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Abstract

Introduction: The infrazygomatic crest (IZC) is an alternative site for miniscrew anchorage. It is important to analyze the anatomy of the region during preoperative planning to minimize the risk of unwanted tooth movement and injury to the vital structures. The literatures on the clinical application of miniscrew in IZC is scarce. **Objective:** To determine bone thickness, height and angle of insertion of miniscrew in the IZC region. **Materials and methods:** This cross-sectional observational comparative study included 44 patients above 18 years. IZC bone thickness and height of miniscrew insertion were measured on cone-beam computed tomographic (CBCT) records. Student t-test was done to compare the bone thickness and insertion height between gender and between sides. **Results:** Infrazygomatic crest bone thickness when measured at an angle of 40° to 75° and 11 to 17 mm above the occlusal plane of the maxillary first molar was 3 to 9 mm. There was no significant gender and side variation in bone thickness of IZC and insertion height. **Conclusion:** Infrazygomatic crest thickness increases with the increase in insertion angle and the decrease in height. The optimal site for miniscrew placement in IZC in an adult is at the angle of 70° and 13 mm from the occlusal plane in the Nepali sample.

Keywords

Cone-beam computed tomography (CBCT); Maxilla; Miniscrew

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ABSTRACT

Introduction: The infrazygomatic crest (IZC) is an alternative site for miniscrew anchorage. It is important to analyze the anatomy of the region during preoperative planning to minimize the risk of unwanted tooth movement and injury to the vital structures. The literatures on the clinical application of miniscrew in IZC is scarce.

Objective: To determine bone thickness, height and angle of insertion of miniscrew in the IZC region.

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Conclusion: Infrazygomatic crest thickness increases with the increase in insertion angle and the decrease in height. The optimal site for miniscrew placement in IZC in an adult is at the angle of 70° and 13 mm from the occlusal plane in the Nepali sample. *Taiwanese Journal of Orthodontics* 2022;34(4):185–189

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INTRODUCTION

Anchorage is defined as the resistance to unwanted tooth movement and is critical especially in extraction cases.^{1,2} Intermaxillary elastics, headgears, transpalatal arch, and lingual stabilizing arch are commonly used for anchorage reinforcement. Intermaxillary elastics and headgear require patients' compliance and the transpalatal arch and lingual stabilizing arch are ineffective without adjunctive anchorage control aid.^{3,4}

Kanomi in 1997⁵ introduced mini-implant for orthodontic use. In the maxilla, miniscrews can be placed in the area below the nasal spine, palate,

infrazygomatic crest (IZC), maxillary tuberosities, and alveolar bone.⁶ After palate, IZC has been considered as an alternative site for miniscrew anchorage. It consists of thick bicortical bone comprising of buccal cortical plate and floor of the maxillary sinus, leading to increased primary stability due to bicortical fixation.^{7,8} Miniscrews placed into the IZC have been successfully used for space closure, posterior intrusion, and distalization.^{9–12}

Penetration of infrazygomatic crest miniscrew into the maxillary sinus is common.¹³ It is important to analyze the anatomy of the region of miniscrew insertion during preoperative planning. Farnsworth D et al. found that adults have thicker cortical bones than adolescents.¹⁴ One safe zone for IZC miniscrew insertion is located 11 mm apical from the alveolar

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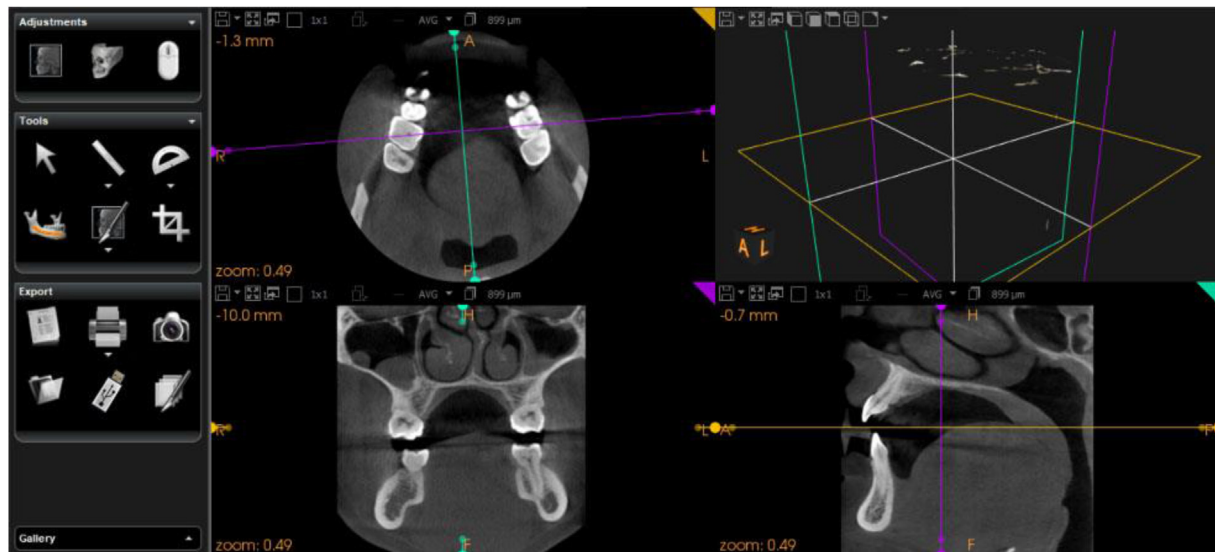


Figure 1. Coronal, axial, and sagittal sections of maxilla on CBCT.

crest between the maxillary first and second molars.¹⁵ Murugesan et al. concluded that the best possible site for miniscrew placement was found to be 12–17 mm and at an angle of 65°–70° to the maxillary first molar occlusal plane.¹⁶

This study aims to determine the bone thickness, height and angle of insertion of the miniscrew in IZC among Nepali sample.

MATERIALS AND METHODS

This is a cross-sectional observational comparative study conducted after approval from Institutional Review Committee, Kantipur Dental College Teaching Hospital and Research Centre. CBCT images of 44 adults (20 female and 24 male) without any craniofacial anomalies were selected from the Department of Oral Medicine and Radiology, Kantipur Dental College and Hospital, Kathmandu. CBCT image was taken via CS9300 Care Stream, USA machine using the standard protocol at 85 kV, 6.3 mA, 11.30 s, voxel size of 300 μm and 17 × 13 cm field of view. Data collection sheet was developed for data collection.

The selected DICOM file was opened in CS imaging suite software and measurements were done as described by Liou et al.¹⁷ Orthogonal slicing was selected and image was displayed simultaneously with their coronal, axial and sagittal slices (Figure 1). Then the image was oriented in all the sections of CBCT for the accurate location of IZC containing the distobuccal root of maxillary first molar.

On the selected coronal slice, reference lines and points were determined. Maxillary occlusal plane

was the first reference line which is a plane between the distobuccal cusps of both maxillary first molars and the second reference line was the tangent line to the buccal surface of the distobuccal root of the maxillary first molar (Figure 2). Sinus point (S) was designated as the point of intersection of this tangent line and the floor of the maxillary sinus.

Through the S point, another eight reference lines, which are the postulated miniscrew insertion

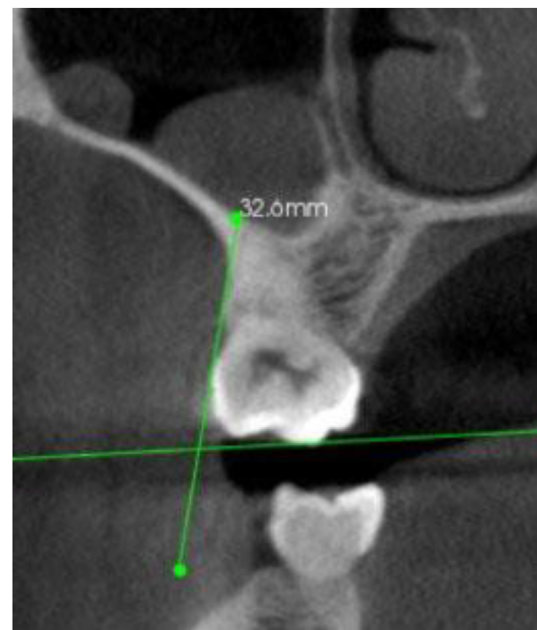


Figure 2. Maxillary occlusal plane and line tangent to buccal cortical plate as reference lines.

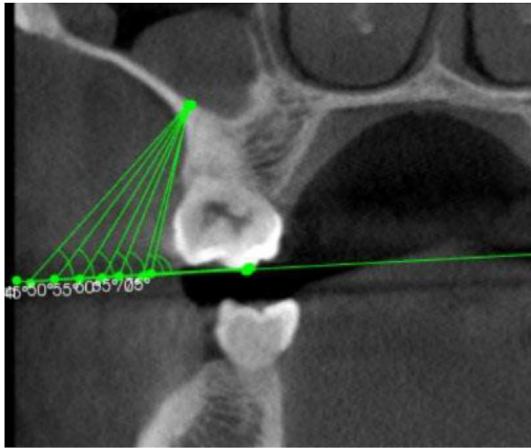


Figure 3. Various angulation from maxillary occlusal plane to sinus point.

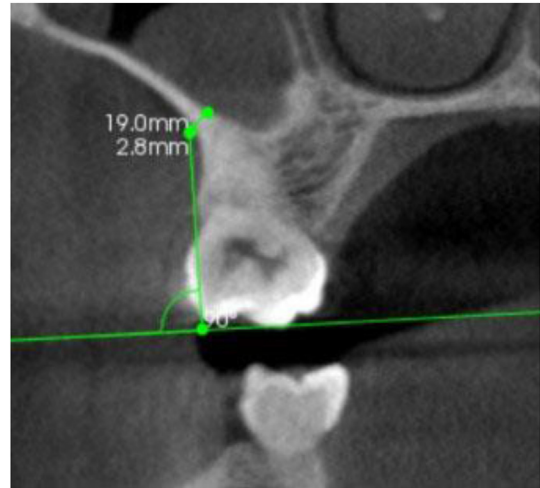


Figure 5. Measurement of IZC thickness and perpendicular distance from occlusal plane.

angles, were established at increments of 5° , from 40° to 75° , to the maxillary occlusal plane (Figure 3). B1 to B8 points were designated for the intersections between these reference lines and the lateral surface of the IZC (Figure 4).

IZC thickness is represented by the distance between the S point and B1 to B8, respectively. The perpendicular distances from B1 to B8, respectively, to the maxillary occlusal plane, were measured which is the postulated miniscrew insertion height (Figure 5). Student t-test was done to compare the bone thickness and insertion height between gender and between sides.

RESULTS

IZC thickness at an angle of 40° – 75° and 11–17 mm from the occlusal plane of the maxillary first molar was 3–9 mm (Table 1). There was no significant gender and side variation ($p > 0.05$) in IZC bone thickness and insertion height (Table 2). With the increase in insertion angle, IZC thickness increased while the height of insertion decreased (Figure 6).

DISCUSSION

According to Liou et al.,¹⁷ the postulated miniscrew insertion position and angle in IZC ranged

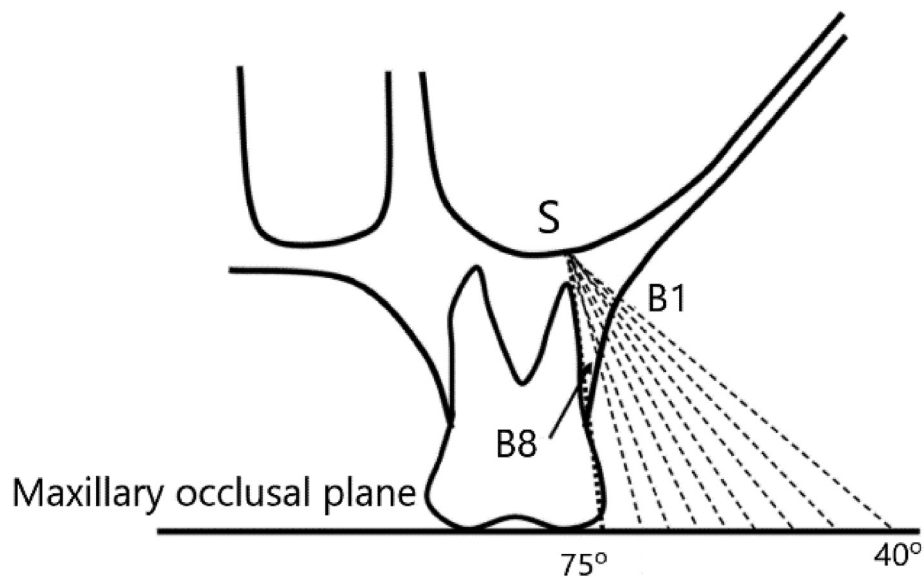


Figure 4. Reference points and lines for linear measurements.

Table 1. Descriptive analysis of IZC thickness and height of insertion at 5° increments to maxillary occlusal plane.

Angle	Mean	S.D.	Height of insertion(mm)	
			Mean	S.D.
40°	3.44	0.75	17.07	1.90
45°	3.54	0.80	16.71	1.94
50°	3.80	0.93	16.27	1.99
55°	4.10	1.17	16.05	3.47
60°	4.54	1.42	15.16	2.36
65°	5.35	1.66	14.28	2.72
70°	6.72	1.80	12.99	2.89
75°	8.20	2.26	11.26	2.65

Table 2. Student-t test comparing IZC thickness and insertion height between gender and between sides.

Angle	p-Value			
	IZC thickness		Insertion height	
	Gender	Side	Gender	Side
40°	0.95	0.40	0.87	0.64
45°	0.44	0.87	0.91	0.69
50°	0.71	0.84	0.84	0.71
55°	0.84	0.92	0.32	0.65
55°	0.94	0.94	0.98	0.58
65°	0.55	0.76	0.92	0.64
70°	0.85	0.93	0.94	0.94
75°	0.61	0.41	0.83	0.95

from 17 mm above and 40° to the maxillary occlusal plane to 14 mm above and 75° to the maxillary occlusal plane. It is found in the present study that

the bone thickness in the IZC ranges from 3 to 9 mm when measured at an angle of 40°–75° and 11–17 mm above the occlusal plane.

Miniscrew insertion at an angle of 75° is technically difficult and leads to slippage of the miniscrew and bone stripping.⁹ At a 40° insertion angle, the biting depth is shallow and the chance of alveolar or buccal mucosa irritation is greater. More than 6 mm biting depth in the IZ crest is sufficient for the stability of the miniscrew throughout the loading period.⁶ Considering these, the optimal site for miniscrew placement in the IZC of an adult is found to be at an angle of 70° and 13 mm from the occlusal plane in the present study.

Bone thickness was found to decrease with an increase in distance from the occlusal plane in the present study, which is also shown in the study by Liou et al.¹⁷ and Baumgaertel et al.¹⁸ There was no significant difference in the bone thickness between gender which is in concordance with the study by Santos et al.¹⁹ According to Al Amri et al., miniscrew insertion in IZC should be done cautiously because of the proximity to the maxillary sinus and nasal cavity.²⁰

The optimal site of miniscrew insertion found in the present study is at an angle of 70°, which is greater than the insertion angle of Taiwanese and Dravidian Indian population.^{16,17} The value of miniscrew angulation and insertion height as determined from this study is closer to Dravidian Indian population than the Taiwanese population.

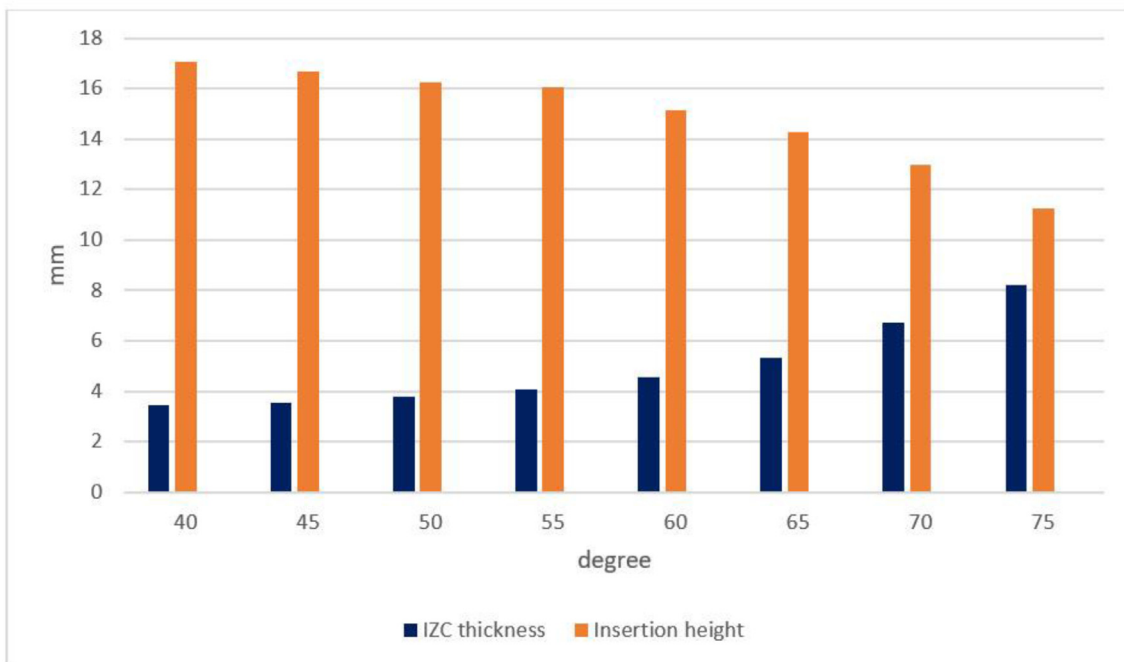


Figure 6. IZC thickness and height from occlusal plane at different miniscrew insertion angulations.

This might be because of the variation in bone morphology and thickness among different ethnicities of the population.

CONCLUSION

Infrazygomatic crest thickness increases with the increase in insertion angle and the decrease in height. The optimal site for miniscrew placement in IZC of an adult is at an angle of 70° and 13 mm from the occlusal plane. As the bone thickness varies with angulation and height from the occlusal plane, IZC thickness should be measured at different angulations which helps in the determination of the ideal site for miniscrew placement for each individual.

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ETHICAL APPROVAL

This study was approved by the Institutional Review Board of Kantipur Dental College Teaching Hospital & Research Center, Kathmandu, Nepal. (No. 7/022).

CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

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