DIFFERENT WAYS FOR PLACEMENT OF MINI IMPLANTS- A REVIEW

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Abstract: Implant placement has always been a complex and difficult treatment modality. Several methods have been proposed to accurately transfer implant locations. there are various techniques that can be used for mini implant placement of absolute anchorage in orthodontics. Guiding templates have been used always, for placing mini-implants since 1980 . They help to assist the orientation of osteotomy preparation and thus aid in correct fixture placement. The aim of this article is to compile and summarize the existing mini implant placement techniques and showing their possible clinical effectiveness of the techniques.
Keywords: Anchorage, Mini-implants, Guiding templates, Retention, Stability.

Introduction

Miniscrew anchorage has significantly reduced the need for patient compliance and allowed orthodontic treatment of more types of cases without surgery.[1,2] Despite its increasing popularity, however, miniscrew placement may be dangerous if the clinician lacks adequate information on the anatomy of the insertion area. Various surgical guides based on different placement techniques that have been proposed as aids to allow precise insertion of miniscrews into the interradicular spaces.[3,4] Numerous studies have demonstrated a skeletal anchorage site,[5,6] It is therefore essential that great care be taken in analyzing the availability of bone for miniscrew insertion to guarantee primary stability and reliable anchorage.[7,8]

The accurate placement of mini-implant is of paramount importance for its stability. Stability depends on a number of factors.[9,10] Proximity to the root surface, placement in the alveolar mucosa, and improper angulations have been attributed to mini-implant failure. Root proximity is a major cause of mini-implant failure[11,12]. Placement in the alveolar mucosa can result in peri-implantitis with failure of the mini-implant. Root proximity can be reduced by angulating the mini implant to the long axis of the tooth. This facilitates placement of the tip of the mini-implant towards the root apex. This reduces root proximity as well as increases the contact between the mini-implant and the cortical bone with increased stability of the mini-implant. Hence, a stent was designed to aid in optimum mini-implant placement. A stent is a surgical guide which aids in the proper placement of the mini-implant in the three dimensions of space, namely, sagittal (root proximity), vertical (attached gingiva/alveolar mucosa), and transverse (angulation).

This article describes how to manufacture an adjustable surgical guide to aid the accurate placement of orthodontic mini-screws, thereby reducing the risk of injury to roots and important anatomical structures and hopefully increasing the chance of success.

Indication for mini implants: Molar protraction, indirect anchorage for space closure, intrusion of supererupted tooth, intrusion for anterior open bite, anterior en masse retraction, molar uprighting, intrusion for maxillary cant, molar distalization, traction on impacted canine, attachment of protraction facemask.[13]

Contraindication for Mini implants: Mini-implants are contraindicated in patients suffering from metabolic bone disease, circulatory disturbances, acute infections, recurring diseases of oral mucosa, patients receiving immune suppressive therapy, chronic steroid, bisphosphonate medication.[14]

Risk and complication of mini implants

1. Complications during insertion

Trauma to the periodontal ligament or the dental root, Miniscrew slippage, Nerve involvement, Air subcutaneous emphysema, Nasal and maxillary sinus perforation, Miniscrew bending, fracture, and torsional stress.

2. Complications under orthodontic loading

Stationary anchorage failure, Miniscrew migration

3. Soft-tissue complications

Aphthous ulceration, Soft-tissue coverage of the miniscrew head and auxiliary, Soft tissue inflammation, infection, and periimplantitis,

4. Complications during removal

Miniscrew fracture, Partial osseointegration. [15]

Different ways for Guiding Templates and stents for mini implant placement

Simple Wire Guide: Simple wire guide is invented by Suma T et al in the year of 2010. It is fabricated using stainless steel wire (0.018 in diameter); helix is made with the diameter of 3mm in the centre of wire. Length of mini-screw insertion is determined (generally 5-6mm from alveolar crest. Wire guide is secured to the adjacent brackets using ligature wire or “O” ring. After determining the vertical height, two horizontal bends are placed at the level of adjacent brackets. Position of the helix is confirmed using periapical radiograph for Miniscrew placement. Wire guide is removed after 3/4th of the Miniscrew is driven in and then Miniscrew is

completely inserted. Placement is reconfirmed with radiograph (Figure 1).[16]

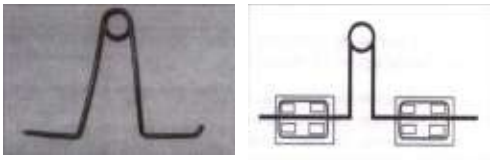

Figure1: Simple Wire Guide

Multiloop Wire Guide: Multiloop wire guide was introduced by Hemanth et al in the year of 2012. It is inexpensive and easy to use; formed from brass or stainless steel may be used to determine the position of the mini-implant. It contains 3 to 5 loops depends on the vestibular depth. Wire guide should be placed in the interradicular space and secured with elastomeric ligature in mesial tooth bracket and position is determined using radiograph, mini-implant is placed on the selected loop. The multiloop wire guide minimizes the failure rate of implants and also significantly reduces the risk of root injury. [17]

Radiographic Template: Radiographic template was introduced by Freudenthaler and associates. It is fabricated from plaster cast of the patient. Flat bite block of 5mm thick is fabricated using autopolymerising acrylic resin and three 0.018 inch stainless steel wires placed parallel to the occlusal plane. Before polymerization wires are placed on to the flat surface of bite block. Middle wire should be superimposed over the imaginary line through the center of the interseptal bone of 2 adjacent teeth. This serves as a radiographic template. A simple film holder is fabricated to obtain intra oral radiographs. This can align the x-ray source, teeth and film in a straight line and it will guide the central x-ray perpendicular to the radiographic film. Resultant radiograph has to be clipped on the buccal side of the template. Middle wire is bent occlusally at 30 to 40 degrees for maxilla and 10 to 20 degree for mandible, this serves as a guide for directing the microimplant placement (Figure 2 & 3).[18]

Figure 2: Radiographic Template

3D Placement Guide: Aleppo University Surgical Orthodontic Miniscrew AUSOM 3D placement guide is introduced by Mahmoud Al-Sueiman et al in the year of 2011 It consists of four parts, Vertical part – It is a round stainless steel wire, used to locate the position of mini-implants in vertical direction and it has a lock which is fixed to the orthodontic wire connected to fixed appliance. Horizontal part – It is a round stainless steel wire, used to locate the position of mini-implants in horizontal direction and it has a lock, movable in vertical direction. Once desired height is reached, lock can be closed. It also holds the placement guide. Placement guide – It has a vertical round wire, has cylinder on the end, which works as a guide to place mini-implant. Film holding part – It is a wire extends from the film holding part of the molar band and inserts into the periapical radiograph holder.[19]

Stereolithographic Surgical Template:
Stereolithographic guide was introduced by Seong-Hun Kim et al in the year of 2008. This template has been used in dentistry since early 1980 for fabrication of subperiosteal dental implants using stereolithiography. The surgical guide was designed using rapid prototyping (RP) machine which uses stereolithography, and rapid prototyping process based on photopolymer liquid resins that solidify when exposed to UV light. The RP machine read angulations and diameter of implant, simultaneously polymerizes the resin around the implant site, and forms the cylindrical guide on the replica corresponding to each implant. Then the supporting resin is removed and cylindrical guide is used to insert surgical grade stainless steel tubing which serves as a guide tube. The surgical template would transfer the planned three dimensional implant positions to the surgical site. It was designed to determine not only the best insertion site but also accurate placement of the head of the screw. Surgical guide can be adjusted before surgery using the radiograph. Template can be disinfected using gluteraldehyde before surgery (Figure 4).[20]

Figure 4: Stereolithographic Surgical Template

Suzuki 3D Guide: Suzuki consists of vertical arm. One end is connected to the orthodontic archwire with gurin lock. Other end is connected to stainless steel tube which determines optimal site for implant placement. Using bitewing radiograph implant site is predetermined for drilling pilot hole and mini-implant placement (Figure 5).[19]

Figure 5: Suzuki 3D Guide

Cone Beam Computed Tomography and 3D Prototyping: CBCT guide was introduced by Ken Miyazawa et al in the year of 2010. CBCT is a safe, accurate, and simple procedure for determining mini-implant position. This helps to proceed in complex surgical procedures using preoperative plan based on CT to minimize risks and optimize clinical results. Three dimensional images acquired from CBCT used to obtain additional information about the anatomic structures. Presurgical 3D model of patient‟s teeth and underlying alveolar bone was created; this helps to place mini-implants in predetermined position. A CBCT record is transformed into 3D images. A replica model of the cast is fabricated using stereolithography apparatus. Mini-implant site and Length of the mini-implant is determined in axial and 3D view of CBCT (Figure 6).[21]

Figure 6: Cone Beam Computed Tomography and 3D Prototyping

Surgical Stent: Morea and colleagues introduced surgical stent. A guide channel for pilot drill may be fabricated from acrylic or metal tubing supported by acrylic. Metal channel provides smooth surface for pilot drill, but doesn‟t allow the drill to be clearly seen. Acrylic channel will contaminate the surgical site with acrylic debris. Local anesthesia should be administered in the desired site, stent is placed temporarily to check the mucosa with probe or round bur. Circular section of mucosa is removed using circular punch. Stent is replaced by a drill to create an appropriate implant drill. Stent is removed and Miniscrew placed with the manual screw driver or slow handpiece. Implant position is verified using radiograph.[22]

Universal Wire Grid: Universal wire grid was introduced by Narendra S Sharma et al in the year of 2013. It consists of positioning grid and guide base. Positioning grid is fabricated by cutting stainless steel wire in 1 inch length and welded to form a column grid, each cell should measure about 1.5mm. Column grid is welded to round “U” frame support arm of the positioning grid. Stent base is fabricated by bending 18 gauze wire forming one end to support the grid and the other end embedding in the occlusal surface of acrylic resin. Grid should be adjusted in vertical direction and it can be placed 5-6mm from the alveolar crest. Softened wax is added to the acrylic base and pressed towards the occlusal surface. IOPA is taken to determine the position of stent in relation to the roots. Once the appropriate cell of the grid is selected, pilot drilling is performed with the grid in place followed by mini-implant placement. Occlusal mirror is used to visualize the occlusal surface to guide the implant driver. Final position is verified using radiographs (Figure 7).[21]

Figure 7: Universal Wire Grid

K.S. MicroImplant Placement Guide: The wire guide is fabricated using round 0.018 or 0.020 (A.J. Wilcock) or 17 × 25 or 19 × 25 stainless steel wire. A helix of 2–3 mm diameter is made at the center of the wire. The appropriate length is determined by the desired mini-screw insertion point (generally 5–6 mm apical to the alveolar crest). After vertical height is determined, continues vertical loop made until measured length and one or two horizontal bends are the place at the level of the adjacent brackets. The wire guide is secured with a bracket or tube by ligature or an “O” ring. The miniscrew is inserted through the helix of the guide in the desired direction. The wire guide is disengaged after ¾ of the miniscrew is driven in and then the miniscrew is completely inserted. Placement accuracy is reconfirmed clinically. A periapical radiograph is taken to confirm the correct position of the helixes for the miniscrew insertion the intraoral periapical radiograph here shown was taken by conebeam paralleling technique (Figure 8).[23]

Figure 8: K.S. MicroImplant Placement Guide

A 3-Dimensional Jig for Accurate Mini-implant Placement: The mini-implant 3D jig is fabricated from a 0.019 x 0.025” stainless steel wire, a 0.022” slot weldable molar double tube and a crimpable hook (3M Unitek, Monrovia, CA 91016, USA). The wire is cut into two

pieces; one piece is used to fabricate an eyelet/helix approximately 2 mm in diameter, which is inserted into the main tube, and the other piece is bent into the form of an 'L' and inserted into the auxiliary tube. The 'L' arm of the 3D jig is inserted into the auxiliary tube of the upper first molar. The anteroposterior movement of the 'L' arm enables selection of the sagittal interradicular position. The vertical position of the eyelet is set to the desired position and marked, following which a crimpable hook is used to lock the vertical level. A periapical radiograph using the paralleling technique is taken to confirm the proposed location. The implant is then inserted into the eyelet guide. The guide arm acts an assistance for angulating the driver; the driver being maintained parallel to the guide arm, so as to enable implant insertion at the predecided angulation to the occlusal plane (usually at 30–40 degrees) (Figure 9).[24] Following the procedure, a periapical radiograph confirms the correct insertion at the desired location vertically and sagittally.

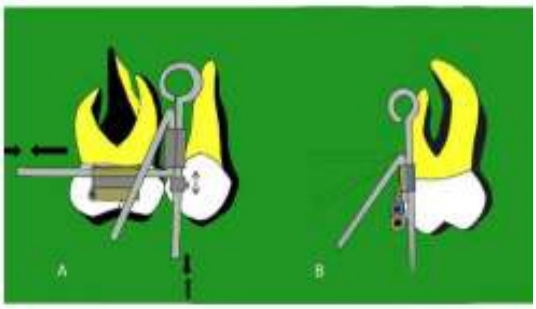

Figure 9: A 3D Jig for Accurate Mini-implant Placement

D.J. Adjustable Surgical Guide for Mini-Screw Placement Precise 3- D positioning of these implants between the root of the teeth is a challage because of the risk of tooth damage due to limited space. With the surgical guide in place pilot drill is passed through stainless steel tube, using normal saline irrigation to avoid excessive heat. The pilot drill should be 0.2 - 0.3 mm thinner than the screw and inserted to a depth of 2 - 3 mm. After the removal of surgical guide with the help of screw driver the selected appropriate size of mini screw is placed.[25]

A Simplified Stent for Anterior Miniscrew Insertion: the roots adjacent to the miniscrew insertion site by firmly pressing the long end of a periodontal probe against the buccal tissue. Securely tie two L-shaped rectangular wires, facing each other, into the bracket slots adjacent to the miniscrew site. These wires should extend. vertically well beyond the mucogingival junction, following the outer surfaces of the roots, and horizontally past the outer edges of the brackets. Using rectangular instead of round wire prevents the stent from rolling away from the gingiva when the patient closes over the film holder. Take a periapical radiograph to confirm the proper positioning of the stent . If necessary, slide the archwires within the bracket slots until they accurately follow the outlines of the roots (Figure 10).[26]

Adjustable Miniscrew Surgical Guide: The surgical guide is placed on the archwire and adjusted for insertion of the mini-screw. The Gurin locks are tightened and a periapical radiograph may be taken using a long cone

Figure 10: A Simplified Stent for Anterior Miniscrew Insertion

parallel technique to confirm the positioning. After careful examination of the radiograph. If the loop of the surgical guide is judged not to be correctly positioned, then the Gurin locks are released and the guide moved. Once the operator is satisfied that the guide is in the right place, then the mini-screw implant is inserted through the loop of the guide. It should be introduced in an apical direction at an angle of $0–30^0$ to the upper occlusal plane and at 0^0 in relation to lower occlusal plane (Figure 11).[27]

Figure 11: Adjustable miniscrew surgical guide

Mini implant jig: The jig is fabricated using commonly available 0.014″ ligature wire. The technique involves twisting the ligature wire around the neck of a probe using Mathieu's needle holder to form a loop. Next a small horizontal offshoot of the ligature wire is twisted at right angles on either side of the vertical segment of the wire. The horizontal offshoots given alternately on either side of the vertical segment of the wire after a certain distance help to prevent obscuring the radiographic image at the placement site and also help to divide the implant insertion region into quadrants for ease of placement. No special grid is required to check the angulation of the horizontal arms, which can be easily evaluated on the routine arch form template. The free ends of the jig are then ligated to the brackets of the two adjacent teeth between the roots of which the implant is to be inserted into, with the vertical arm lying in the sulcus between the two teeth. The site of implant placement is determined, and the quadrant of the jig in which the implant is to be placed is decided. After implant placement into the desired quadrant another regular intraoral periapical (IOPA) is taken to determine the accuracy of the implant insertion. No additional

exposure to X-rays renders this technique to be patient and clinician friendly (Figure 12).[28]

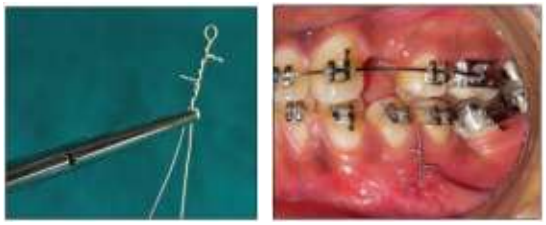

Figure 12: Mini implant jig

Conclusion

Several factors have been attributed to the success of mini-implant, namely, mini-implant factors (type, diameter, site of mini-implant placement and length), local host factors (occlusogingival positioning), and management factors (angle of placement, onset and method of force application, ligature wire extension, exposure of mini-implant head and oral hygiene).[29,30] The stability of the mini-implant is affected by extreme root proximity rather than the width of the alveolar septum. However, stability of the mini-implant is not greatly affected if there is no periodontal ligament invasion.[31] Buccal and palatal interradicular cortical bone thickness and alveolar process width tend to increase from crest to base of the alveolar process. Hence, the mini implant should be placed apically to avoid root proximity. The distance between the roots is widest between second premolar/first molar and first premolar/second premolar and the least between central incisor/lateral incisors.[32] This should be taken into consideration when selecting the site of mini-implant placement.

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