International Journal Dental and Medical Sciences Research
Volume 6, Issue 2, Mar - Apr 2024 pp 439-443 www.ijdmsrjournal.com ISSN: 2582-6018

Infrazygomatic Crest and Buccal Shelf Implant- A Review Article

Dr. Kritika Kant[1], Dr. Syed Akbar Ali[2], Dr. Trilok Shrivastava[3], Dr. Chandresh Shukla[4], Dr. Siddharth Dixit[5], Dr. Aakash Patel[6], Dr. Kirti Kardam[7]

[1] *PG Student, Department of Orthodontics & Dentofacial Orthopedics, People's College Of Dental Sciences & Research Centre, Bhopal.*

[2] *MDS (Professor), Department of Orthodontics & Dentofacial Orthopedics, People's College Of Dental Sciences & Research Centre, Bhopal.*

[3] *MDS (Professor & HOD), Department of Orthodontics & Dentofacial Orthopedics, People's College Of Dental Sciences & Research Centre, Bhopal.*

[4] *MDS (Professor), Department of Orthodontics & Dentofacial Orthopedics, People's College Of Dental Sciences & Research Centre, Bhopal.*

[5] *MDS (Reader), Department of Orthodontics & Dentofacial Orthopedics, People's College Of Dental Sciences & Research Centre, Bhopal.*

[6] *MDS (Reader), Department of Orthodontics & Dentofacial Orthopedics, People's College Of Dental Sciences & Research Centre, Bhopal.*

[7] *PG Student, Department of Orthodontics & Dentofacial Orthopedics, RKDF Dental College, Bhopal.*

Corresponding author- Dr. Kritika Kant, PG Student, Department of Orthodontics & Dentofacial Orthopedics, People's College Of Dental Sciences & Research Centre, Bhopal.

Submitted: 05-04-2024 Accepted: 13-04-2024

ABSTRACT- During orthodontic treatment the teeth are exposed to forces and moments, and these acting forces generate reciprocal forces of same magnitude but opposite in direction. To avoid unwanted tooth movements and maintain treatment success, these reciprocal forces should be diverted or resisted [1]. Conservation of anchorage plays pivotal role in effective management of orthodontic cases for attaining structural and facial esthetics. Even teeth have been found to lack sufficient stability to produce certain changes desired in the dentures and basal bone, some other source of resistance has become desirable. Therefore, it was thought that if anchorage could be gained from a point within the basal bone, stability would be greatly increased. In 1980's conventional endosseous dental implants were the focus of skeletal anchorage system. TAD's were introduced in the field of Orthodontics in 20th century. Although initially developed TAD's had given a strong foundation for anchorage but they too had several limitations. To overcome the limitations of these mini-screws, new temporary anchorage devices were developed with increased overall dimensions which use extra-alveolar sites for placement, infrazygomatic and buccal shelf implants. This review article aims to provide an overview on the new advent of extra-radicular implants, the design, methods of insertion, indications, contraindications, application and limitations which have helped us extend the envelope of discrepancy.

KEYWORDS- Anchorage, unwanted tooth movement, endosseous dental implants, skeletal anchorage system, TADs, mini-screws, infrazygomatic implants, buccal shelf implants, extra-radicular implants.

I. INTRODUCTION

Anchorage in orthodontics means resistance to displacement [1]. It is defined as the nature and degree of resistance to displacement offered by an anatomic unit when used for the aim of effecting tooth movement. During orthodontic treatment the teeth are exposed to forces and moments, and these acting forces generate reciprocal forces of same magnitude but opposite in direction. To avoid unwanted tooth movements and maintain treatment success, these reciprocal forces should be diverted or resisted [1]. Conservation of anchorage plays pivotal role in effective management of orthodontic cases for attaining structural and facial esthetics.

Anchorage can be sourced from the teeth, oral mucosa, underlying bone and extra orally. The sources of anchorage can be – (1) extraoral and (2) intraoral sources. The intraoral sources of anchorage include the teeth, alveolar bone, the basal jaw bone, the musculature. Certain extra oral areas can also be used when adequate resistance cannot be obtained from intra oral sources for the purpose of anchorage .The extra oral sources of anchorage include. (1) The cranium (2) The back of the neck (3) The facial bones.

International Journal Dental and Medical Sciences Research
Volume 6, Issue 2, Mar - Apr 2024 pp 439-443 www.ijdmsrjournal.com ISSN: 2582-6018

Even teeth have been found to lack sufficient stability to produce certain changes desired in the dentures and basal bone, some other source of resistance has become desirable. Therefore, it was thought that if anchorage could be gained from a point within the basal bone, stability would be greatly increased. Such anchorage can only be obtained by means of skeletal anchorage which includes all the devices that are fixed to the bone. Evolution of orthodontic implants was followed the development of dental implants and orthognathic fixation methods. These techniques were combined with basic biological and biomechanical principles of osseointegration. Earliest record of idea for skeletal anchorage was by Gainsforth and Higley (1945) who proposed possibilities of orthodontic anchorage in the basal bone by inserting Vitallium screws into a dog's ramus for the purpose of distalising a maxillary canine [2]. Absolute anchorage, when the anchorage units remain completely stationary, is sometimes desirable but is usually unattainable with traditional orthodontic mechanics. Therefore, over the past 60 years, methods have been developed to create absolute skeletal anchorage and thus widen the scope of orthodontics.

II. HISTORY

Creekmore and Eklund (1983) gave the first clinical report of TAD usage in the anterior nasal spine for intrusion of upper incisors in a patient with severe deep bite[2]. Kanomi (1997) was the first to describe that mini implant of 1.2 mm diameter and 6 mm length can be explicitly used for orthodontic purpose[2]. Abso-Anchor Screw was developed in 1999 by a group of Korean clinicians, Aarhus Mini-Implant was created by a Scandinavian group and an Italian group developed.

In 1980's conventional endosseous dental implants were the focus of skeletal anchorage system. TAD's were introduced in the field of Orthodontics in 20th century. Although initially developed TAD's had given a strong foundation for anchorage but they too had several limitations. To overcome the limitations of these mini-screws, new temporary anchorage devices were developed with increased overall dimensions which use extra-alveolar sites for placement, unlike inter-radicular mini screw placement. IZC screws were developed by Dr. Eric Liou from Taiwan in 2007, which gave a ray of hope to overcome limitations of TAD's.

More recently an apt balance was achieved with the advent of the - Orthodontic Bone Screws (OBS) which had an extra-radicular site of placement in the infrazygomatic crest of the maxilla and the buccal shelf area of the mandible, with significantly less failure rates than regular mini-implants and doesn't require extensive surgical intervention for their placement. Recently they have gained popularity in orthodontics as it helps expand the envelope of discrepancy.

III. PARTS OF EXTRA-RADICULAR IMPLANTS

Orthodontic bone screws generally have 3 parts-

- Head
- Neck
- Core

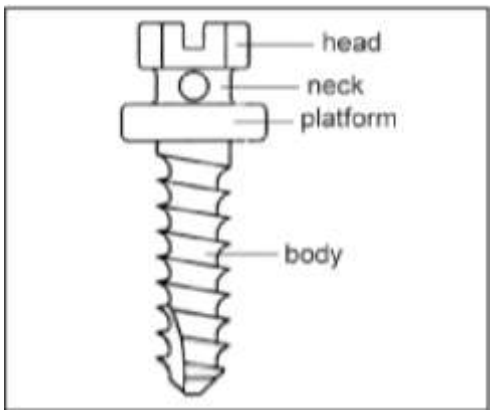

Figure 1- Parts of implant

Head of the screw is the part which is engaged in the hand of the screw driver. It is the orally exposed portion of the screw which provides attachment for the springs and elastics. For better patient compliance and retention of elastic chain, the shape of the screw head is mushroom shaped.

Between the head and core is the part which contacts the soft gingival tissue, known as neck or collar. The surface of the neck should be smooth and well-polished to diminish plaque accumulation around the neck[2]. It has a specific double neck design for better maintenance of oral hygiene and extra attachment. Threads are wrapped around core which determines the pitch of the screw, i.e vertical distance between the adjacent screw thread.

The screw part gets embedded in the cortical or medullary bone to provide retention. The thread of the screw around shank or main body of the TAD has the cutting edge that facilitates insertion.

International Journal Dental and Medical Sciences Research
Volume 6, Issue 2, Mar - Apr 2024 pp 439-443 www.ijdmsrjournal.com ISSN: 2582-6018

Figure 2- Specifications of extra-alveolar bone screw

IV. DIMENSIONS OF EXTRA-RADICULAR BONE SCREWS

A 0.8mm diameter hole in the head or neck of the screw is mostly used for direct anchorage[2]. The diameter of the screw is measured either at the core, which is known as inner diameter, or the outer diameter when threads are also included. Minimum diameter of 2 mm is required to enhance the fracture resistance of the screw. Screw must have a sharp cutting edge so that pre drilling would not be required.

The normal size of a mini- implant is between 6-11 mm in length and 1.3-2 mm in diameter, whereas bone screws are big in size ranging from 10-14 mm in length and diameter of 2 mm. Minimum bone required for stability of bone screw is 8 mm.

Mini- implants which were generally used, were revamped with following features to form a bone screw-

1. Length of about 10-14 mm which would facilitate insertion in areas of high bone density with adequate primary stability. Increased length also owes to its placement steered away from the roots at extra alveolar sites.
2. Diameter of 1.5-2 mm ensures fracture resistance. The resistance to torsional fracture is directly proportional to greater diameter and length, therefore, these features have been introduced.
3. Mushroom shaped head is incorporated to allow greater comfort and more ease in attachment of elastic chains.
4. A four way rectangular hole offers lever arm for disimpacting canines.

Bone screws inserted in extra- alveolar areas are made up of either stainless steel or titanium alloys[4]. Pure surgical stainless steel is more popular as preferred choice of material due to its high placement torque which occurs when they are placed in areas of high bone density[3].

V. INDICATIONS OF IZC & BS IMPLANTS

1. Treatment of borderline surgical and extraction cases with non extraction procedure.
2. For camouflage treatment where mild skeletal discrepancy can be corrected without extractions
3. For uprighting of molars by crown distalization or root mesialization
4. Correction of open bite by intrusion of molars
5. Correction of severe transverse discrepancies such as scissor bite and cross bite
6. Levelling to correct canting of occlusal plane
7. For space closure in first premolar extraction cases
8. Correction of deep bite and gummy smile by whole maxillary arch intrusion
9. Correction of impacted teeth by forced eruption

VI. CONTRAINDICATIONS OF IZC & BS IMPLANTS

Absolute contraindications-

1. Systemic diseases such as diabetes, osteoporosis, osteomyelitis, metabolism disorders, etc.
2. Patient undergoing radiotherapy in arches
3. Psychological disorders
4. Presence of pathological formations, such as tumors and cysts
5. Thin cortical bone and insufficient retention
6. Deficient quality of bone
7. Soft tissue lesions, such as lichen planus, leukoplakia, etc.

Relative contraindications[5]**-**

1. Tobacco, alcohol and drug abuse
2. Presence of any active oral infection
3. Uncontrolled periodontal diseases
4. Absence of ability of maintaining proper oral hygiene

VII. SITES OF PLACEMENT OF EXTRA-RADICULAR SCREWS

Infrazygomatic crest implant

IZC screws can be positioned on cortical plate of both first and second molar higher or lying lateral to it, usually mesial to mesiobuccal root of molar. Initial point of insertion is between 1st and 2nd molar interdentally and 2 mm superior to the muco-gingival junction in alveolar mucosa [6]. An indentation should be made 14-16 mm above and

International Journal Dental and Medical Sciences Research
Volume 6, Issue 2, Mar - Apr 2024 pp 439-443 www.ijdmsrjournal.com ISSN: 2582-6018

perpendicular to the maxillary occlusal plane, along the long axis of the tooth.

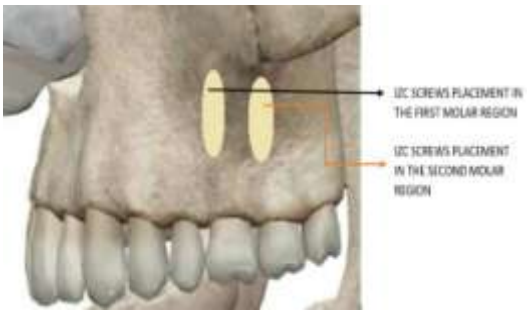

Figure 3- Sites of IZC placement

The driving of the screw in bone should begin 14-16 mm above the maxillary occlusal plane at an angle of 90º to the occlusal plane[6]. After a couple of turns, screw handle should be turned to an angle of 55-70º as suggested by Liou, to avoid damage to the roots of molar teeth. Angle greater than 75º has difficulty in insertion, with possibility of slippage of the screw, bone stripping and a greater chance of damage to mesiobuccal root of molar[6]. The screw is screwed until only the screw head is visible. There is no need for pre drilling, flap raising or mucosal vertical slit is deemed unnecessary.

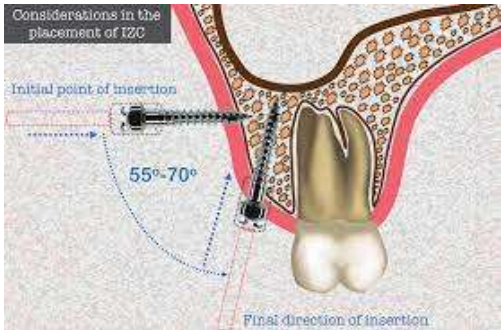

Figure 4- Angle of IZC insertion

To ensure better precision, numbers of guides are available for installation of IZC screws[6]-

- Chen double film radiographic method
- Pin Head soft tissue penetration method
- Double film method with a transparent adhesive patch like comfort brace strips

Buccal shelf implants

Mandibular buccal shelf offers an ample amount of bone quality and quantity for insertion of screw. Bone screw can also be placed on external oblique ridge, if buccal shelf region is thin and deep. Nucera et al stated that enough cortical bone thickness in buccal shelf area is present lateral to distal root of second molar, with screw insertion located 4 mm buccal to cement-enamel junction. The region distal to mandibular 1st and 2nd molar should be palpated for triangular bony buccal shelf which is usually located between 1st and 2nd molar where an indentation should be made using explorer. It acts as site of insertion for mandibular buccal shelf screw and is placed between 1st and 2nd molar. Screw is inserted in upright direction[7].

Figure 5- Buccal shelf screw insertion site

Insertion point should be in mucogingival junction. The screw is directed at 90º to the occlusal plane, after intial notch the driver direction is changed by 60-75º towards the tooth, upwards and directed the screw to the buccal shelf area of the mandible[7]. This upward change in direction helps to bypass teeth roots and directs the screw to the buccal shelf area of the mandible. Pre-drilling or vertical slit in mucosa may be necessary in case of thick bone density. However, raising flap is never necessary.

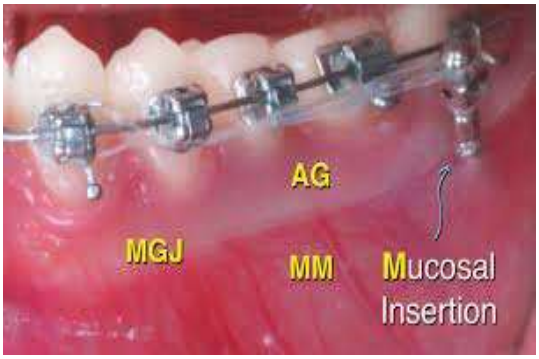

Figure 6- Insertion point

VIII. BIOLOGICAL LIMITATIONS OF IZC & BS IMPLANT

There are several limitations where clinician should reconsider using implants, such as-

1. Young subjects where cortical bone density is not enough in infra zygomatic and buccal shelf region[8].
2. Ozdemir et al stated that increased vertical skeletal pattern has reduced cortical bone thickness which will affect primary stability of orthodontic anchorage screws. Miyawaki et al reported that patients with high mandibular plane angle have a low success rate[8].
3. Poor oral hygiene, local inflammation around screw and type of mucosa surrounding the bone screw are the factors which affect the stability. Viwatannatipa et al reported infra zygomatic crest has low non keratinized tissue. Non keratinized tissue is less resistant to the effect of plaque which could be one of the reasons of affecting the primary stability of orthodontic anchorage screw[8].
4. Chang et al stated that primary stability is affected due to the less attached gingival and presence of movable mucosa in infrazygomatic crest and mandibular buccal shelf region[8].

IX. CONCLUSION

Anchorage plays a prominent role in utilization of extraction spaces, use of head gears, retraction mechanics, etc[9]. Many modalities of anchorage have been suggested like extra-oral anchorage, use of opposing anchors, increasing number of teeth in anchor units that have unwanted side effects and require patient compliance, but the extra-oral anchorage is difficult to use and causes injury that effects the patient compliance to use it.

Still extra-alveolar approach of anchorage via orthodontic bone screws proves beneficial and provide better results with minimal invasive procedures and patient compliance[1]. Therefore, these implants have been the advent of the era, but bone density and soft tissue health directly affects implant stability. Mandibular buccal shelf and infra zygomatic crest offers enough bone quality and quantity for bone screw insertion. However, the anatomy of the site varies considerably between individuals. While they gain an upper hand in terms of safety to roots and effective tooth movements, it is pivotal that the clinician must focus on the appropriate case selection for the same. One cannot deny their role of marching into the orthodontic field and that too with a roaring success.

REFERENCES

[1]. Siva Krishna P, Prasad Mandava, Gowri Shankar Singaraju, Vivek Reddy Ganugapanta; Anchorage In Orthodontics- A literature review; Vol. VIII Issue 2 Apr –Jun 2016.

[2]. Nausheer Ahmed , Rithika Joseph, Abrar Younus A , K Ranjan R Bhat; Temporary anchorage devices in orthodontics: A review; IP Indian Journal of Orthodontics and Dentofacial Research 2020;6(4):222–228.

[3]. Agharsh Chandrasekaran, H.P. Naga Deepti and Harshavardhan Kidiyoor; Understanding Orthodontic Bone Screws- Current Trends in Orthodontics.

[4]. Rahul Jeswani , Gaurav Jasoria , Kaushal Gangil , Sumit Kumar Tomar , Natasha Patil; ROLE OF BONE SCREW (IZC & BSS) IN SKELETAL ANCHORAGE SYSTEM – A REVIEW ARTICLE; TMU J Dent Vol 6.; Issue 4. Oct-Dec 2019.

[5]. Umalkar S S, Jadhav V V, Paul P, et al. (November 14, 2022) Modern Anchorage Systems in Orthodontics. Cureus 14(11): e31476. DOI 10.7759/cureus.31476.

[6]. Sandeep Shetty, Katheesa Parveen; An overview of extra alveolar bone screws- IZC/BS screws- Biomedicine- Vol. 40 No. 2: 2020.

[7]. Sumedh Deshpande, Susmita Bala Shenoi, Rohan Hattark; A simple system for improving the accuracy of IZC bone screw placement- APOS Trends in Orthodontics Volume 10 Issue 4 October-December 2020.

[8]. Pathak S, Patil T, Mahamuni A, Jaju K, Rai R. Mandibular buccal shelf and infra zygomatic crest – A safe zone for miniscrew insertion. Indian J Orthod Dentofacial Res 2019;5(2):60-62.

[9]. Marcio R. Almeida; Biomechanics of extra-alveolar mini-implants- Dental Press J Orthod. 2019 Jul-Aug;24(4):93-109.