Site Selection for Mandibular Buccal Shelf (MBS) and Infra-Zygomatic Crest (IZC) Bone Screws

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Introduction

Multiple studies indicate primary stability of TAD is the critical factor for clinical success.[1-3]

Primary stability has a positive relationship to cortical bone thickness and density.[1-4] At least 1 mm of buccal cortical bone thickness is necessary to achieve primary stability.[5,6]

To facilitate oral hygiene and prevent soft tissue irritation, Chang et al.[7] recommended 5 mm distance between screw head and soft tissue surface. With the 5 mm soft tissue clearance, screws can be positioned in either attached gingiva or movable mucosa. There is no statistical significance affecting screw success rate between these two types of tissue.

Anatomical Analysis of MBS Screw

The mandibular buccal shelf (MBS) is the buccal aspect of alveolar bone of the mandibular molars. It extends from the alveolar crest to the external oblique ridge (Fig. 1).[8] The flatness and cortical bone thickness increase gradually from the anterior to posterior MBS. The insertion point, around the mucogingival junction (MGJ), depends on patients' individual anatomy; however, the flatter platform of MBS and the more attached gingiva are favorable factors that make it a suitable location to insert a

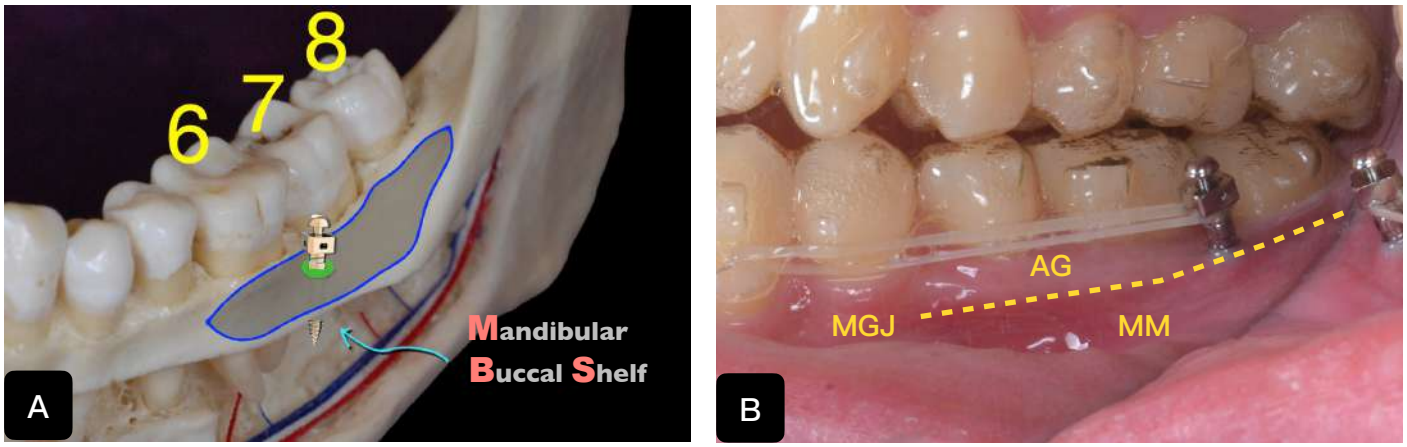

Fig. 1:
A. *The lateral cutaway view of human mandible shows the area of buccal shelf (gray area lined by blue contour). The green area shows the insertion site for MBS screw.*
B. *The insertion point of MBS screw is suggested around MGJ which separates the attached gingiva (AG) and movable mucosa (MM). However, it is acceptable to place on either AG or MM depending on the individual MBS anatomy of each patient, as long as there is a 5 mm screw head clearance from the soft tissue.*

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MBS screw.[9] The relatively consistent and flat zone was noted around the interproximal area of first and second molars, which is an ideal site for MBS screw insertion. As to the insertion angle, 30° to the perpendicular plane of bone surface is recommended as more cortical bone engagement leads to higher primary stability of the screw.[10]

Inferior alveolar nerve is a common anatomical concern when inserting MBS screws. The distal side of the mandibular second molar shows the greatest proximity to the inferior alveolar nerve (5.46 ± 1.63 mm) measuring from the screw tip. It is still considered sufficient and safe for screw placement.[11] However, considering the root length of the lower molars, the length and the 5-mm soft tissue clearance of screw, as well as the distance between the apices of the molars and the inferior alveolar canal,[12] there is sufficient distance for MBS screw insertion.

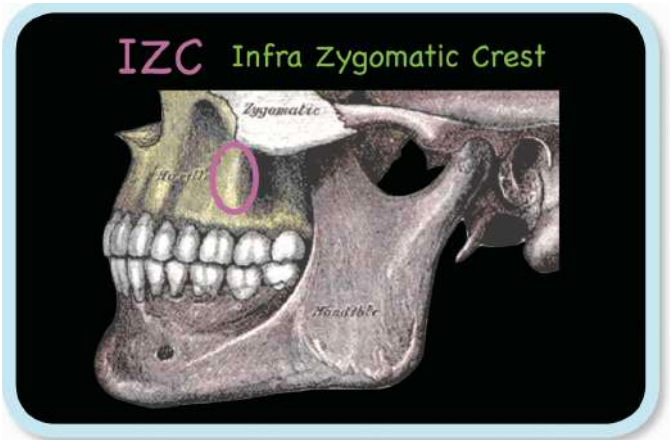

Fig. 2:
Infra-zygomatic crest (IZC), lateral to the roots of maxillary first and second molar, is marked with pink ovoid circle. Courtesy to Dr. John Jin-Jong Lin)

Anatomical Analysis of IZC Screw

The infra-zygomatic crest (IZC) is an osseous bone crest on the buccal side of posterior maxilla. It originates from the buccal alveolar process, lateral to the roots of maxillary first and second molars, to the zygoma (Fig. 2). IZC screws are placed in the base of the zygomatic crest eminence which is the IZC region and buccal to the roots of U6 and U7 (Fig. 3).[13] In patients younger than 14 years old, since U7s have not erupted yet or have just erupted, the buccal bone outside the mesiobuccal root (MBR) of U7s might still be soft as it lacks the force loading to condense the alveolar bone. The first choice of screw insertion site in patients younger than 14 is buccal to the root of U6s (Fig. 4).

Sinus perforation is a common concern among clinicians. Chang et al.[14] reported sinus penetration will lead to decreased insertion torque and interface bone contact but not to TAD success. Fortunately, there are three compensating factors: bicortical stabilization, age-related increase in bone quality, and increased TADs surface (2-mm diameter). Also none of the samples with sinus perforation

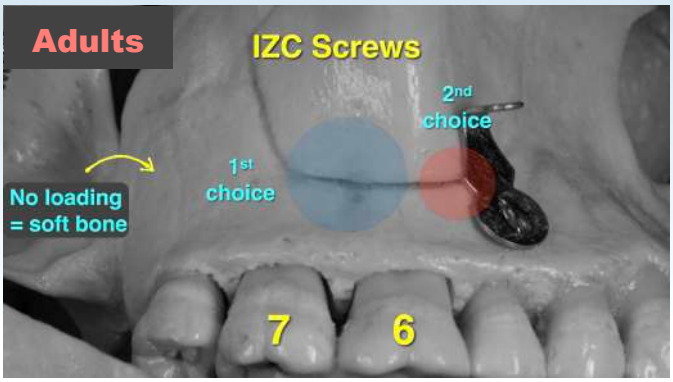

Fig. 3:
The first choice of IZC screw insertion site is around the U6 and U7 (blue circle).

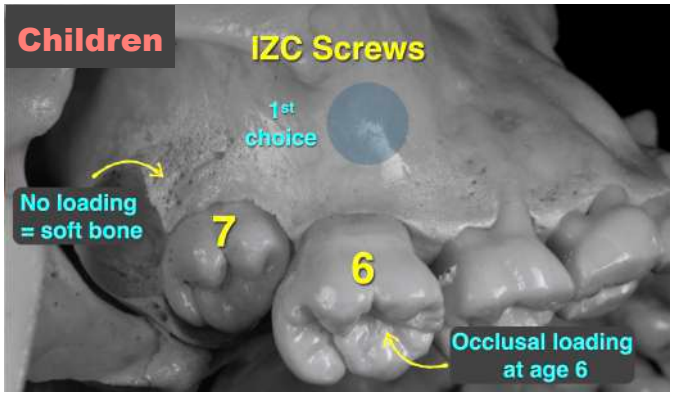

Fig. 4:
In young patients, the first choice of IZC screw insertion site is over the MBR of U6 (blue circle). See text for details.

presented any adverse signs or symptoms. This might be contributed to the use of prophylactic antibiotics and/or small sinus wound diameter (≤ 2 mm) which has good healing potential.[15]

MBS Screw for Class III

MBS miniscrews are proposed to be a reliable source of extra-alveolar (E-A) anchorage for retracting the entire mandibular arch to correct severe crowding, protrusion, and skeletal malocclusion, with/without extractions or orthognathic surgery.[16-18] Since the retraction force does not pass through the center of resistance (CR) of the entire lower dentition (Fig. 5), it is likely to lead to posterior rotation (counterclockwise rotation) of the lower dentition, often causing a posterior open bite (Fig. 6). This side effect could be corrected by passive eruption,[19] such as intermaxillary elastics and patients' chewing force after debonding the active devices.

IZC Screws for Class II

Correcting a skeletal Class II with excessive overjet in adult is a challenging task (Fig. 7). Protrusive maxilla with excessive overjet (> 10 mm) usually requires extractions and/or orthognathic surgery. However, patients often appeal more to conservative approaches such as non-extraction and non-surgical treatments. With non-extraction or non-surgical approaches, the finished results might be compromised, for instance, flared lower incisors and incompetent, protrusive lips. E-A bone screws in the

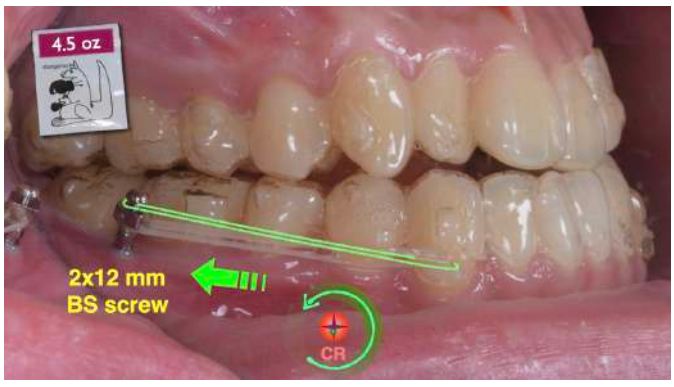

Fig. 5:
The force system of MBS screw anchorage to retract the mandible. Since the retraction force does not pass through CR of the mandible, it tends to cause a counterclockwise rotation of the lower dentition, often leading to a posterior open bite.

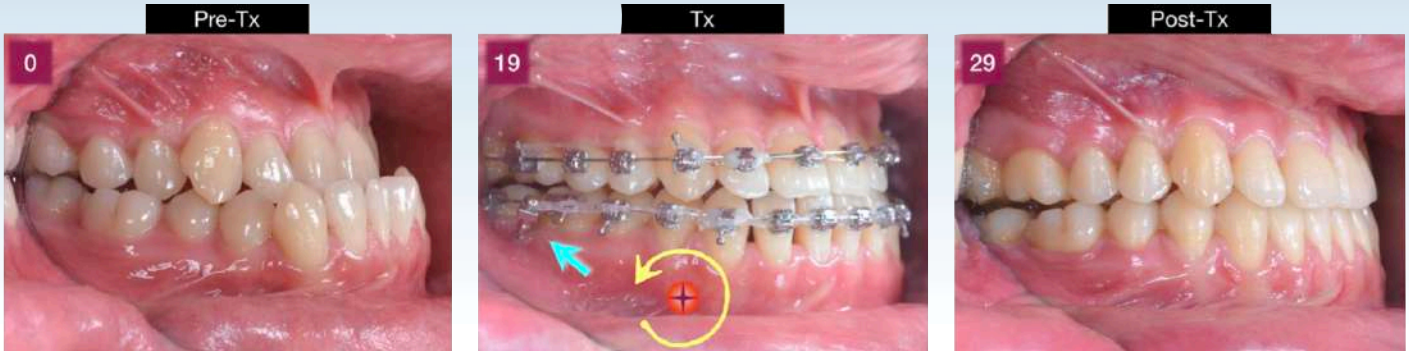

Fig. 6:
A panel shows pre-treatment (Pre-Tx), during treatment (Tx), to posttreatment (Post-Tx) records from left to right for a Class III patient treated with MBS screw (blue arrow) as mandibular retraction anchorage. The months of treatment are marked on the upper left side. Since the retraction force of the mandible did not pass through the mandibular center of resistance, it created a counterclockwise rotation of the mandibular arch and led to a posterior open bite.

Fig. 7:
A 3-image panel of intraoral photographs documenting the correction of skeletal Class II with 8 mm overjet. Pretreatment (Pre-Tx), in-treatment (Tx), and posttreatment (post-Tx) records are shown from left to right. The major mechanics were elastics anchored by the IZC miniscrew with Class II elastics to retract the maxilla and correct the excessive overjet.

IZC produce definite anchorage to retract the entire maxillary arch. The bilateral force system is diagrammed in a 2-dimensional representation (Fig 8).[8] However, not only in Class II treatments, IZC screws can also be used with Class III elastics to correct skeletal Class III cases by hooking elastics from mandibular canines to the IZC screws. The downside is elastics are prone to fall-off during mouth opening if the screw is tilted mesially.

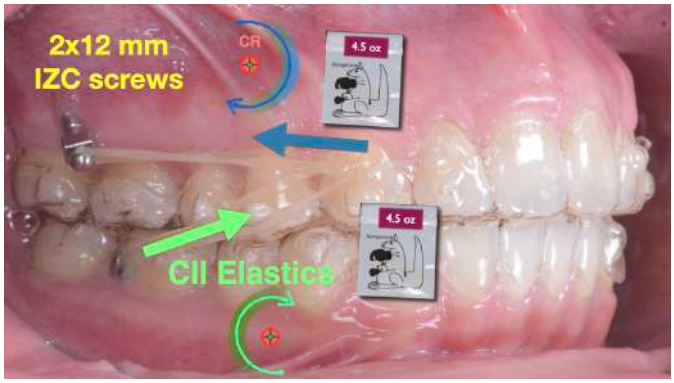

Fig. 8:
IZC screws served as anchorage to retract the maxillary arch backward (blue straight arrow). Class II elastics hooked from lower molars to upper canines reduced overjet (green straight arrow). Since both forces on the maxilla and the mandible did not pass through the CR of both arches, they created a clockwise rotation on both dentition (green and blue curved arrows). See text for details.

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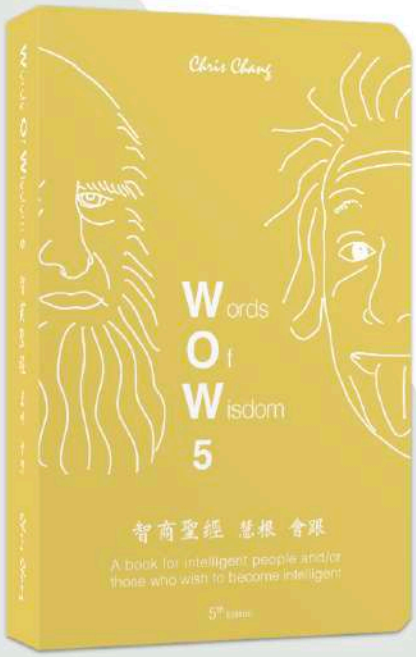

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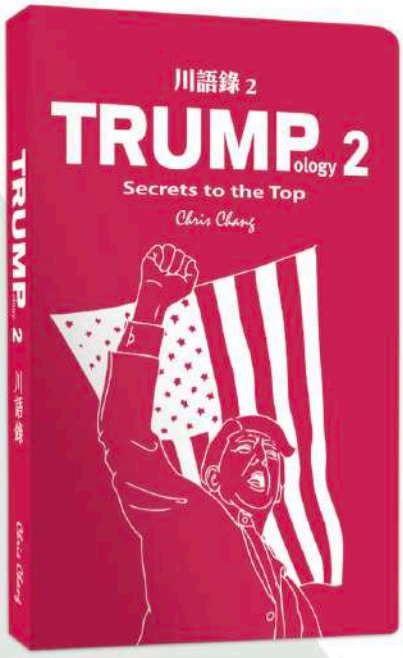

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Dr. Chang received his PhD in bone physiology and Certificate in Orthodontics from Indiana University in 1996. As publisher of Journal of Digital Orthodontics-a journal for interdisciplinary dental treatment, he has been actively involved in the design and application of orthodontic bone screws.

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