SURGICAL AND RADIOGRAPHIC GUIDE FOR MICROIMPLANT PLACEMENT

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INTRODUCTION

Orthodontic miniscrews provide stable skeletal anchorage for both direct and indirect orthodontic traction.[1-5] Precise, three-dimensional positioning of implants has been found to be critical for their success.[6,7] The insertion technique for miniscrews should maximize the available bone volume while avoiding adjacent anatomical structures such as dental roots, nasomaxillary cavities, and neurovascular tissues[8]. Although root surfaces appear to repair after traumatic contact with bone screws[9], it is essential to minimize the risk of such iatrogenic damage.

The optimum three-dimensional position for each miniscrew is determined from an intra-oral radiograph and a dental cast. For accurate placement of the implant, the clinician must consider three major parameters[10]:

1. Topographical entry point of the implant
2. Antero-posterior angle of implant
3. Vertical angle of implant

Once all the above mentioned parameters are considered, a surgical guide should be fabricated to transfer this planned three-dimensional position of a particular implant to the surgical site and help clinician to place the implant exactly in the determined spatial relation with the adjacent structures.

Any variation between focal point, object and film can cause an oblique projection and thus a distorted image. In such situation the two-dimensional radiograph will not necessarily reflect the true spatial relationship of tooth with adjacent anatomical structures. This in turn can lead to inaccuracy in the penetration angle of implant and can result in damage of important anatomical structures. So, a radiographic guide should standardize and maintain the relationship between focal point, object (teeth), and film, both before and after the implant placement procedure.

The present article describes a combined surgical and radiographic guide which can help clinician to determine the true spatial relation of the teeth with the adjacent structures, as well as plan and execute the three-dimensional placement of implant in the inter-radicular bone.

PROCEDURE

Parts of the guide:

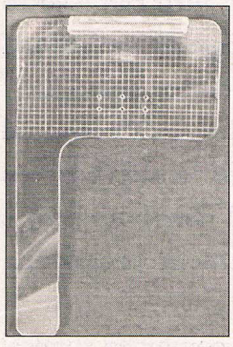
1. Locator
2. Acrylic bite block

3. Two small rectangular wires embedded in the bite block horizontally
4. One long rectangular wire embedded in the bite block horizontally
5. Two, 5 mm long 0.9mm round wire placed vertically on the bite block
6. Film holder

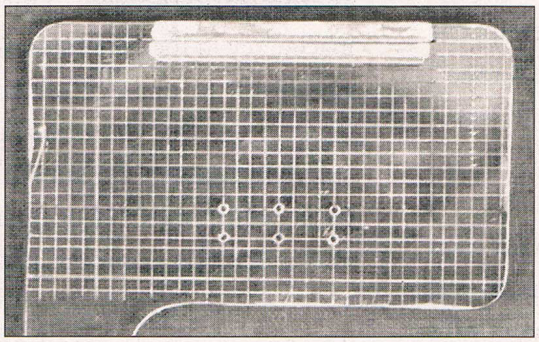
Film holder Fabrication:

1. Take 2 mm thick, commercially available clear acrylic sheet of 5cm x 12cm size and cut it into a shape of a flag (Fig 1a).
2. Using cyanoacrylate super-glue, add two pieces of acrylic sheet of 1 cm x 3 cm of size on the top margin of the flag in vertical direction, in such a way that it can hold an intra-oral radiographic film (Fig 1b).
3. With help of a ruler and a sharp pointed instrument, etch a 2 mm x 2 mm grid on the broader part of the flag (Fig 1c).
4. In the middle of the grid, make 6 holes at the intersection of the horizontal and vertical lines of the grid with help of a 0.8 mm diameter straight diamond point (Fig 1c). This allows for adjusting the film placement according to the anatomic constraints of the patient's oral cavity.
5. The long arm of the flag shaped film holder helps to align the x-ray tube (Fig 1d).

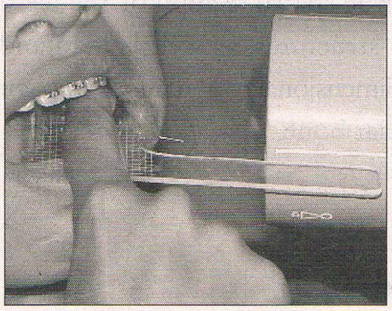
Film holder fabrication.



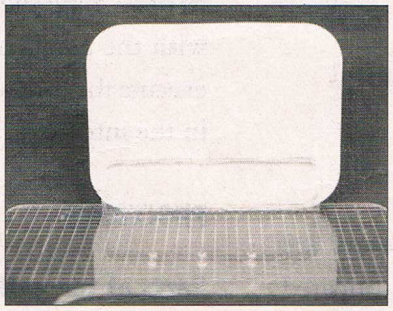
1-a Flag-shaped acrylic sheet.



1-b Vertical pieces of acrylic sheet for holding IOPA film.



1-c Etching of grid and holes placed in acrylic film holder.



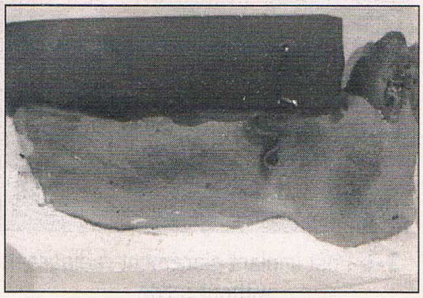
1-d Long arm of film holder helps to orient the x-ray tube.

Fabrication of Guide:

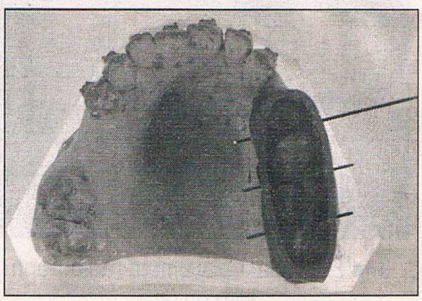
1. From an intra-oral IOPA, determine the tentative point of entry of the implant and mark it on the pretreatment cast (Fig 2a).
2. Take 5 cm of rectangular stainless steel archwire and fabricate the locator (Fig 2a).
3. Remove the locator from the cast and take a sheet of modeling wax and wrap it around all the teeth present in the buccal segment of that quadrant to form a trough (Fig 2b).
4. Reduce the wax trough to a height of 5 mm from occlusal surface of the posterior teeth with the help of a hot spatula, in such a way that the occlusal margin of the trough should be parallel to the occlusal plane (Fig 2b).
5. Place the locator in the same orientation as in the Step 2, so that the horizontal portion of the locator will pierce the buccal and lingual walls of the trough (this will stabilize the locator on the cast) (Fig 2b).
6. Take a piece of stainless steel rectangular archwire, about 5 cm long, and place it bucco-lingully in the region just occlusal to the inter-radicular region in which implant is to be placed. It should be parallel to the occlusal plane as well as inter-dental septum. It should be placed about 2-3 mm gingival to the occlusal margin of the trough (Fig 2c).
7. Take two pieces of stainless steel rectangular archwire, each of 2 cm

Guide fabrication

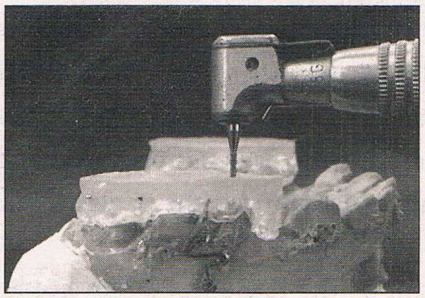
2-a Tentative point of entry of the implant marked on the cast and fabrication of locator.



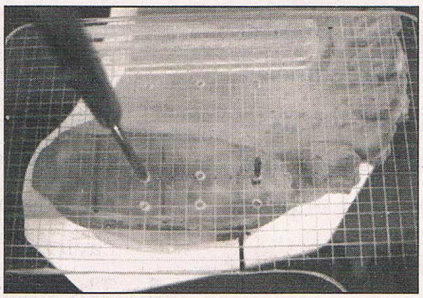
2-b Wax trough reduced and locator placed.



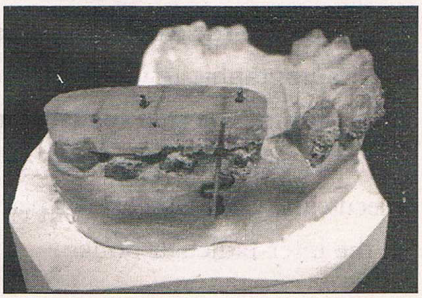
2-c Rectangular wires parallel to the occlusal plane & interdental septum.



2-d 0.8mm diameter, 3mm depth hole perpendicular to the occlusal surface of the bite block, and 5mm wire length fixed in it.



2-e Alignment of film holder on bite block.



2-f Bite block with two vertical wires in place.

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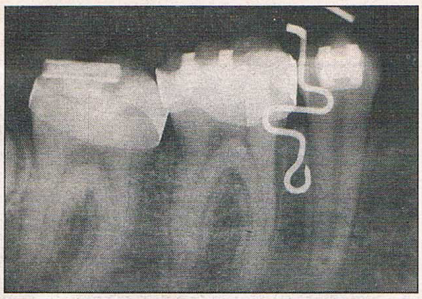
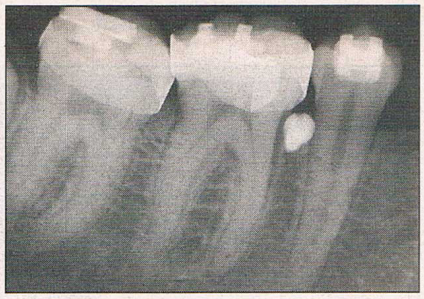
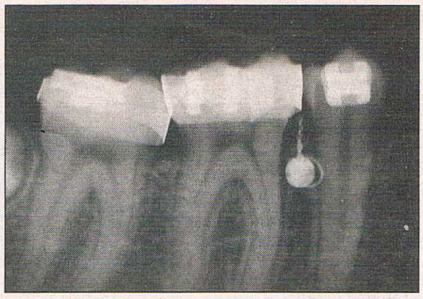


3-a Preimplant placement radiograph with guide.



3-b Post implant placement radiograph without guide.



3-c Post implant placement radiograph with guide. Images of small rectangular wires on pre and post implant radiograph are same.

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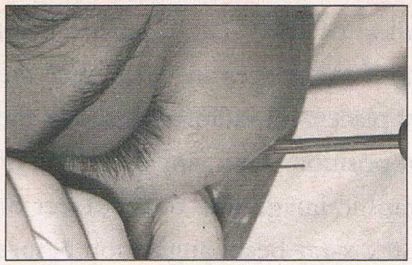

Figure 4 Monitoring the mesiodistal orientation.

Figure 5 Monitoring the occlusogingival orientation.

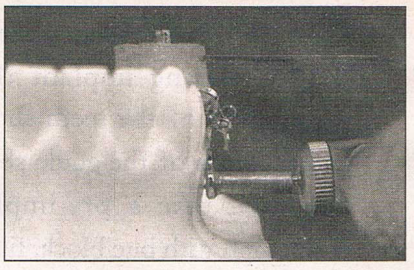

Figure 6 Use of sleeve for pilot hole.

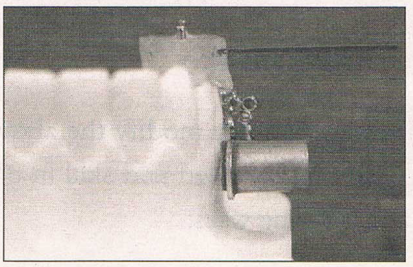

Figure 7 Use of sleeve for screw-driver.

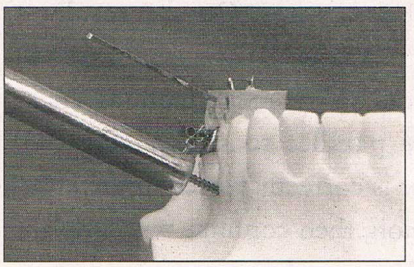

Figure 8 Modification for implant angulation.

radicular region in which implant is to be placed. It should be parallel to the occlusal plane as well as inter-dental septum. It should be placed about 2-3 mm gingival to the occlusal margin of the trough (Fig 2c).

7. Take two pieces of stainless steel rectangular archwire, each of 2 cm length and place them bucco-lingually, parallel to the inter-dental septum and the occlusal plane (Fig 2c). All the three wires should be in the same plane and parallel to the occlusal and inter-radicular septum.
8. After application of separating medium, fill the trough with clear cold cure acrylic and put the cast into pressure pot for maximal curing.
9. Once curing is completed, remove the wax from the outer side of the cured bite block, cut all the excess wire coming out of the bite block (except the long wire which will help in implant placement).
10. Finish the bite block with acrylic trimmers and smoothen it out.
11. Take a 0.8 mm diameter, straight diamond point and place a hole of about 3mm depth, perpendicular to the occlusal surface of the bite block, mesial to the long rectangular wire (Fig 2d).
12. Fix a 5 mm long piece of 0.8 mm diameter wire into the hole with cynoacrylate glue
13. Place the film holder on the bite block in such a manner that the 0.8 mm round wire passes through one of the holes present on the film holder. Align the film holder in such a manner that the all the three rectangular wires should be parallel to the grid lines on the film holder. Take a sharp pointed instrument and pass it through the second hole and mark an indentation on the bite block (Fig 2e).
14. At the indentation, make another similar hole as made for the first one and fix another piece of 0.8 mm diameter wire in similar way. Put the film holder on the bite block and check that the alignment of both the round wires is correct and film holder is seating properly (Fig 2f).

Clinical procedure:

Both the guide and the film holder should be immersed in glutaraldehyde for sterilization at least

for 12 hours before implant placement procedure.

1. Before placing implant the true spatial relationship of the teeth should be assessed and accuracy of the guide should be verified. For that, take a pre-implant placement radiograph with bite block, film holder and the film in place. This radiograph will show the true relation of the teeth and the locator with the adjacent structures. On the resultant radiograph, the two small horizontal wires will be seen as dots on the radiograph (as the x-ray beam is parallel to them) (Fig 3a).
2. If the locator is correctly placed in the inter-radicular region, then continue with implant placement. If it is not, then correct the position of the locator, repeat the radiograph to ensure the correct position of the locator.
3. Remove the film holder; place the guide with the locator at the surgical site. Apply topical anesthesia and pierce the gingiva through the center of the locator with the help of a surgical needle, to mark the point of the entry of the implant or the pilot drill. Remove the locator or cut it and place the implant. The direction of the long rectangular wire placed just above the inter-radicular bone, will help the clinician in orienting the pilot drill direction, and inserting the implant in correct direction. Clinician can monitor the mesio-distal angle of the screw driver by ensuring the parallelism of the screw driver to the long rectangular wire, as viewed from above the patients head (Fig 4). The parallelism of the rectangular wire and screw driver in the occluso-gingival direction should be monitored from the direct frontal view of the operating site (Fig 5).
4. After implant placement, again take the radiograph with guide, film and the film holder in place (Fig 3c).
5. Compare the image of the short rectangular wires on the pre and post implant placement radiograph. If there is any change, it implies that the angulation of the x-ray beam has been changed, and if the images are same, then the post implant placement radiograph shows the true implant position. Thus, any distortion of the radiographic image due to incorrect or variation in the x-ray beam angulation before and after the implant placement can be detected.

Modifications:

Clinician can modify the above guide according to his/her need and skill in one or more of the following ways:

1. Use of sleeve for making a pilot hole: If clinician wants to use a metal sleeve which can guide the pilot drill, then a sleeve with internal diameter that is 0.1mm or 0.2 mm greater than the diameter of the drill can be welded to the locator (Fig 6). The length of the sleeve can be adjusted according to the depth to which the drill needs to be taken.

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