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A Novel Approach to Fabrication of Surgical Guide Template For Accurate Implant Placement: A Dental Technique

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Abstract:
Implant-supported prostheses have become a standard in rehabilitative therapy, requiring precise placement for optimal functional and aesthetic outcomes. This article presents an innovative yet simple technique for fabricating a surgical guide to ensure accurate implant positioning. The method involves bone mapping, impression taking, die fabrication, and a stepwise process for designing a customized surgical template incorporating metallic sleeves. The guide facilitates sequential drilling, allowing implants to be placed accurately, and enables immediate provisionalization. While offering advantages like ease of fabrication, cost-effectiveness, and precision, it has limitations, including potential metal sleeve abrasion and challenges with external irrigation. This technique serves as a practical and accessible alternative to advanced digital guides, making it valuable for routine dental practice.

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I. INTRODUCTION:

Implant supported prostheses have become the main-stay of rehabilitative therapy in recent years. This surge in such a treatment modality can be attributed to achieving predictable osseointegration with dental implants. [1,2] However, placement of implants that will support a properly functioning and aesthetically pleasing restoration still remains a challenge.[3] The functional and aesthetic demands combined with anatomic limitations make the precise placement of implants imperative to achieving a successful prosthesis. Biomechanical and phonetic results can also be improved by the optimal positioning of oral implants. Correct placement of implants is also necessary as no change in their position can be made following osseointegration. The need for such precise positioning of implants has led to the development of surgical templates. [4,5]

Numerous types and designs of surgical templates have been recommended over the years. Some of them include the labial outline surgical guide using a wax arrangement of the proposed definitive restoration [6,7], a clear vacuum-formed matrix, a duplicate of the existing restoration etc. [8] While some of these templates are simple and effective, others are cumbersome in their technique of fabrication. [9, 10] This case report describes a simple and innovative technique for the fabrication of a surgical template to aid in the accurate positioning of single tooth implants.

II. DENTAL TECHNIQUE:

A 45-year-old female patient reported to the Department of Prosthodontics, Govt. Dental College, Trivandrum with a complaint of missing lower back teeth. On examination, the patient showed a partially edentulous mandibular arch with missing 36 and 46. The various treatment options available, their merits and demerits were dicussed with the patient.

The treatment plan decided upon was replacement of missing teeth using an implant supported fixed prosthesis. An informed consent was obtained from the patient.

A surgical guide for accurate placement of the implant was then fabricated in the following manner:

1. Bone mapping was done using an endodontic file under local anaesthesia. (Fig. 1) Measurements were made at the crest of the ridge, 3 mm apical to the ridge crest and 6 mm apical to the ridge crest, both buccally and lingually from the crest of the ridge. [11]

Fig. 1: Bone mapping using an endodontic file.

2. Appropriate stock impression trays were selected. The maxillary impression was made using irreversible hydrocolloid impression materi dia Pvt. Ltd. Gurgaon, Haryana) while mandibular arch impression was mad terial (Fig.2).

Fig. 2: Maxillary irreversible hydrocolloid impression and mandibular PVS elastomeric impression.

3. Both the impressions were poured using Type-IV gypsum product.
4. Dies were fabricated using the Pindex system. (Fig.3)

Fig. 3: Fabrication of dies using the Pindex system.

5. The madibular cast was placed on the surveying table of the dental surveyor (MARATHON 103, SAEYANG MICROTECH). Tilt was given to the surveying table depending upon the angulation required for implant placement which was arbitrarily decided from the intraoral periapical radiograph.

6. A metallic rod, 1.5 mm in diameter, was placed at the proposed site and a radiographic stent was fabricated incorporating it in autopolymerising acrylic resin.

7. The radiographic stent was placed in the patient's mouth and periapical and true occlusal radiographs were taken for evaluating mesiodistal and buccolingual angulation of implant.

8. The radiographs revealed the discrepancy in the previously proposed implant site from the most ideal implant site, both buccolingually and mesiodistally.

9. After making the necessary corrections in the proposed implant site, midline splitting was done on the edentulous region forming mesial and distal halves on the die. (Fig. 4 and Fig. 5)

Fig.4 and Fig. 5: Midline splitting of the edentulous region (mesial and distal halves of die).

10. The distal section of the die was used to transfer the clinical data obtained from bone mapping as pencil markings. With this as a guide, scraping of the mesial segment of the die was done to obtain the configuration of bone in the region.

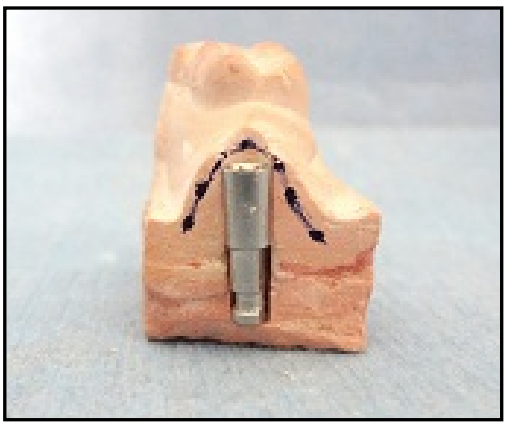

Fig. 6: Provisional position of implant analogue.

11. An implant analogue of suitable diameter and length is selected, based on the configuration of bone thus identified.

12. The provisional position of the implant analogue is drawn on the mesial side of the die and transferred to the gingival crest to aid in indicating the starting point for cast osteotomy. (Fig. 6)

13. The depth of the implant platform is marked with a horizontal line perpendicular to the long axis.

14. The two pieces of the cast were placed back on the die system, placed on the survey table and oriented to the selected path of insertion. (Fig. 7)

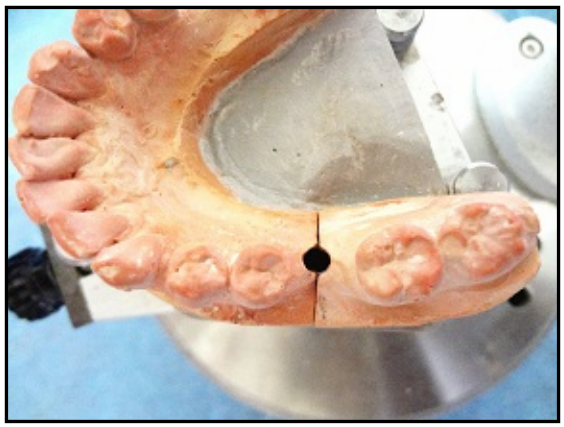

Fig. 7: Repositioning of the mesial and distal halves on the survey table.

15. Following this mock osteotomy in cast was performed. The mock osteotomy was visually inspected and reaffirmed.

16. The laboratory analogue was positioned in the osteotomy, checked for accuracy of placement and secured with cyanoacrylate. (Fig. 8)

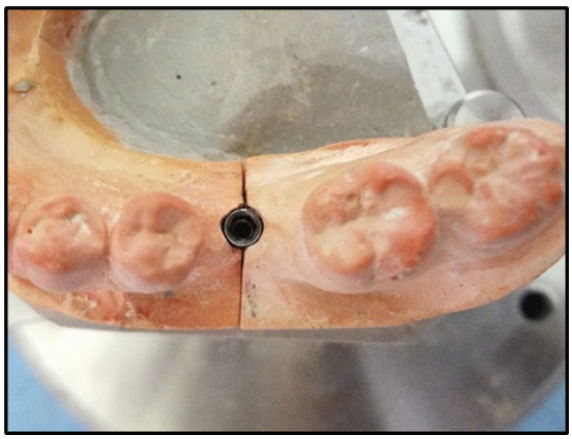

Fig. 8: Placement of implant analogue in the osteotomy site.

17. Surgical sleeve placement: The titanium surgical sleeve consisted of an outer and an inner cylinder of varying dimensions. The length of the inner and outer cylinders was 5 mm. The inner diameter of each cylinder was made to correspond to the diameter of each drill. Eg., 2 mm, 2.5 mm, 2.8 mm, 3.2 mm. The outer dimension of the inner cylinders was made to correspond to the inner dimension of the outer cylinder. The cylinders had a tolerance value of 0.3 mm to the corresponding drill. Each inner cylinder was tightly fitted to the outer cylinder by friction, in order to prevent any movement between the outer and inner cylinders during osteotomy. The inner cylinders consisted of three wings at their occlusal ends, projecting towards outer sleeve. The wing slot system prevented the increase in height of the system while fixing the inner cylinder on to the outer one. The inner

cylinders were interchangeable during osteotomy. Each inner cylinder could be inserted into the outer cylinder from the top by applying finger pressure or by the sleeve remover. The sleeve remover could also be used to remove the inner cylinders from the outer sleeve.

18. The outer sleeve of the surgical guide is then positioned over the analogue. (Fig. 9)

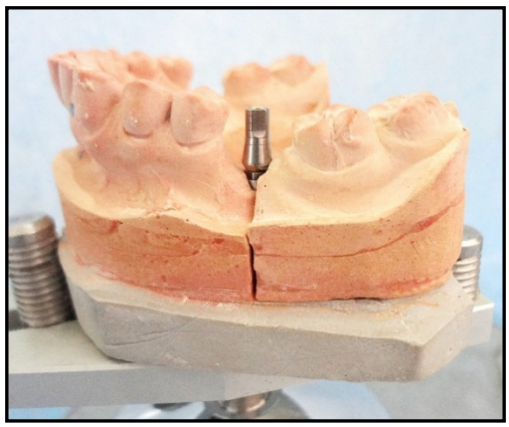

Fig. 9: Positioning of the outer sleeve of the surgical guide over the analogue.

19. Separating medium (cold mould seal) was applied over the cast.

20. Autopolymerizing clear acrylic resin (PYRAX Rapid Repair, Pyrax Polymers, Rookee) was mixed and placed over the analogue following the dough technique.

21. The surgical guide was extended to one tooth on either side of the edentulous span.

22. Once polymerization of the resin was complete, the guide was removed, finished and polished in the conventional manner. (Fig. 10 and Fig. 11)

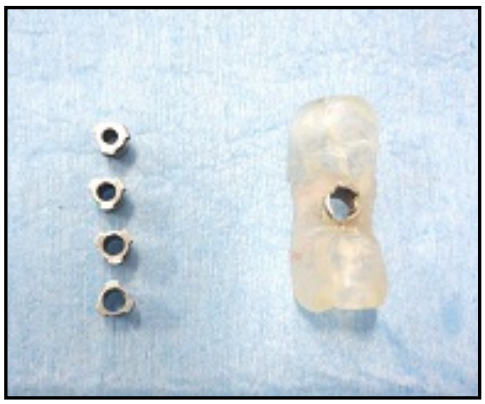

Fig. 10 and Fig. 11: Surgical guide with titanium sleeves.

23. The surgical guide was positioned in the patient's mouth and checked for proper seating.

24. A face bow transfer was done and the casts were mounted on a semi-adjustable articulator. (Fig. 12)
25. A provisional restoration was fabricated in the routine manner as the exact position of the implant was planned before the surgery. (Fig. 13)

At the time of first stage surgery, the surgical guide thus fabricated was used to aid in the accurate positioning of the implant (Fig. 14 to Fig. 17) and the provisional restoration was placed immediately. Care was taken to ensure that the provisional restoration was in infra-occlusion. The final restorations were fabricated and cemented after 3 months using conventional techniques.

Fig. 12: Facebow record of the patient.

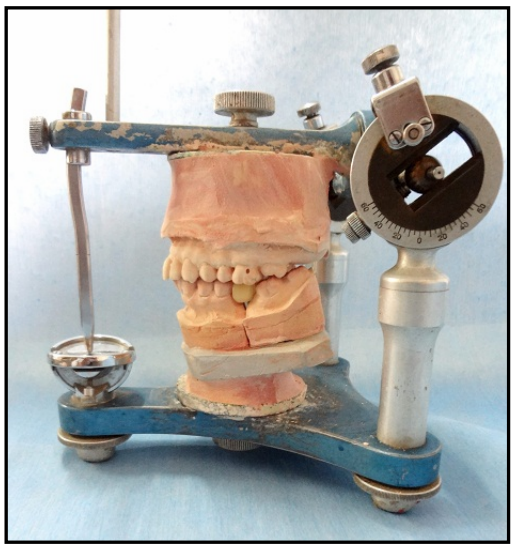

Fig. 13: Fabrication of provisional restoration.

Fig. 14: Preoperative intraoral view.

Fig. 15: Surgical guide with titanium sleeves.

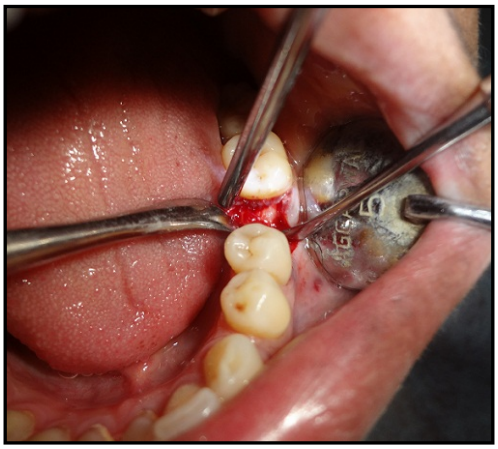

Fig. 16: Incision and full thickness mucoperiosteal flap reflection.

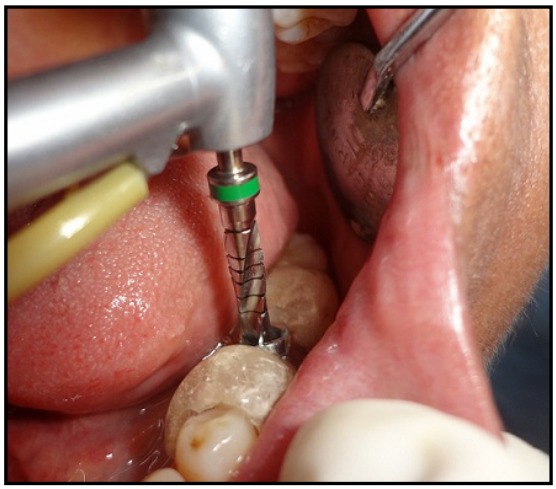

Fig. 17: Osteotomy Drilling through the titanium sleeves of surgical guide.

III. DISCUSSION:

Several methods of fabrication for the surgical template are available. Irrespective of the type of surgical template used, all surgical templates should satisfy certain requirements. The template should be stable and rigid when in correct position. If the arch treated has remaining teeth, the template should fit over or around adequate number of teeth to stabilize it in position.The template should not be bulky and difficult to insert or obscure surrounding surgical landmarks. The surgical template must not contaminate a surgical field during bone grafts or implant placement and should be transparent and allow easy access for the prosthodontist and assistant.

The surgical guide described in the article meets most requirements that have been mentioned above.
Some of the advantages of this template are:

1. Easy to fabricate.
2. Sequential drilling is possible.
3. Several implants can be placed with one guide using multiple metallic sleeves.
4. Economical.
5. Time saving

6. Immediate provisionalization possible.
7. Precise and accurate placement of implants.

The limitations are:

1. There are chances of abrasion of metal sleeves which may contaminate the surgical site
2. External irrigation of the osteotomy site is difficult due to the presence of sleeves
3. Cannot be used when bone augmentation is required
4. The need for two radiographs

IV. SUMMARY:

With the growing need for implant-based therapy, predictable implant placement techniques have become imperative. Optimal placement of implants aids tremendously in simplifying the prosthetic phase of rehabilitation using implants. While a multitude of surgical guide designs have been proposed ranging from non-limiting vacuum formed stents to partially and completely limiting designs using CT scans and CAD-CAM technology, simple designs play an important role in routine dental practice. The case report described above helps achieve the same by proper planning and execution of a simple yet innovative technique of surgical guide fabrication.

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