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'Enter Safe Zone': A Versatile Radiographic and Surgical Guide for Miniscrew-Implant Placement

Abstract: The use of miniscrew-implants for enhancing orthodontic anchorage has become standard care in many orthodontic practices. The present article describes a 3-dimensional, user-friendly, radiographic and surgical guide for the placement of miniscrew-implants in the safe zone.

Clinical Relevance: Proper placement of miniscrew-implants between the roots of the adjacent teeth is a strategic problem faced by the orthodontist. The clinician could use a technical aid for the successful placement of the miniscrew-implant.

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The miniscrew-implant has become part of the standard care in many orthodontic practices. Stability of the miniscrew-implant is correlated with correct placement at the first attempt.[1] The correct horizontal (inter-radicular) and vertical placement of the miniscrew-implant can be determined with a mechanical guide more precisely than with clinical observation and palpation. Although contact between dental roots and implants has been shown to produce no remarkable adverse effects, the risk of injuring critical anatomic structures and manual placement error can be minimized by precise positioning of the miniscrew-implant.[2,3] Several clinicians have developed 3-dimensional surgical guides in the past, that are recorded on radiographs.[4-9] Such guides mentioned in the literature either require tedious laboratory procedures or appliances which are not easily available in routine orthodontic practice. This article describes a 3-dimensional, user-friendly, radiographic and surgical guide with its application in two clinical cases. The device is simple in design and fabrication. It allows the orthodontist easy and rapid assembling at any position along maxillary or mandibular arches. It can be used with either labial or lingual appliances, and can also be autoclaved. It ensures an exact correspondence between the X-ray and implant placement trajectories, which gives optimum 3D control to the operator.

Design principles

Armamentarium

The Versatile Radiographic-Surgical Guide (VRSG) is fabricated from three standard edgewise 0.022" x 0.028" molar tubes: two double slot tubes and one with single slot; one 5 cm long 0.021" x 0.025" stainless steel wire, and a 10 mm length Ni-Ti open coil spring.

Fabrication

On the buccal surface of a

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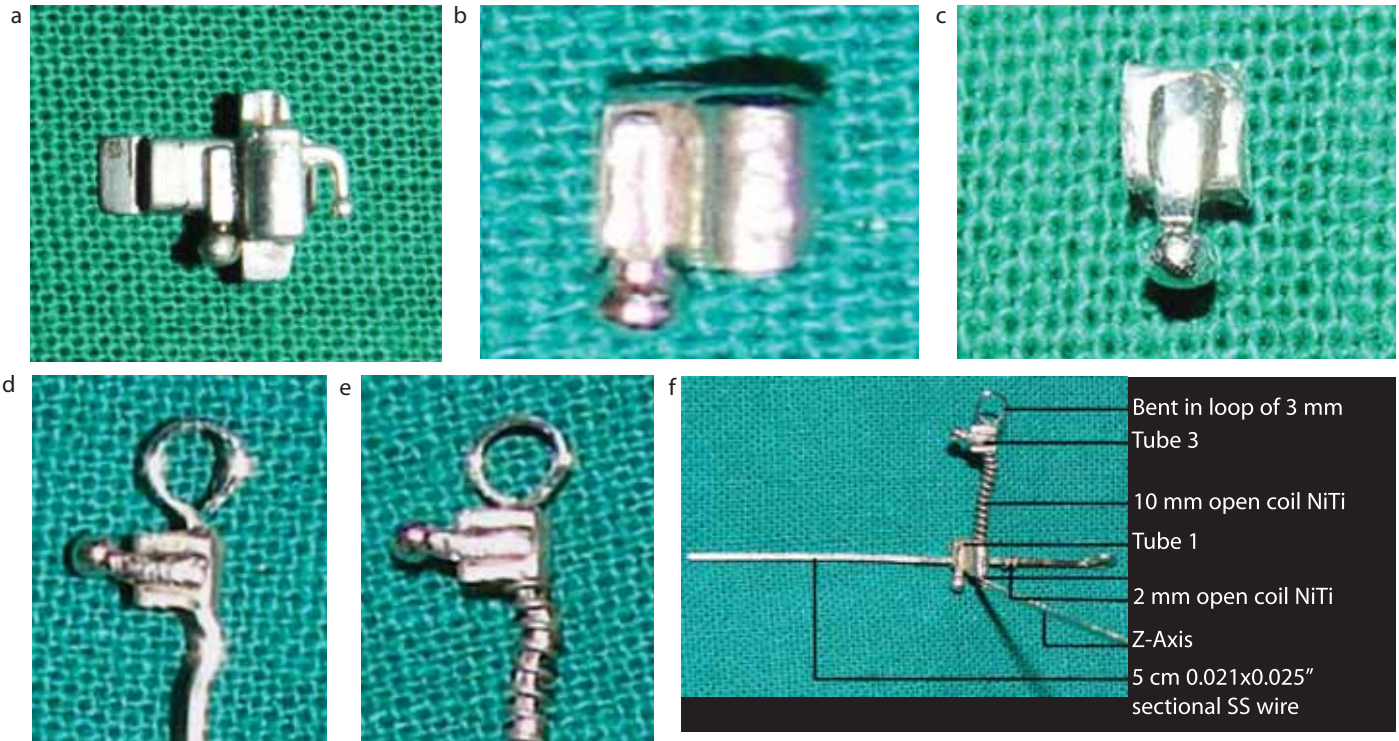

Figure 1. Steps in the fabrication of the guide: **(a)** tube 2 soldered on tube 1; **(b)** frontal/buccal view of reduced tube 2 soldered on tube 1; **(c)** reduced tube 3 on either side of hooks; **(d)** tube 3 assembled with a bent in V–bend; **(e)** tube 2 in position with 10 mm Ni-Ti open coil spring; **(f)** complete assembly of guide with the horizontal arm bent in buccally.

double slot molar tube (tube 1), a single slot molar tube (tube 2) is soldered vertically mesial or distal to the hook (Figure 1a).

The horizontally placed double slot molar tube is reduced in width on one end to the hook and from the other end to the vertically positioned single slot molar tube with the help of a diamond wheel (Figure 1b).

Another double slot molar tube (tube 3) is reduced on either side of the hook to a width of 2 mm with the help of a diamond wheel (Figure 1c).

A loop of 3 mm is bent on a 10 cm long 0.021″ x 0.025″ stainless steel wire which reduced from the inner side with a diamond bur to maximize the clinical interest field in the radiograph. Tube 3 is slid from the other end of wire to the loop. Then a V-bend is bent just flush with the tube 3 that acts as a stop for the tube in vertical direction (Figure 1d).

A 10 mm long Ni-Ti open coil spring is passed from the free end of wire. The tube 2 is slid through the vertical arm till it contacts the open coil spring (Figure 1e).

A right angle bend is bent just flush with tube 2. Now the horizontal arm of the wire, when seen from the frontal view, coincides with the centre of the loop. Tube 1 is slid in a 5 cm long section of 0.021″ x .025″ stainless steel wire with a bent in loop and a 2 mm to 5 mm long (depending on the interbracket distance) Ni-Ti open coil spring is placed mesial to it (Figure 1f).

Tube 1 gives freedom in the x-axis, Tube 2 gives freedom in the y-axis, the horizontal arm acts as z-axis and hence this assembly gives 3-dimensional control to the operator, which is mandatory for safe insertion of a miniscrew-implant.

Clinical procedure

The surgical procedure for placing a self-drilling, self-tapping miniscrew-implant is as follows:

- The evaluation of available bone for miniscrew-implant placement using panoramic radiograph is done.[10]
- The patient is asked to rinse with a chlorhexidine mouthwash.
- The autoclaved surgical guide along with the sectional wire is assembled at the site of insertion of the implant (Figure 2a). Horizontal stabilization of tube 1 is done by tying the hook with the 0.010″ ligature (ligature tie 1) to the adjacent bracket (Figure 2b).Note, compress the open coil NiTi mesial to tube 1 until the desired horizontal position is obtained. Next, the vertical stabilization is done by tying the hook of tube 3 with the ligature (ligature tie 2) to the same adjacent bracket (Figure 2 c, d). Note, the ligature tie 2 should pass beneath the horizontal arm as it provides stability to the horizontal arm.
- Radiograph is taken with the direction of the X-ray beam parallel to the horizontal wire (ie z-axis) in horizontal and vertical dimension to evaluate the relationship of the VRSG and adjacent anatomical structures. (If there are no image superimpositions of VRSG with adjacent anatomical structures, the miniscrew-implant insertion will be safe. On the other hand, if there is a superimposition of the VRSG, the device should be adjusted by tightening or loosening the ligature wire. This should be confirmed with another exposure).

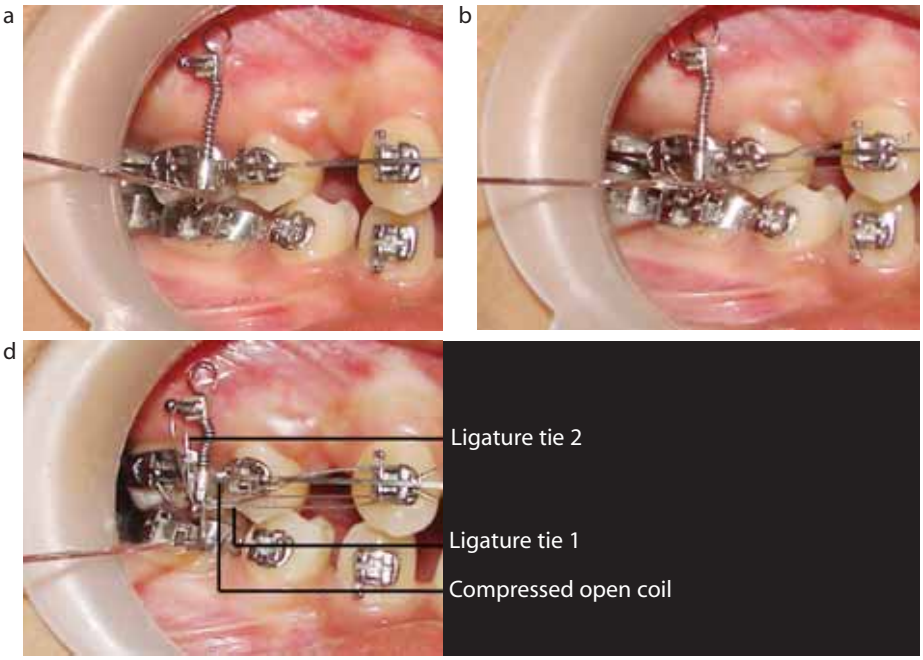

Figure 2. Procedure for ligature ties: **(a)** VRSG positioned between UR5 and UR6 (note 2 mm open coil spring placed mesial to the tube 1); **(b)** horizontal stabilization with ligature tie 1; **(c)** for vertical stabilization, ligature tie 2 should pass beneath the hook of tube 1; **(d)** after completing ties.

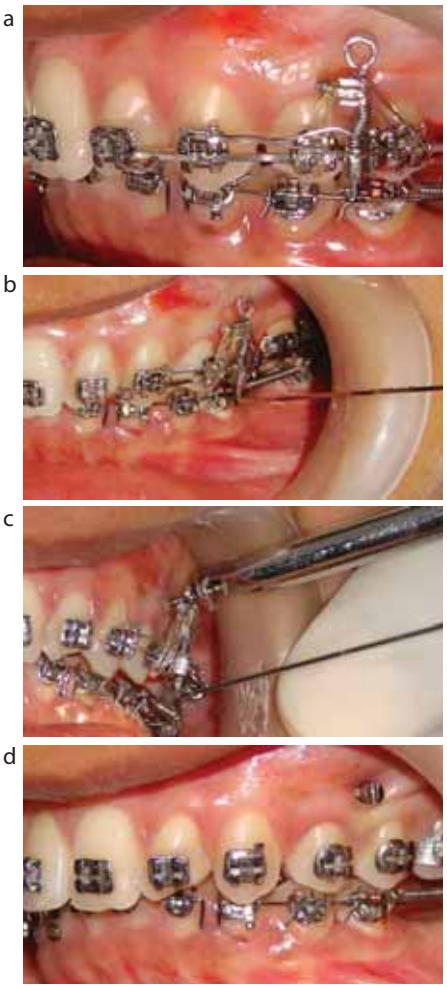

Figure 3. Clinical photographs of case 1 in which micro-implant is placed between UL4 and UL5: **(a)** guide in position frontal view; **(b)** buccal view; **(c)** maintaining parallelism; **(d)** implant in position.

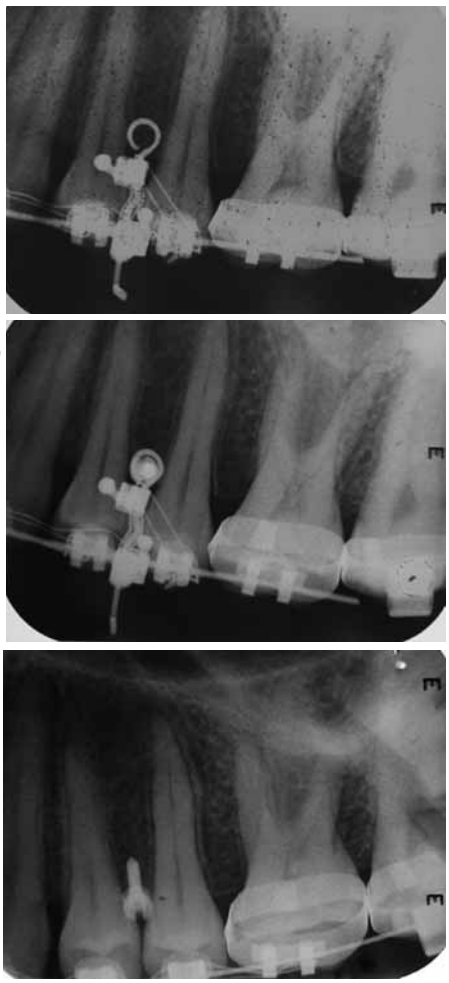

Figure 4. Radiographs of case 1 in which micro-implant is placed between UL4 and UL5: **(a)** site selection between UL4 and UL5; (b) micro-implant in position; **(c)** without guide.

- A local infiltration anaesthesia is administered at the selected site.
- The mucosa at the centre of the loop is indented with a dental probe or round bur.
- A round carbide bur is used under constant irrigation with a coolant, to indent the cortical plate at the centre of the surgical site.
- Insert the miniscrew-implant slowly using a screwdriver.
- While inserting the implant using the screwdriver, strict parallelism with the z-axis in horizontal and vertical plane is maintained.
- When the implant is almost completely seated, take a radiograph with the guide in position to verify the implant position relative to the adjacent roots.
- After removing the guide, minor adjustments to the insertion depth and screw head projection are made if needed.

Two cases are illustrated, Case 1 (Figures 3 and 4) in which the miniscrew-implant is placed between the first and second premolars in the upper left quadrant and Case 2 (Figures 5 and 6) in which the miniscrew-implant is placed in the lower left quadrant between second premolar and first molar using the same clinical procedure.

Discussion

Surgical stents[4,6] and guides[5,7] can transfer a radiographically planned, 3-dimensional implant position to the surgical site more accurately. The fabrication of these guides is complicated and time-consuming, and requires elaborate laboratory equipment. Moreover, such devices do not allow the orthodontist to perform the minor clinical adjustments that may be needed to ensure precise miniscrew-implant placement. They are used only for pilot drilling, not for placement. When placing the miniscrew-implant, the clinician must remove the guide. Recently, the 3D

Figure 5. Clinical photographs of case 2 in which micro-implant is placed between LL5 and LL6: **(a)** micro-implant insertion maintaining parallelism; **(b)** post insertion buccal view with VRSG in position; and **(c)** implant in position.

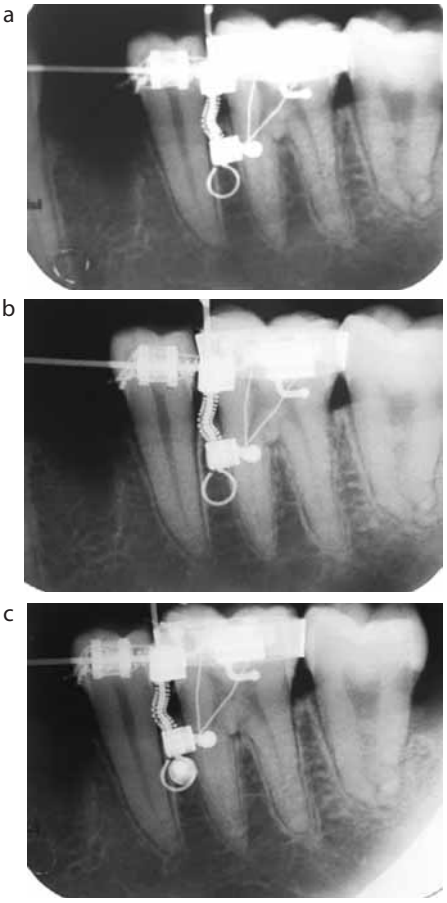

Figure 6. Radiographs of case 2 in which micro-implant is placed between LL5 and LL6: **(a)** site selection between LL5 and LL6; **(b)** VRSG adjusted by loosening ligature; **(c)** micro-implant in position with VRSG.

guide by Suzuki and colleagues has tried to overcome these problems to a certain extent.[8] However, in their guide, different sizes of vertical arm length (5 mm, 7mm or 9 mm) are used that needed to be changed as per clinical requirement. Such prefabricated fixed lengths also reduce the amount of freedom in vertical dimension that the operator desires. It also needs elastomeric impression material for bite registration which adds on to the cost.

The design and fabrication of the present guide is simple, versatile and can be fabricated by an orthodontist with the materials that are readily available in his set-up. It permits the operator to locate the desired point of insertion of miniscrew-implant by positioning the loop, which is attained by sliding the molar tube and wire in the horizontal and vertical directions, respectively. Further, the horizontal arm (z-axis) guides the path of insertion of implant with exact parallelism.

Overall, the chair time for fixing the guide and subsequent radiograph takes as little as 10–12 minutes. This has been verified after successfully using the guide in several patients. The guide can easily be removed from the archwire after miniscrew-implant placement and re-used for any other site, if required, saving chair time and expense.

Limitation and caution

Sufficient cheek retraction is needed with a cheek retractor while taking radiographs in the buccal region.

Care must be taken to avoid needlestick injury from the free end of the horizontal arm (z-axis). Either a drop of sticky wax can be applied on the sharp end or it can be encased with slightly overextended plastic tubing.

Conclusions

This VRSG provides accurate 3-dimensional positioning of miniscrew implants so that bone support can be maximized and damage to adjacent structures can be avoided.

The clinical use of this versatile guide adds to the confidence of the orthodontist and enables precision placement.

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CPD Answers for April 2009

1. B, D
2. A, C, D
3. A, C, D
4. D
5. C
6. A, B
7. B