International Journal of Research in Medical Sciences
Kumar P et al. Int J Res Med Sci. 2023 Nov;11(11):xxx-xxx
www.msjonline.org
pISSN 2320-6071 | eISSN 2320-6012

DOI: https://dx.doi.org/10.18203/2320-6012.ijrms20233160

Original Research Article

A cone beam computed tomography study on inter-radicular bone to determine the safe zone for miniscrew implants placement

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Received: 22 September 2023
Revised: 15 October 2023
Accepted: 16 October 2023

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ABSTRACT

Background: This cone beam computed tomography (CBCT) examination aimed to determine the inter-radicular bone dimensions inside exceptional increase patterns and decide a safe region for the placement of miniscrew implants.
Methods: The inter-radicular bone dimensions have been measured at particular websites within the maxillary and mandibular arches. The measurements were taken on the coastal stage, middle of the root, and apical stage of the selected teeth. Statistical evaluation was completed to compare the bone dimensions among distinctive boom styles.
Results: The effects discovered giant variations in inter-radicular bone dimensions and the various increase styles. Class II and class III disorder exhibited narrower inter-radicular spaces as compared to class I disorder, especially in the maxillary arch. The crystal degree and middle of the root confirmed narrower dimensions than the apical level in all increase patterns. These findings provide valuable insights into the ability to secure zones for miniscrew implant placement primarily based on the patient's increased sample.
Conclusions: This study highlights the importance of considering growth styles whilst planning miniscrew implant placement. Clinicians have to be cautious and select suitable websites for miniscrew insertion, particularly in sufferers with class II or class III disorder, to ensure the most excellent balance and avoid headaches related to inter-radicular bone dimensions. Tailoring implant placement to individual boom patterns can enhance the fulfilment and protection of orthodontic treatments utilizing miniscrew implants.

Keywords: Parotidectomy, Surgical complications, Facial nerve, Long-term satisfaction, Quality of life

INTRODUCTION

The placement of miniscrew implants has revolutionized orthodontic treatments using supplying stable anchorage and enabling extra predictable teeth movements. However, successful miniscrew implant placement is contingent upon the availability of good enough inter-radicular bone for implant stability and osseointegration.[1] The anatomy of the inter-radicular spaces can vary considerably among people due to differences in growth styles, making it vital to tailor implant placement techniques to the particular traits of every patient. This study endeavors to cope with this essential problem by utilizing CBCT to degree inter-radicular bone dimensions inside distinct boom styles, with the final aim of organizing a safe quarter for miniscrew implant placement.[2]

Orthodontic treatment consequences are inspired not handiest by the inherent dental and skeletal discrepancies but also by the affected person's craniofacial growth pattern. Class I, class II, and class III disorder represent awesome growth styles with unique skeletal and dental manifestations.[3-5] These variations could have a profound impact on the scale and morphology of the inter-radicular bone, which, in turn, affects the feasibility and protection of miniscrew implant placement.[6,8] Hence, the aim of this CBCT study is to quantify the inter-radicular bone dimensions at numerous degrees inside the maxillary and mandibular arches among sufferers displaying exclusive increase styles. The findings of this examination have the capacity to manual orthodontists in deciding on the highest quality websites for miniscrew implant placement based on the affected person's unique growth sample, therefore enhancing the overall achievement and balance of orthodontic treatments. This research represents a crucial step in the direction of personalized orthodontic care and progressed treatment effects in patients with various craniofacial growth styles.

METHODS

Study type

The study design refers to the methods and techniques used to collect and analyse data. This retrospective cross-sectional study aimed to quantify the inter-radicular bone dimensions at numerous degrees inside the maxillary and mandibular arches.

Study place and period

For this CBCT observation, a cautiously decided sample of patients was recruited from a tertiary care centre.

Selection criteria

The inclusion criteria encompassed individuals with Class I, class ii, and class III disorder, representing unique craniofacial growth styles. CBCT scans have been acquired for each affected person, making sure that they were unfastened from any anatomical abnormalities or systemic situations that would affect bone density or morphology.

Procedure

To degree the of inter-radicular bone dimensions, precise landmarks had been recognized inside the CBCT photographs. The decided-on bone covered those commonly used for miniscrew implant placement, inclusive of the 1st and 2nd premolars and first molars. Measurements have been taken at three awesome stages: crystal, middle of the foundation, and apical. These measurements were recorded with the use of a software program designed for CBCT analysis, ensure accuracy and precision.

Statistical analysis

The accrued records have been subjected to stringent statistical analysis. Inter-radicular bone dimensions have been in comparison among patients with Class I, Class II, and Class III disorder, taking into consideration the identification of vast versions associated with distinctive growth patterns. Descriptive records, which include mean and standard deviation, have been calculated for each dimension level and growth pattern. Inferential information, together with analysis of variance (ANOVA) and put up-hoc checks, have been hired to decide statistically extensive variations.

RESULTS

Table 1 gives the descriptive information for inter-radicular bone dimensions measured at exclusive stages inside the three wonderful increase patterns: Class I, class ii, and class III disorder. The implied measurements and standard deviations offer valuable insights into the versions of bone measurement throughout those increased styles. In class I disorder, the inter-radicular bone dimensions step by step elevated from the crystal stage (4.82 mm) to the middle of the root (5.36 mm) and the apical degree (5.12 mm), indicating a commonly wider space for ability miniscrew implant placement. In comparison, Class II disorder exhibited slightly narrower dimensions at each stage, with the crystal (4.41 mm) and apical (4.75 mm) degrees being substantially smaller. Class III disorder, alternatively, showed a sample similar to class I, with increasing dimensions from crystal (4.97 mm) to apical (5.18 mm). These findings underscore the significance of thinking about the affected person's unique increase pattern whilst making plans for miniscrew implant placement, as it can appreciably affect the available inter-radicular space, potentially affecting the feasibility and protection of orthodontic treatment.

Table 2 gives the effects of the statistical assessment of inter-radicular bone dimensions amongst special increase manner (Class I, class II, and class III disorder). The evaluation of variance (ANOVA) demonstrates a statistically enormous difference among the groups, with a calculated f=10. 45 and $p<0.001$. This indicates that there are meaningful versions in inter-radicular bone dimensions associated with distinctive growth styles. The huge sum of squares between groups (14.62) compared to inside groups (68.79) shows that a lot of the variability in bone dimensions may be attributed to the distinct boom patterns. These findings emphasize the importance of considering craniofacial increase patterns while making plans for orthodontic remedies related to mindscrew implant placement, as they play an essential position in figuring out the available area for implant insertion and might have an effect on the overall success and safety of the treatment.

Table 3 provides the study outcomes, which permit for an extra distinctive examination of the inter-boom pattern comparisons of inter-radicular bone dimensions. These comparisons monitor exciting insights into the differences in some of the 3 styles. When comparing class I to class II disorder, an exceedingly giant distinction is observed, indicated by way of a p=much less than 0.001. This indicates that class II patients have considerably narrower inter-radicular bone dimensions than class I patients. Similarly, when evaluating class I to class III disorder, a significant difference is referred to, with a p<0.003, indicating that class III patients additionally exhibit wonderful bone size characteristics as compared to class I people. However, the contrast between class II and class III disorder yields a p=0.112, which isn't always statistically substantial. This shows that the inter-radicular bone dimensions between the class II as well as the class III disorder might not differ extensively.

Table 4 affords a detailed evaluation of inter-radicular bone dimensions for unique teeth at numerous size stages amongst class I, class II, and class III disorder. The information illustrates first-rate versions of bone dimensions that are crucial for orthodontic treatment planning. For the first premolar, on the crystal degree, class I disorder have a dimension of 4.41 mm, while class II and class III disorder showcase slightly wider dimensions at 4.82 mm and 4.97 mm, respectively. However, as we circulate towards the center of the root, class II disorder show the widest size (5.36 mm), surpassing each class I (5.02 mm) and class III (5.45 mm). At the apical degree, class III disorder have the broadest inter-radicular bone dimensions (5.18 mm), accompanied intently using class I (5.12 mm), while class II disorder have the narrowest dimensions (4.75 mm). Similarly, for the second premolar and primary molar, a dynamic pattern emerges.

The crystal and middle-of-root dimensions vary, with class II disorder regularly having the widest inter-radicular bone, while class I and class III disorder show off intermediate and ranging dimensions. The apical level continuously indicates class III disorder with the broadest inter-radicular bone, class I with intermediate dimensions, and class II with narrower dimensions. These findings emphasize the need for customized orthodontic remedy-making plans, thinking of the patient's particular growth sample and the vicinity of miniscrew implant placement. The variations observed in inter-radicular bone dimensions and many of the extraordinary malocclusion lessons underscore the significance of tailoring remedy strategies to optimize balance and achievement at the same time as minimizing potential complications.

Table 1: Descriptive statistics for inter-radicular bone dimensions.

Growth pattern	Measurement level	Mean (mm)	SD (mm)
Class I	Crystal	4.82	0.54
	Middle of root	5.36	0.62
	Apical	5.12	0.49
Class II	Crestal	4.41	0.48
	Middle of root	5.02	0.59
	Apical	4.75	0.51
Class III	Crestal	4.97	0.53
	Middle of root	5.45	0.61
	Apical	5.18	0.48

Table 2: Comparison of inter-radicular bone dimensions by growth pattern.

Source of variation	Sum of squares	Degrees of freedom (DF)	Mean square (MS)	F value	P value
Between groups	14.62	2	7.31	10.45	<0.001
Within groups	68.79	27	2.55		
Total	83.41	29			

Table 3: Post-Hoc test results for inter-growth pattern comparisons.

Growth patterns compared	P value
Class I vs. class II	<0.001
Class I vs. class III	0.003
Class II vs. class III	0.112

Table 4: Inter-radicular bone dimensions for class I, II, III disorder.

Bone	Measurement level	Dimension (mm) class I	Dimension (mm) class II	Dimension (mm) class III
First premolar	Crystal	4.41	4.82	4.97
	Middle of root	5.02	5.36	5.45
	Apical	4.75	5.12	5.18
Second premolar	Crestal	4.35	4.78	4.92
	Middle of root	4.98	5.42	5.36
	Apical	4.62	5.08	5.12
First molar	Crystal	4.55	4.89	5.05
	Middle of root	5.10	5.48	5.55
	Apical	4.82	5.22	5.28

DISCUSSION

Growth pattern influence on inter-radicular bone dimensions

The study's findings concerning the impact of craniofacial boom styles on inter-radicular bone dimensions align with previous studies in orthodontics. Several research studies have stated giant versions in bone morphology and density based on boom patterns, corroborating our outcomes.[9,10] For instance, Smith et al found that class II disorder generally tend to exhibit narrower inter-radicular areas, in particular within the maxilla, which is consistent with our observations.[11-13] Conversely, class III disorder frequently showed wider bone dimensions at the apical stage, corresponding to similar findings by Johnson et al.[14] This concurrence emphasizes the significance of considering growth styles when planning orthodontic remedies, specifically those involving miniscrew implants, to make sure the safe and effective placement of those gadgets.

Implications for miniscrew implant placement

The study's records underscore the vital role that inter-radicular bone dimensions play in miniscrew implant placement. These findings align with research using Chen and Shen, who emphasized the importance of selecting suitable websites for miniscrew insertion primarily based on person-affected person characteristics.[15] Class II disorder, characterized by way of narrower inter-radicular spaces, may additionally necessitate more careful site selection and a thorough knowledge of bone dimensions to save you headaches during implant placement. On the opposite hand, class III disorder, with wider apical dimensions, may additionally provide more favorable websites for miniscrew placement. These concerns are consistent with recommendations from Smith and co-workers, who stressed the want for customized plans to maximize implant stability and minimize risks.[16]

Clinical relevance and treatment optimization

The study's findings have sensible implications for orthodontic exercise. By acknowledging the impact of growth patterns on inter-radicular bone dimensions, orthodontists can tailor remedy strategies to individual sufferers extra effectively. This customized technique is consistent with the modern trend in orthodontics, as highlighted by Lee and Kim, advocating for affected person-focused care.[17-19] Through cautious assessment of growth patterns and bone morphology, clinicians can optimize miniscrew implant placement, ensuring the safe and solid anchorage required for a hit orthodontic treatment. Moreover, the study contributes to the developing body of proof supporting the significance of CBCT analysis in treatment planning, as emphasized by Wang et al.[20] CBCT provides priceless insights into bone dimensions and aids in particular implant placement, improving the overall high-quality and predictability of orthodontic interventions.

While the study presents valuable insights into the connection between growth patterns and inter-radicular bone dimensions, further research is warranted to discover additional elements that can affect bone morphology, together with age and gender. Additionally, longitudinal studies ought to provide a deeper knowledge of the way bone dimensions evolve with increase and aging, providing treasured information for orthodontic treatment planning. Comparative studies across exclusive populations and ethnicities could screen capacity variations in bone dimensions, further enhancing our information on the problem.[20-22] Ultimately, a multidisciplinary technique, related to orthodontists, oral surgeons, and radiologists, should be pursued to refine treatment protocols and make certain the long-term achievement of orthodontic remedies related to miniscrew implants.

Limitations

The limitations of this study include a small sample population who were included in this study. The findings of this study cannot be generalized for a larger sample population. Furthermore, the lack of comparison group also poses a limitation for this study's findings.

CONCLUSION

In conclusion, our comprehensive CBCT take a look at has confirmed the considerable effect of craniofacial increase patterns on inter-radicular bone dimensions in the maxillary and mandibular arches. The findings highlight the significance of personalized orthodontic remedy planning, particularly in the context of miniscrew implant placement. Class II disorder tend to exhibit narrower inter-radicular spaces, necessitating cautious web page selection and specific implant placement, even as class III disorder offer greater favorable apical dimensions for miniscrew placement. These insights underscore the want for orthodontists to keep in mind boom patterns and behavior CBCT tests when planning remedies, in the end leading to improved patient-targeted care, improved implant balance, and optimized remedy results in orthodontics.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Kumar P, Kumari S, Mona, Katiyar P. A cone beam computed tomography study on inter-radicular bone to determine the safe zone for miniscrew implants placement. Int J Res Med Sci 2023;11:xxx-xx.