Academia Journal of Medicine

Research Paper | **AJM** | **ISSN: 2663-8290 (Online)**

Open Access **https://medjournal.co.in/index.php/ajm** **Volume 7, Issue 1**

Optimal Placement Site and Angulation for Infrazygomatic Screw's Insertion – A CBCT Study

Dr. Srishti Hariharno[1], Dr. Tanuj Choudhari[2], Dr. Shirish Goel[3], Dr. Neeraj Gupta[4], Dr. Aman kumar[5], Dr. Sham Susar[6]

[1]PG student, [2]Associate Professor, [3]Professor and HOD, [4]Professor, [5]PG student, [6]PG student, Orthodontics and Dentofacial Orthopaedics, Maitri College of Dentistry and Research Centre, Anjora, Durg, India.

Article History

Received: 15-03-2024
Revised: 30-03-2024
Accepted: 10-04-2024
Published: 19-04-2024

How to Cite

Srishti H, Tanuj C, Shirish G, Neeraj G, Aman K, Sham S. Optimal Placement Site and Angulation for Infrazygomatic Screw's Insertion – A CBCT Study. Acad J Med 2024; 7(1): 35-43.

Abstract

Anchorage control acts as foundation of the orthodontic force system. Any undesirable movement of tooth should be controlled otherwise existing malocclusion will worsen and to prevail over this unwanted movement skeletal anchorage has been introduced in orthodontic treatment. Infrazygomatic screws are introduced to provide good anchorage control. The study was conducted to determine optimal site and angulation for placement of Infrazygomatic screw. Study includes thirty patients (15 male and 15 female) above 18 years of age. IZC bone thickness and height are measured using cone beam computed tomographic images. Theia imaging software is used for linear and angular measurement. One Way Analysis of Variance (ANOVA) test was used to determine the relation between bone thickness at different angle. Study concluded that with increase in insertion angle, infrazygomatic crest bone thickness increases. The best site for mini screw insertion in IZC is at angle of 70° in Durg population.

Corresponding Author

Dr. Srishti Hariharno
Email: srishtihariharno@gmail.com

Keywords

Infra-zyomaticmini screw, Cone- beam computed Tomography, Skeletal anchorage

DOI **https://doi.org/10.62245/ajm.v7.i1.6**

1. INTRODUCTION

Anchorage control acts as foundation of the orthodontic force system. Any undesirable movement of tooth should be controlled otherwise existing malocclusion will worsen and to prevail over this unwanted movement skeletal anchorage has been introduced in orthodontic treatment[1]. Absolute anchorage has converted orthognathic cases into non-surgical and extraction cases into non-extraction, which was not possible by conventional mechanics[2].

Infrazygomatic screws are important advancement in field of orthodontic anchorage reinforcement[3].It consists of thick bi-cortical bone comprising of buccal cortical plate and floor of the maxillary sinus, leading to increased primary stability due to bi-cortical fixation. Mini screws placed into the IZC can be used for closing space, intrusion of posterior, and distalization[4]. Cortical and overall bone thickness play major role in initial stability and success of orthodontic treatment[5].Thus it is very important to us as orthodontists to place IZC in optimal site with correct insertion angle.

The present study aims to evaluate the Infrazygomatic crest bone thickness, height from occlusal plane and angle of insertion of mini-screw in Infrazygomatic region among Durg population. This study will include subject of age above 18 years. The finding of the study will provide valuable information about the optimal site, angle and height for insertion of mini-screw.

IZC screw can be used for space closure, arch distalization, molar up-righting, intrusion, protraction and retraction of dentition.

2. MATERIALS AND METHODS

The subjects for this study are selected from the patients coming for the treatment in Department of Orthodontics and Dentofacial Orthopaedics, Maitri college of Dentistry and Research Centre, Anjora, Durg. The study comprises of 30 patients (15 male and 15 female) above age of 18 years.

Those who required CBCT for diagnosis and treatment planning are selected. Written consent are obtained from all subjects after explanation of the research aims and goals.

All CBCT images are acquired with the head positioned along the Frankfort horizontal plane, running parallel to the floor. Images are saved as digital imaging and communication in medicine (DICOM) files, and sagittal and horizontal views of those will be extracted and evaluated using an image analysis analysis software.

Theia imaging software is used for linear and angular measurement. Measurements are done as described by Liou in his study to determine bone thickness in IZC region[6]. On coronal view reference line and points are marked to evaluate IZC bone thickness. The first reference line is maxillary occlusal plane, a plane between mesio-bucaal cusp of both maxillary first molar. The second reference line is drawn tangent to buccal surface of mesio-buccal root maxillary first molar. The intersection point of the reference line and floor of maxillary sinus is the sinus point (S point). Through S point, 8 reference lines are drawn at increments of 5°, from 40° to 75°. These 8 reference lines are considered as mini-screw insertion angles. The intersections between these reference lines and the lateral surface of Infrazygomatic crests are points from B1 to B8. The length between s point and B1 to B8 are infrazygomatic crest thickness. The perpendicular distances between from B1 to B8 to maxillary occlusal plane are considered as insertion positions.

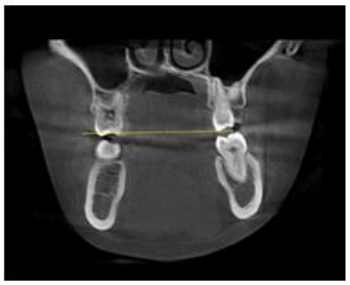

Fig.1 Reference line (Occlusal plane)

Fig. 2 Reference line (Tangent to the buccal surface of mesiobuccal root of maxillary first molar)

3. STATISTICAL ANALYSIS

Mean values and standard deviation were calculated for all measurements. One way analysis of variance test was used to evaluate variation between bone thickness measurement at different insertion angles. Correlation between parameters were examined by Pearson's correlation test.

4. RESULTS

Table 1, 2, 3, 4 represent mean, standard deviation for bone thickness and height. Table 5,6,7,8 represent mean comparison. The Infrazygomatic bone thickness and insertion height of mini screw vary with mini screw insertion angle. For an insertion angle of 40 ° to the occlusal plane, bone thickness for male was 5±1.44 and height 14.2± 1,47, for female bone thickness was 4.3±2 and height was 14±1.5 whereas for an angle of 75 ° for male bone thickness was 11.7±2.2 and height was 10.1±1.8, for female bone thickness was 10.1±1.6 and height was 9.9±2.As the Miniscrew insertion

angle increases, the bone thickness increases and insertion height decreases. Table 9 describe the correlation between bone thickness and angle. It was found that there was strong positive correlation between bone thickness and height which suggest that with increase in angle bone thickness also increased. This was found to be statistically significant among both male and female ($p \leq 0.05$).

It is found in the study that the bone thickness in the Infrazygomatic crest region ranges from 4 to 12 mm when measured at an angle of 40 ° to 75 ° and 10-14 mm above the occlusal plane.

Table 1: Descriptive statistics for bone thickness at various angles recorded for males

Angles	N	Min value	Max value	Mean	SD
40°	15	3.40	9.00	5.0600	1.44163
45°	15	4.00	9.80	5.8933	1.61531
50°	15	4.50	10.40	6.8600	1.59320
55°	15	5.10	12.00	7.7800	1.78253
60°	15	6.70	14.00	8.7200	1.94466
65°	15	6.90	15.00	9.7600	1.88596
70°	15	7.00	15.50	10.8467	2.11487
75°	15	7.20	16.00	11.7267	2.21374

Table 2: Descriptive statistics of various heights recorded for males

Height	N	Min value	Max value	Mean	SD
H1	15	12.00	17.00	14.2643	1.47053
H2	15	11.00	16.50	13.7933	1.54387
H3	15	11.50	16.30	13.3667	1.38392
H4	15	11.00	16.00	12.8867	1.44661
H5	15	10.50	15.80	12.2400	1.39274
H6	15	8.00	15.50	11.5600	1.66425
H7	15	7.00	15.30	10.8667	1.86267
H8	15	6.90	15.00	10.1733	1.82031

Table 3: Descriptive statistics of various angles recorded for females

Angles	N	Min value	Max value	Mean	SD
40°	15	2.00	10.20	4.3867	2.08048
45°	15	2.20	10.80	5.0400	2.19766
50°	15	2.50	11.40	5.7600	2.18560
55°	15	2.80	11.80	6.5333	2.18882
60°	15	3.50	12.50	7.4800	2.06405

65°	15	4.20	13.00	8.3733	1.99444
70°	15	5.90	13.50	9.3333	1.69776
75°	15	7.00	14.00	10.1600	1.62252

Table 4: Descriptive statistics of various height recorded for females:

Height	N	Min value	Max value	Mean	SD
H1	15	10.00	17.00	14.0800	1.50390
H2	15	9.50	16.90	13.5800	1.59920
H3	15	9.00	15.30	13.0133	1.39891
H4	15	8.70	15.00	12.4133	1.77235
H5	15	8.10	14.90	11.8200	1.83116
H6	15	7.30	14.20	11.0733	1.88470
H7	15	7.10	14.00	10.3800	2.18671
H8	15	6.90	13.00	9.9000	2.06640

Table 5: Mean comparison of insertion angles measured among males

Angles	N	Mean	SD	f-value	p-value
40°	15	5.0600	1.44163	18.87	0.001 (s)
45°	15	5.8933	1.61531		
50°	15	6.8600	1.59320		
55°	15	7.7800	1.78253		
60°	15	8.7200	1.94466		
65°	15	9.7600	1.88596		
70°	15	10.8467	2.11487		
75°	15	11.7267	2.21374		

Statistical test: ANOVA; (p<0.05- significant, CI=95%), N= number of study subjects s- Significant, n. s: Not Significant

Table 6: Mean comparison of height recorded for males

Height	N	Mean	SD	f-value	p-value
H1	15	14.2643	1.47053	12.49	0.001 (s)
H2	15	13.7933	1.54387		
H3	15	13.3667	1.38392		
H4	15	12.8867	1.44661		
H5	15	12.2400	1.39274		
H6	15	11.5600	1.66425		
H7	15	10.8667	1.86267		
H8	15	10.1733	1.82031		

Statistical test: ANOVA; (p<0.05- significant, CI=95%), N= number of study subjects s- Significant, n. s: Not Significant

Table 7: Mean comparison of angle recorded among females

Angles	N	Mean	SD	f-value	p-value
40°	15	4.3867	2.08048	15.74	0.001 (s)
45°	15	5.0400	2.19766		
50°	15	5.7600	2.18560		
55°	15	6.5333	2.18882		
60°	15	7.4800	2.06405		
65°	15	8.3733	1.99444		
70°	15	9.3333	1.69776		
75°	15	10.1600	1.62252		

Statistical test: ANOVA; (p<0.05- significant, CI=95%), N= number of study subjects s- Significant, n. s: Not Significant

Table 8: Mean comparison of height recoded among females

Height	N	Mean	SD	f-value	p-value
H1	15	14.0800	1.50390	10.55	0.001 (s)
H2	15	13.5800	1.59920		
H3	15	13.0133	1.39891		
H4	15	12.4133	1.77235		
H5	15	11.8200	1.83116		
H6	15	11.0733	1.88470		
H7	15	10.3800	2.18671		
H8	15	9.9000	2.06640		

Statistical test: ANOVA; (p<0.05- significant, CI=95%), N= number of study subjects s- Significant, n. s: Not Significant

Table 9: Correlation statistics for height and angles recorded

S.No.	Gender	variables	r-value	p- value
1	**Female**	Bone thickness Angle	0.75	0.05 (s)
2	**Male**	Bone thickness Angle	0.79	0.001 (s)

Statistical test: Pearson's correlation; (p<0.05- significant, CI=95%), N= number of study subjects s- Significant, n.s: Not Significant

5. DISCUSSION

In this study both bone thickness in infra-zygomatic crest region and height from occlusal plane are assessed so that optimal position of mini-screw insertion could be determined. It is found in the study that the thickness of bone in the Infrazygomatic crest region ranges from 4 to 12 mm at an insertion angle of 40 ° to 75 ° and 10-14 mm above the occlusal plane. This was also concluded by Liou et al.[6] and Baungaertel

and Hans[7] in their studies. Liou found bone thickness of 5-9 mm when measured at an angle of 40 º to 70 º and 13-17 mm above the occlusal plane.[6] Santos et al. found bone thickness of 2.49 and 2.29, which was measured 2mm and 4mm above the distobuccal root of maxillary first molar respectively[8].

Gibas Stanek[9] in his study evaluated the thickness of IZC region. He found increased bone thickness in interdental space between the first and second molar area at height of 12mm and decreased bone depth was at level of mesial root of first molar, 16mm above the occlusal plane.

The Infrazygomatic screw as the absolute skeletal anchorage has become successful treatment plan for orthodontic patients for controlled and desirable tooth movement.[10].As IZC is inserted at a long distance from the root area due to long distance from the root region, an Infrazygomatic crest mini-implant will not hamper tooth movement.

For initial stability and good outcome of Infrazygomatic crest miniscrews, bone thickness of Infrazygomatic crest play major role. Sufficient amount of bone thickness should be available for insertion of Miniscrew so that no perforation to anatomical structure occur like maxillary sinus perforation and nasal cavity perforation[11].

Poggio et al.[12] estimated that the buccal area between the first molar and the second premolar had the biggest amount of bone while the tuberosity area had the thinnest amount and thickness of bone.

At the zygomatic process of the maxilla, the infra-zygomatic crest functions as a pillar of cortical bone. Clinically it is hard edge arch running among alveolar and zygomatic course of maxilla[13]. The thicker cortical bone of the infra-zygomatic crest provides excellent primary stability. Buccal cortical plate and sinus floor are two cortical plates of Infrazygomatic peak. As a result, it is advantageous for orthodontic anchorage screws' primary stability anatomically.

6. CONCLUSION

The optimal site for mini-screw placement in Infrazygomatic crest is at angle of 70 degree and 12 mm from occlusal plane. As the bone thickness varies with angulation and height from occlusal plane, IZC thickness should be measured at different angulations which help in determination of ideal site for mini-screw placement.

7. REFERENCES

1. Lovely, PR, Reddy CM. Clinical applicability of IZC's in orthodontics - A review. J ContempOrthod 2022;6(4):172-177.

2. Ghosh A. Infra-zygomatic crest and buccal shelf - Orthodontic bone screws: A leap ahead of micro-implants – Clinical perspectives. J Indian Orthod Soc 2018;52:S127-41.
3. Arathi Murugesan, Arvind Sivakuma. Comparison of bone thickness in infrazygomatic crest area at various mini screw insertion angles in Dravidian population – A cone beam computed tomography study. International Orthodontics 2020; 18: 105–114.
4. Dangal, Rajju; Shrestha, Rabindra Man; Dhakal, Jyoti; Shrestha, Sujita; Gupta, Alka; and Shah, Shreya (2022) "Comparison of Bone Thickness in Infrazygomatic Crest Area at Various Miniscrew Insertion Angles: A Cone-beam Computed Tomographic Study," Taiwanese Journal of Orthodontics: Vol. 34: Iss. 4, Article 2.
5. Qinxuan Song. Optimal sites and angles for the insertion of orthodontic mini-implants at infrazygomatic crest: a cone beam computed tomography (CBCT)-based study. Am J Transl Res 2022;14(12):8893-8902.
6. Liou EJ, Chen PH, Wang YC, Lin JC. A computed tomographic image study on the thickness of the infrazygomatic crest of the maxilla and its clinical implications for miniscrew insertion. Am J Orthod Dentofacial Orthop. 2007 Mar;131(3):352-6.
7. Baumgaertel S, Hans MG. Assessment of infrazygomatic bone depth for mini-screw insertion. Clin. Oral Impl. Res. 20, 2009; 638–642.
8. Santos AR, Castellucci M, Crusoé-Rebello IM, Sobral MC. Assessing bone thickness in the infrazygomatic crest area aiming the orthodontic miniplates positioning: a tomographic study. Dental Press J Orthod. 2017 July-Aug;22(4):70-76.
9. Gibas-Stanek, M.; Slusarska, ´ J.; Urz ˛edowski, M.; Zabicki, S.; Pihut, ˙ M. Quantitative Evaluation of the Infrazygomatic Crest Thickness in Polish Subjects: A Cone-Beam Computed Tomography Study. Appl. Sci. 2023, 13, 8744.
10. Jia X, Chen X, Huang X. Influence of orthodontic mini-implant penetration of the maxillary sinus in the infrazygomatic crest region. Am J Orthod Dentofacial Orthop. 2018 May;153(5):656-661.
11. Al Amri MS, Sabban HM, Alsaggaf DH, Alsulaimani FF, Al-Turki GA, Al-Zahrani MS, et al. Anatomical consideration for optimal position of orthodontic miniscrews in the maxilla: a CBCT appraisal. Ann Saudi Med 2020; 40(4): 330-337.
12. Poggio PM, Incorvati C, Velo S, Carano A. "Safe zones": a guide for miniscrew positioning in the maxillary and mandibular arch. Angle Orthod. 2006 Mar;76(2):191-7.

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