# Accurate Determination for Orthodontic Mini-implant Placement Using Acrylic Resin Surgical Guide and CBCT

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*Various techniques have been proposed for the fabrication of surgical guide templates in orthodontics. The objective of this paper is to review the associated literature and recent advancements in this field, based on design concept , materials and technique.*

*Keywords: acrylic resin, surgical guide, mini-implant, CBCT*

Surgical template is a guide used to assist in proper surgical placement and angulation of orthodontic mini-implants. The main objective of surgical template is to direct the mini-implant drilling system and provide a accurate placement of the implant according to the orthodontic treatment plan . To precisely transfer the plan to the operative site, customized conventional radiographic or computed image guided surgical templates have become a treatment of choice.A surgical guide is the union of two components : the guiding cylinders and the contact surface. The contact surface can be: bone supported, mucosa supported and tooth supported .

Placing a mini-implant without a surgical guide increase the risk of problems. If the placement of the mini-implant relies only on the clinician's experience, technique and skill, complications can occur : rooth contact or damage, penetration of the maxillary sinus.

The advantages of accurate mini-implant positioning include : improved retention during orthodontic loading and precise control of the force vector.

There are many different classifications of the surgical guide based on the materials used, design concept and technique .

In the literature there are many studies about surgical guides using different materials (table 1).

| Author | Material used for the fabrication of the template |
|---|---|
| Engelman et al | *Autopolymerizing acrylic resin* |
| Tarlow et al | *Vacuum formed thermoplastic matrix* |
| Espina Marino et al | *Heat polymerizing acrylic resin* |
| What et al | *Autopolymerizing acrylic resin mixed with barium sulfate* |
| Jae Jung Yu et al | *Teflon- Perfluoroalkoxy (PFA)* |
| Ken Miyazawa et al | *Stainless steel guide and light curing splint-resin* |
| A SumathiFelicita | *Stainless steel 0,018X0,025 wire* |
| Seong-Hun Kim et al | *Polimer liquid resins (stereolithography)* |

**Table 1**

Design concept

The fabrication of the surgical guide templates is based on one of the following design concepts:

- non limiting design – indicates the ideal position of the mini-implant 2. without any emphasis on the angulation of the drill;
- partially limiting design -the first drill used for the osteotomy is directed using the surgical guide and then is finished freehand by the surgeon;
- completely limiting design – restricts all of the instruments used for the osteotomy in a buccolingual and mesiodistal plane.

*Techniques*

Three tehniques are commonly used for preparing the guide holes and fabricating the radiographic and surgical implant guide :

- conventional free-hand;
- milling;
-computer - aided design/computer assisted manufacture (CAD-CAM).

**Experimental part**

We present a clinical case where we used a acrylic resin surgical guide .

Diagnostic casts of the dental arches are made from irreversible hydrocolloid impressions. Dental casts were prepared and the planed insertion site was marked on the casts.

In order to examine the prospective screw position and the optimal angle of insertion site ,CBCT was carried out.

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A *self polymerizing acrylic resin* was adapted over the occlusal and insertion area of the cast . The surgical guide was fabricated to insert 2 orthodontic mini-implants (Leone : 1.6 mm in diameter and 8 mm in length ) . It was designed to determine not only the best insertion site but also accurate placement of the head of the screw. One mini-implant was inserted on the bucal side between the premolar and molar and the other one on the palatal side.

Another partial CBCT was carried out to evaluate the position of the inserted mini-implants.

Fig. 1. Acrylic resin surgical guide

Fig. 2. Acrylic surgical, bucal view

Fig 3. Acrylic surgical, oral view

Fig.4. Pre treatment periapical view

Fig. 5. CBCT view : interradicular space is 1.45- 1.86 mm

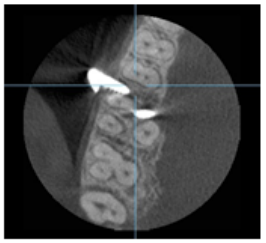

Fig. 6. CBCT view : post insertion

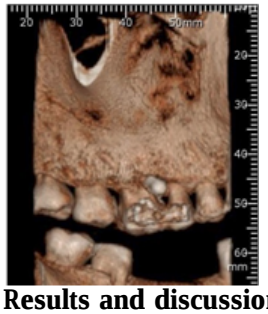

Fig. 7. CBCT view post insertion 3D

## Results and discussions

The completed surgical guide was easily placed intraorally and permitted simple and rapid placement of the mini-implants. The sites of the mini-implants wereaccurate.

Conventional dental panoramic radiography and plain film radiography are usually performed, however it has diagnostic limitations such as: expansion and distortion , setting error, positional artefacts and there is no information regarding the dimension of the bone bucco-lingual direction .

This research investigated the use of cone-beam computed tomography (CBCT ) and precise surgical guides , an approach that provides three-dimensional control for accurate placement of self-drilling mini-screw implants at the desired location and angle.

## Conclusions

It is now also possible to produce a 3D stent directly from a 3D CT or CBCT using orthodontic planning software . In the future it is likely that this process will supersede the manual production of the stents .

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