An Adjustable Surgical Guide for Miniscrew Placement

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The first devices widely used for skeletal anchorage in orthodontics were osseointegrated dental implants, placed in the midpalate[1-5] or in the retromolar area of the mandible.[6] More recently, miniscrews have been successfully inserted in the dentoalveolar areas.[7-14] The placement of these implants between the roots of the teeth has been challenging, however, because of the limited space and the risk of root damage.[9-14]

Several methods have been proposed to accurately transfer implant locations from the two-dimensional radiographs used for surgical planning. A radiopaque marker such as a brass wire[9] or a bent stainless steel wire[10,11] has been inserted into the interproximal space of the selected implant site to guide the pilot drill, but these do not eliminate the possibility of a deviation in the trajectory of the drill, nor do they completely avoid the risk of root contact.

The present article describes a three-dimensional surgical guide that permits accurate miniscrew placement in the septal bone area while preventing root damage.

Implant Placement

The totally adjustable surgical guide* consists of a rigid horizontal connector with an articulated joint at each end, to which are attached two adjustable vertical arms that rotate on different axes (Fig. 1). One arm is connected to the orthodontic archwire for rigid and stable anchorage of the device; the other arm is attached to a 5mm-long stainless steel tube with a 3mm internal diameter. The articulated joints allow complete three-dimensional adjustment, permitting the miniscrew to be placed at a 30-40° angle to the long axes of the teeth, as recommended by Kyung and colleagues for optimum surface contact between implant and bone.[9]

The guide is positioned as accurately as possible at the selected implant site, and a periapical radiograph is taken to determine whether the image of the stainless steel tube is in the cor-

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Fig. 1 A. Adjustable surgical guide. B. Guide anchored to orthodontic archwire and oriented in three dimensions for planned miniscrew location.

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rect position. If not, the device is adjusted, and successive radiographs are taken until the placement of the tube is correct. The coordinates of the preoperative planning site are compared with those on the radiograph using a custom software application designed by our department** (Fig. 2).

With the surgical guide in place, a 1.5mm-diameter spiral drill is used to make a pilot hole directly through the stainless steel tube under local anesthesia. A slow drill speed (400-500rpm) should be used with normal saline irrigation to avoid excessive heat. For good mechanical retention, the pilot hole should be drilled just into the cortical bone (Fig. 3). Using a custom manual screwdriver,* which fits exactly inside the stainless steel tube, the miniscrew is inserted through the surgical guide. This prevents any deviation from the planned direction and, thus, assures precise placement of the miniscrew with no risk of root damage (Fig. 4).

**Smart'n Ceph, version 11, Research Center, Chiangmai University, Thailand.

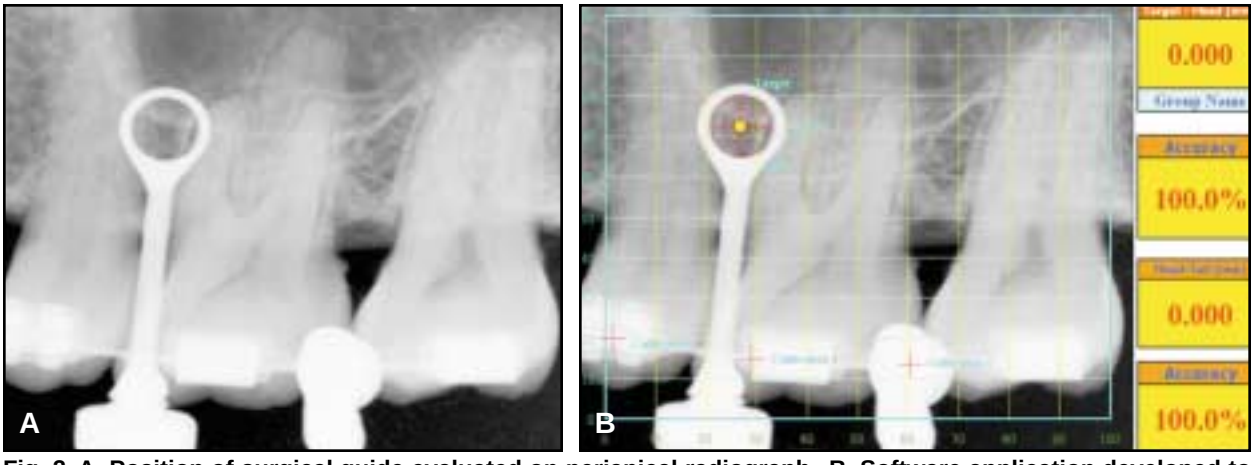

Fig. 2 A. Position of surgical guide evaluated on periapical radiograph. B. Software application developed to compare position of implant on radiograph with planned location.

Fig. 3 A. Pilot hole drilled directly through surgical guide. B. Miniscrew inserted through surgical guide with custom screwdriver.

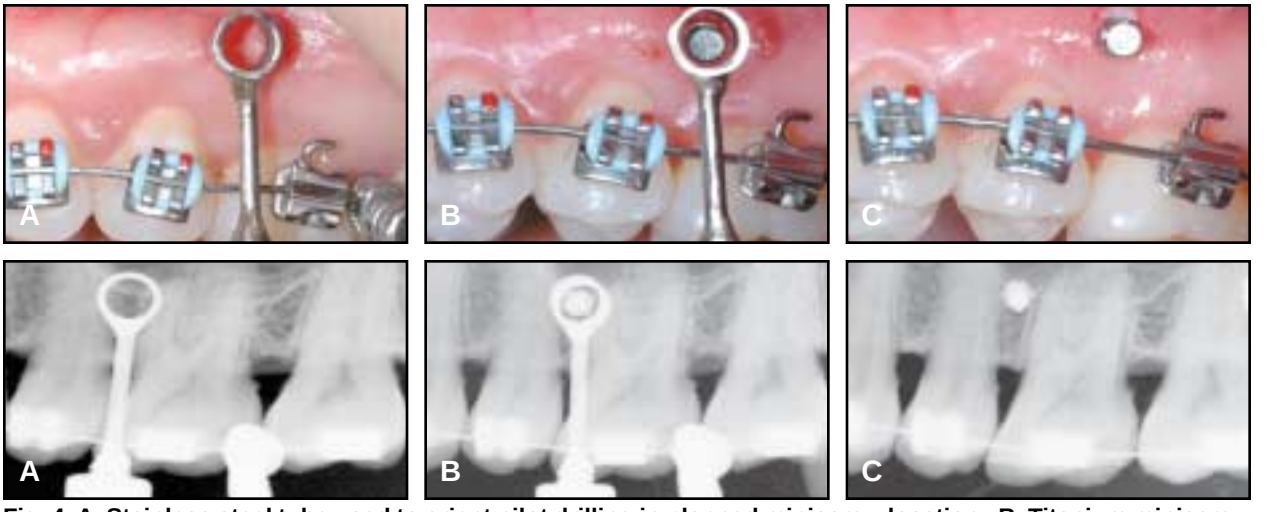

Fig. 4 A. Stainless steel tube used to orient pilot drilling in planned miniscrew location. B. Titanium miniscrew inserted through attached gingiva into buccal alveolar bone. C. Optimum miniscrew placement with surgical guide.

Discussion

Several authors have suggested that the drill will stop or the patient will report pain if a root is contacted, and that the direction of drilling can then be adjusted until a satisfactory implant site is found.[9,14] According to Kyung and colleagues, the roots can be expected to recuperate completely even when severely damaged.[9] There have been no evidence-based studies, however, focusing on potential iatrogenic complications of miniscrew placement. In our opinion, any approach that avoids patient discomfort or stress during implant surgery should be favored.

The three-dimensional surgical guide described in this article can accurately identify the positions of a miniscrew and nearby dental roots using simple periapical radiographs. After more than 40 miniscrew placements, we have not seen any trauma to the teeth or roots.

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