EXTRA ALVEOLAR SKELETAL ANCHORAGE IN ORTHODONTICS-A REVIEW

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Abstract

In order to improve orthodontic anchorage, orthodontic implants or temporary anchorage devices (TADs) are temporarily anchored to the bone, either by supporting the reactive unit's teeth or by eliminating the need for the reactive unit altogether. Extra-alveolar TADs are placed away from roots. Infra-zygomatic crest screws, the buccal shelf screws andramal screwsare some of the commonly used extra alveolar implants. They help in various tooth movements like en-mass distalization, intrusion, uprighting, mesialization etc. The purpose of this review is to discuss the type of screw utilised, its size, the locations where extra-alveolar TADs are placed, the indications for its usage, and any unique concerns when treating malocclusion in all three dimensions without damaging reciprocal forces.

Keywords: Absolute anchorage, buccal shelf screw, Infrazygomatic screw, ramal screw

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1. Introduction

Proffit defined anchorage as resistance to undesirable tooth movement, and it is crucial for intended tooth movement to occur without any opposing force. Poor anchoring control will result in longer treatment times, which will have unfavorableeffects [1]. Hence, it is recommended to plan anchorage in three dimensions. Till recently, the resistance was mainly provided by other teeth and palate via intraoral appliances and extraoral force applied to the head and neck[2]. Intraoral sources of anchorage don't provide absolute anchorage and some anchorage loss was observed [3]. Various studies showed better treatment results with implant supported anchorage thanwith traditional anchorage.[4]

Absolute or infinite anchorage is zero movement of the anchor unit; this type of anchorage occurs naturally in ankylosed teeth. Skeletal anchorage devices,otherwise known as TADS, was developed following the same analogy and is anchored directly to the bone [5]. Mini implants, or MIs, are frequently inserted in the dentoalveolar region, particularly in the spaces between tooth roots, to fulfil anchorage demands in contemporary orthodontic therapy.Inter radicular miniscrews have the advantages of smaller size, decreased cost and easier placement and removal. However, miniscrews are limited by the narrow alveolar bone between the roots. There is only 2-2.5mm of bone between the roots of molars and premolars. Also, proximity of miniscrews to the roots may lead to failure of screw anchorage [5].

The use of miniplates (skeletal anchorage system) and extra alveolar TADS, which are fixed at a distance from the root apices and do not interfere with tooth movement, can overcome the drawbacks of interradicular Mini screws on both buccal and palatal side [6,7].Miniplates require the surgeons for placement and removal that makes it use less than extra alveolar TADS.The purpose of this review is to discuss the type of extra alveolar screws utilised on the buccal side, its size, the locations where extra-alveolar TADs are placed, the indications for its usage, and any unique concerns when treating malocclusion in all three dimensions without damaging reciprocal forces.

Infrazygomatic Crest Screw

Infrazygomatic crest is a pillar of cortical bone located near the zygomatic process of the maxilla anatomically. Clinically, it is a palpable bony ridge that curves around the maxilla's alveolar and zygomatic processes. This enables bicortical fixation by buccal cortical plate and the sinus floor and improves the miniscrew's primary stability. More miniscrew biting depth and more osseous contact are made possible by thicker bones [8].

Material used:

While the overall success rate was 93.7%, both Stainless Steel(SS) and Titanium(Ti) are clinically acceptable.SS has long been the material of choice for applications requiring resistant to fracture.Despite Ti being a suitable material, a detailed fracture investigation is required [9].

Size of the implant:

Better pull-out strength is provided by the longer mini-implants and higher implantation angles [10].Stress at the implant-bone interface was not significantly influenced by the implant length.[11]The soft tissue in the buccal vestibule is thick, as it is in the majority of clinical scenarios, a 14 mm screw with a 7 mm head and collar area is the choice. In situations when there is only thin soft tissue at the vestibule, orthodontic bone screws of 12 mm length are preferred.Screw length between 9 and 11mm can be inserted without sinus perforation [12].

Location:

The placement involves at the level of 12 - 17mm above the occlusal plane at an angle of 65 - 70 degrees to the distobuccal root of the first molar.

The factors that affect the amount of screw surface area in contact with the boneare the length of the root, pneumatization of the maxillary sinus, bucco-lingual inclination of the maxillary first molar, the height and depth of the alveolar processes, and the morphology of the buccal furcation that can be studied in CBCT. [13][14]

Placement:

The screw is directed at 90° to the occlusal plane. The direction of the bone screw driver is shifted by 55° to 70° towards the tooth, downward, after initial insertion in the bone is formed. This helps to avoid the teeth's roots and directs the screw to the infra zygomatic region of the maxilla.For proper hygiene, there should be 5 mm of space between the BS's head and the soft tissue surface [13].

Indications:

Sagittal-Class II malocclusion with severe overjet that warrants retraction of incisors by using the complete extraction space, distalization of maxillary arch, distalization of maxillary molar for the purpose of gaining space. Location of IZC bone screws is ideal for anchoring mechanics to distalize the buccal segments

Vertical- maxillary posterior intrusion in open bite cases, full arch intrusion along with anterior implant in vertical maxillary excess

Transverse-asymmetry correction of the occlusal plane and midline deviation [15].

Advantages:

Primary stability is ensured by superior cortical bone quality, and the placement of the implant is considerably more suitable for the application of intrusive forces and does not interfere with the movement of neighboring teeth.

Disadvantages:
It is in the vestibular region, there is significant soft tissue movement, and the implant may easily be covered. Bone quantity may be insufficient and increasing the risk of maxillary sinus injury.

Failure rate:
IZC mini-implants have slightly lower success rate (78.2 %) than that of the average mini-implant.
The success rate is affected by various factors likeexperience of operator, length of mini implants, time period used, skeletal facial pattern, oral hygiene status, mucosa vs attached gingiva, angle of placement and the direction of loading force [16].

Buccal Shelf Screws
Buccal shelfis a bony fossa with thick cortical plateextends buccally with a considerable amount of bone bilaterally in the posterior part of the mandibular body, and anterior to the oblique line of the mandibular ramus and lateral to the molar area.

Size of the implant: The buccal shelf area is typically thin and deep in the Indian population; a 2x12 mm screw is the recommended choice [17].

Location: The ideal site is 4 mm buccal to the man dibular 2nd molar CEJ, near the muco-gingival junction usually to distal root.It is possible to consider an insertion site lateral to the mesial ro ot of the second molar, but insertion will likely nee ded to bemore apical to achieve adequate buccal bo ne thickness [18].

Placement:
Self-drilling screw is placed into the bone perpendicular to the occlusal plane and as nearly parallel to the mandibular first and second molar roots as possible. After the first notch, the driver's orientation is shifted by 60° to 75° towards the tooth, upward, which helps the screw avoid the root contact and direct to the mandibular buccal shelf area. Considering the cortical bone thickness pre-drilling is recommended in order to avoid high insertion torque[14]. For proper hygiene like IZC BS, there should be 5 mm of space between the BS's head and the soft tissue surface.

Indications:
Sagittal Problem- class III malocclusionwith anterior cross-bite and/or open-bite, distalization of mandibular arch,distalization of mandibular molar for the purpose of gaining space
Transverse Problem- unilateral full buccal cross-bite or scissors bite, correction of occlusal plane asymmetries and midline deviation
Vertical- intrusion of posterior teeth [15]

Advantages: The miniscrew prevents possible screw-to-root contact during anterior-posterior dental movements by being inserted along the long axes of the teeth.

Special consideration: Different ethnic origins are associated with morphological variance in the buccal shelf area, such as an excess of brachycephalic face pattern in Asian individuals.The implant's tip is often kept at a safe distance from the inferior alveolar nerve so as to prevent any iatrogenic harm and Indians' buccal shelf area is more suitable for screws [19].

Ramal Screws
Ramusscrews are inserted into the anterior aspect of the ramus of the mandible in the area between internal and external oblique ridge

Size of the implant: Before the screw engages the dense cortical bone, the thickness of the soft tissue that a ramal bone screw must pass through is greater than that of a buccal shelf screw, hence a screw with extended collar is recommended that is 2x14mm screw[20].

Location: The retromolar fossa lies medial to the external oblique ridge of the ramus intraorally, which is clearly palpable and located. The ideal location for ramal screws to be inserted without interfering with the occlusal plane is thought to be 5 to 8 mm above the occlusal plane, halfway between the internal- and external-oblique ridges of the ascending ramus [21].

Placement: The N angle, which represents the angle between the constructed line of insertion and the occlusal line, shows that, in order to prevent nerve damage, ramal implants should be placed at an angle between 13 and 25 degrees from the occlusal line [22].

Indications: Uprighting the impacted lower molarsand distalizing mandibular molars
Advantages: Ramal screw has the biomechanical advantage because of their location and provide occlusal and distal direction of force for the correction of horizontal impacted mandibular molars

Special considerations: The most common cause of failure is because of highly mobile thick layer of alveolar mucosa and difficult oral-hygiene maintenance, hence 5 mm of space between the

BS's head and the soft tissue surface is recommended along with routine oral hygiene

2. Conclusion

Extra alveolar skeletal anchoring is widely used in orthodontic treatment now a days due to a paradigm change. With the right information on screw placement, indications, and specific considerations, we may better avoid any injuries or problems related to it and helps in gaining full advantage of it.

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