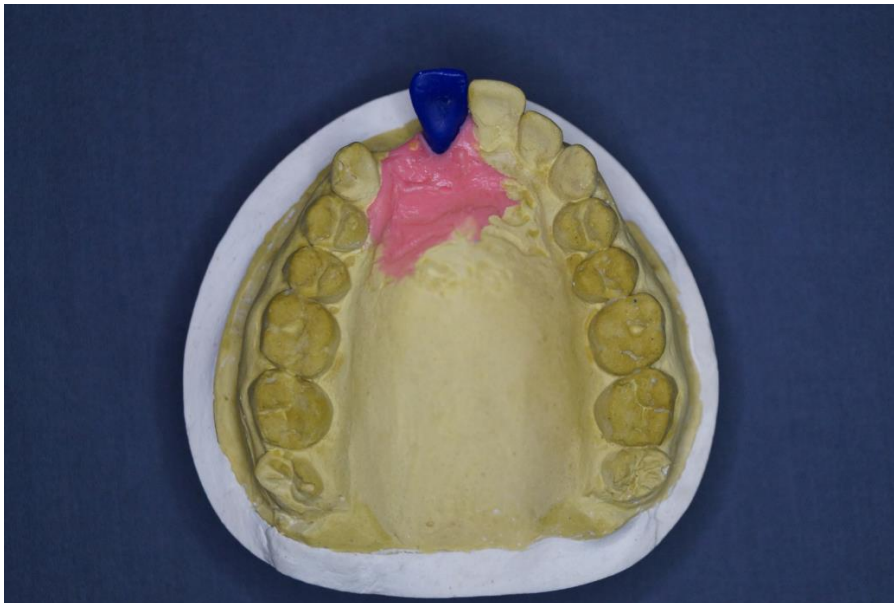


Figure 3: Working cast simulating the soft tissue profile and bone around the intended implant site post extraction.



Figure 4: Implantation in simulated post extraction socket in occlusal and lateral view



Figure 5: Implant in a simulated model with provisional restoration.

