Review Articles

An overview of extra alveolar bone screws-IZC/BS screws

Sandeep Shetty[1], Katheesa Parveen[2]

[1]Professor, Department of Orthodontics and Dentofacial Orthopaedics, [2]Senior lecturer, Yenepoya Dental College and Hospital, Mangalore, Karnataka, India

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Corresponding author: **Katheesa Parveen**. Email: drkatheesaparveen@gmail.com

ABSTRACT

Anchorage has been a strong content in the Excellency of the orthodontic treatment. The anchorage conservation was a difficult problem until the early 1900s. The introduction of the mini-screws followed by the skeletal anchorage system and the recent introduction of extra alveolar Bone Screw (EBS) has overcome this problem. The introduction of EBS has also changed the concept of treatment planning by converting borderline surgical cases to non-surgical cases. This is a review article providing an overview of the infra-zygomatic crest (IZC)/ buccal shelf (BS) screws in its application into the field of Orthodontics.

Keywords: Anchorage; infrazygomatic crest screw; buccal shelf screws; temporary anchorage devices.

INTRODUCTION

The conservation of anchorage is a strong pillar for successful orthodontic treatment. Undesired tooth movement due to orthodontic forces has been a consistent problem throughout treatment until the introduction of Temporary Anchorage Devices (TADS) into the field of Orthodontics in the early 20th century (1). Although earlier TADS that were initially developed had given a strong foundation for anchorage, it comes with its limitations. The development of IZC screws in recent years has tried to overcome the limitations of existing mini-screws. These screws are a temporary anchorage device with increased overall dimensions and that which uses an extra-alveolar site of placement; unlike inter radicular mini-screws. Dr. Eric Liou introduced IZC screws from Taiwan, which has added a ray of hope to overcome the limitations of existing TADS.

A brief history of TADS

Either a temporary anchorage device (TAD) is a device, which is temporarily fixed to bone for enhancing orthodontic anchorage by supporting the teeth of the reactive unit, or by obviating the need for the reactive unit altogether and which is subsequently removed after use (1). The first experiments of TAD were performed on ascending ramus of the dogs using Vitallium screws of 3.4 mm diameter and 13 mm length by Gainsforth and Higley (2) unfortunately all the screws failed because of an infection. Later around 1983, Creekmore did the first human clinical trial and Eklund on a deep bite case with a mini-screw inserted in the Anterior Nasal Spine. Even though it was successful, it lacked an immediate acceptance (3). The invention of the Onplant, an Osseo integrated TADS in 1995 by Block and Hoffman (4) and the mini implants derived from surgical screws used to fixate bone fragments during orthognathic and reconstructive surgery by Kanomi (5) popularized TADS anchorage system. Melson, Peterson, and Costa used the concept of gaining anchorage from infra zygomatic crest since 1998 for intrusion and retraction in a partially edentulous patient using zygomatic ligatures (6). However, the infra zygomatic crest screws were developed by Dr. Eric Liou from Taiwan in recent years.

Anatomy of infrazygomatic crest and buccal shelf

Infra-zygomatic crest is a bony crest in the maxilla extending from the buccal plate of the alveolar process. It runs lateral to the roots of first and second maxillary molars and extends 2cms or more to the zygomaticomaxillary suture, superiorly. Clinically it is a palpable ridge running along the curvature between the alveolar and zygomatic process of the maxilla. The location of this crest of the cortical bone is said to vary among young and old subjects. In young subjects, it is said to be located between the maxillary second premolar and first molar and in adults, it is above the maxillary first molar (7).

The mandibular buccal shelf area is an extra alveolar site for the placement of mini-screws. It lies on the buccal alveolar bone of the Mandible extending from the first molar region to the external oblique region. To be specific in the placement of the buccal shelf screw it is placed lower and lateral to the second molar region. However, in the Indian population, most of the time the buccal shelf region is thin, hence buccal shelf bone screws can be placed on the external oblique ridge (8).

Case selection for placement infrazygomatic screws

The infra zygomatic screws can be used in the patients who require maximum anchorage for movement of the teeth like protraction, retraction, intrusion, extrusion, up-righting, segmental or full

arch treatment, asymmetric tooth movement. This can also be used to provide indirect anchorage. Though it can be used in the treatment of various malocclusion, the ideal cases are the distalization of entire maxillary dentition, cases that have relapsed and lost the anchorage (9).

Why Infra-zygomatic crest and buccal shelf area considered for the extra alveolar screw placement?

When planning and driving the TADS the several factors should be taken into consideration like the presence of anatomical structures, the density of the bone, bone width, cortical bone thickness. The IZC and BS region are considered the safer zone as these areas are devoid of important anatomical structures like a tooth root, nerves, etc. The absence of hindrance to the roots of teeth allows for more versatility of Orthodontic tooth movement. The other factor is the primary stability. It is defined as the absence of mobility in the bone bed after mini-screws placement (9). It is dependent on how bone screws engage mechanically the bony region while and after driving into the bone. IZC/BS regions have good quality and quantity of the bone to provide good primary stability. Bone density is also high with D1 >1250 HU (10).

Description of an infra-zygomatic screw

IZC screw is nothing but a temporary anchorage device, which is larger in dimension compared to mini-implant; hence, it should possess basic properties of mini-implant like excellent biocompatibility, non-toxicity, excellent mechanical properties and provide resistance to stress, strain, and corrosion. The materials used for the manufacturing of these TADS can be divided into three categories: bio tolerant (stainless steel, chromium–cobalt alloy), bioinert (titanium, carbon), and bioactive (hydroxyapatite, ceramic oxidized aluminum). Titanium is considered to be an ideal material as it possesses no immunologic reactions and no neoplasm formation (11). However, the pure titanium has less fatigue strength, for this reason, an alloy of titanium that is titanium-6 aluminum-4 vanadium is used in the manufacturing of TADS. Nevertheless, the IZC/BS screws are placed in high bone density region (>1250 HU) and it requires greater fracture resistance to drive the screws through bone, so the stainless steel is preferred material of choice for infra-zygomatic screws (10).

Mini implant varies in sizes from 1.5-3mm in diameter (12) and 6-11mm in length (9). The TADS designed to use in the infra-zygomatic region is available commonly in 12mm and 14mm sizes with a diameter of 2mm. The larger 14 mm size is used in the case of thick soft tissue whereas 12mm in the thinner soft tissue region. Further dimensions of screws and their parts may vary according to the manufacturers (9).

Method of driving screws into the bone

IZC screws can be positioned on the cortical plate of both first and second molar higher and lateral to it, preferably mesial to the mesiobuccal root of molar (fig. 1). Nevertheless, the region of the second molar is more preferred as compared to first molars alveolar bone is thicker on the buccal surface in this region (7).

The driving of the IZC screws into the bone begins 14-16mm above the maxillary occlusal plane at an angle of 90° to the occlusal plane. After a couple of turns, the mini-screws handle is turned to an angle of 55° to 70° to avoid damage to the roots of the molar teeth. The angle less than 55° technically is said to be easier but biting depth is reduced hence lacks stability and there is a higher failure rate with the above-mentioned angle. There is also a chance of alveolar or buccal mucosa irritation. An angle greater than 75° faces technical difficulty in placement, there might be slippage of IZC screws, bone stripping and also there is a greater chance of damage to the mesiobuccal root of the molar. Hence, the angulation between 55°-70° is chosen. Various guides have been developed for the accurate positioning of the IZC screw, which includes Chen double film method, Pinhead soft tissue penetration method and Transparent Adhesive patch for double film technique (7).

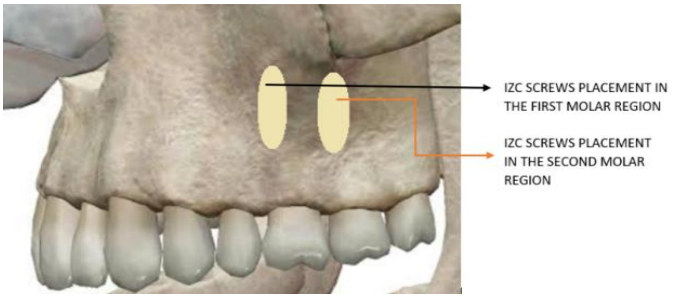

Fig. 1: Sites for the placement of IZC screw

Fig. 2: Sites for the placement of the BS screw

For the placement of the BS screw, the region distal to first mandibular molar and second mandibular molar is palpated for a triangular bony shelf (fig. 2). When the bony shelf is palpated which might be located in the interdental region between first and second molar/second or third molar, screws are inserted parallel to the long axis of the lower molars initially, after a couple of the turns, driver direction is changed towards the tooth so that screw tip does not hinder the roots of the tooth.

Complications

The problems associated with mini-implant during placement or after the placement are also seen with IZC with an exemption of trauma to the root of the tooth if IZC screw driving angle is proper. Other complications like maxillary sinus perforation, check mucosa irritation, ulceration is also commonly seen (13). The soft tissue irritation is a common problem faced with IZC/BS screw, so to avoid this a clearance of 2.5mm has to be given between screw head and soft tissue. Another common problem is the perforation of the maxillary less, which is commonly seen in the first molar region or in case of the missing posterior teeth as the sinus wall is lower. The penetration of 2mm heal themselves, hence orthodontic treatment can be continued in such cases (14-16). Further anatomy of the IZC/BS site has to be taken into consideration for the proper selection of the screw length. Other complications associated with mini-screws like mini-screws bending, failure or fracture, stationary anchorage loss is also seen, but to a lesser extent. In the case of early loosening of the screw -replacement is advisable in the different sites.

CONCLUSION

The discovery of IZC/BS screw is a magical innovation in the field of orthodontics. They have truly brought a change in perspective of conservation of an anchorage and have changed the paradigm of orthodontic biomechanics by converting border line surgical cases to non-surgical cases and extraction cases to non- extraction. They even bought an aesthetic impact, which was difficult to be achieved by conventional mechanics. Finally, it is the proper case selection and precise placement of the screws with the good biomechanics that will help in achieving an optimum result in patients.

CONFLICT OF INTEREST: None.

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