



CLINICAL RESEARCH:

Alveolar Bone Thickness of Mandibular Molars Assessed by Cone-Beam Computed Tomography: A Cross-Sectional Study of a Peruvian Population

Espesor óseo alveolar de los molares mandibulares evaluado mediante tomografía computarizada de haz cónico: un estudio transversal en una población peruana

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ABSTRACT: To evaluate alveolar bone thickness on the buccal and lingual surfaces of mandibular first and second molars using cone-beam computed tomography (CBCT) and to assess possible variations according to age and sex in a Peruvian population. A descriptive cross-sectional study was conducted using 112 CBCT scans obtained from a radiology center between 2022 and 2023. A total of 448 mandibular molars (224 first molars and 224 second molars) were analyzed. Alveolar bone thickness was measured at the mesial and distal roots on both buccal and lingual surfaces at coronal, middle, and apical levels. Descriptive statistics were calculated, and group comparisons were performed according to age and sex. Significant age-related differences were observed in several buccal and lingual measurements. Younger individuals presented greater buccal bone thickness at coronal and middle root levels, whereas older individuals exhibited greater lingual thickness at selected middle and apical sites. Sex-related differences were limited to specific coronal buccal measurements of the first molar and were of small magnitude. Alveolar bone thickness in mandibular molars varies according to age and anatomical location. Age-related variations should be considered during surgical, orthodontic, and implant treatment planning in the posterior mandible.

KEYWORDS: Alveolar bone; Mandible; Molars; Cone-beam computed tomography; Diagnostic imaging; Oral surgery.

RESUMEN: Evaluar el espesor óseo alveolar en las superficies vestibular y lingual de los primeros y segundos molares mandibulares mediante tomografía computarizada de haz cónico (TCHC) y determinar posibles variaciones según la edad y el sexo en una población peruana. Se realizó un estudio descriptivo de corte transversal utilizando 112 tomografías computarizadas de haz cónico obtenidas de un centro radiológico entre 2022 y 2023. Se analizó un total de 448 molares mandibulares (224 primeros molares y 224 segundos molares). El espesor óseo alveolar se midió en las raíces mesial y distal, tanto en las superficies vestibular como lingual, a nivel coronal, medio y apical. Se calcularon estadísticas descriptivas y se realizaron comparaciones entre grupos según la edad y el sexo. Se observaron diferencias significativas relacionadas con la edad en diversas mediciones vestibulares y linguales. Los individuos más jóvenes presentaron un mayor espesor óseo vestibular en los niveles coronal y medio de la raíz, mientras que los individuos de mayor edad mostraron un mayor espesor lingual en sitios seleccionados de los niveles medio y apical. Las diferencias relacionadas con el sexo se limitaron a mediciones vestibulares coroneales específicas del primer molar y fueron de pequeña magnitud. El espesor óseo alveolar en los molares mandibulares varía según la edad y la localización anatómica. Las variaciones relacionadas con la edad deben considerarse durante la planificación de procedimientos quirúrgicos, ortodóncicos e implantológicos en la región posterior de la mandíbula.

PALABRAS CLAVE: Hueso alveolar; Mandíbula; Molar; Tomografía computarizada de haz cónico; Diagnóstico por imagen; Cirugía bucal.

INTRODUCTION

Alveolar bone thickness is a key anatomical factor influencing the success of several dental procedures, including tooth extraction, implant placement, orthodontic tooth movement, and endodontic surgery. Inadequate buccal or lingual bone support may increase the risk of cortical perforations, dehiscences, fenestrations, and postoperative complications, particularly in the posterior mandible where root morphology and surrounding bone architecture are highly variable (1-3).

Accurate assessment of alveolar bone dimensions is therefore essential for treatment planning. Conventional radiographic techniques, such as periapical and panoramic radiographs, provide limited information because of image

superimposition and the inability to evaluate structures in three dimensions. Cone-beam computed tomography (CBCT) overcomes these limitations by allowing precise visualization and measurement of alveolar bone structures with high spatial resolution and minimal distortion. Consequently, CBCT has become an important tool for evaluating anatomical conditions relevant to surgical, orthodontic, and implant-related procedures (4-6).

Previous CBCT studies have demonstrated considerable variation in alveolar bone thickness according to tooth type, root location, and measurement level. Differences between buccal and lingual cortical plates have been reported, particularly in mandibular molars, where anatomical characteristics may influence surgical access, implant positioning, and the risk of cortical plate

perforation (7-9). However, findings regarding the influence of demographic variables such as age and sex remain inconsistent across studies.

Most available evidence has been generated from Asian, Middle Eastern, or European populations. Because alveolar bone morphology may vary according to anatomical characteristics, skeletal patterns, and population background, the direct extrapolation of findings from other geographic regions to Latin American populations should be made with caution (10-12).

Therefore, the aim of this study was to evaluate buccal and lingual alveolar bone thickness in mandibular first and second molars using CBCT and to assess possible differences according to age and sex in a Peruvian population.

MATERIALS AND METHODS

STUDY DESIGN AND ETHICAL CONSIDERATIONS

A descriptive, observational, cross-sectional study was conducted using cone-beam computed tomography (CBCT) scans obtained from patients examined at a private maxillofacial radiology center between January 2022 and December 2023.

The study protocol was reviewed and approved by the Research and Ethics Committee of the Faculty of Stomatology, Universidad Nacional de Trujillo, Peru (Approval Code: P.I.B. EST.-022-2024). Authorization was also obtained from the radiology center for access to the imaging database. All patient information was anonymized before analysis to ensure confidentiality and data protection.

The study was conducted in accordance with the ethical principles of the Declaration of Helsinki (2013 revision) and the Council for Inter-

national Organizations of Medical Sciences (CIOMS) guidelines regarding the use of health-related data in research.

SAMPLE SIZE AND SELECTION

The study population consisted of 300 CBCT scans available during the study period. Sample size was calculated using the formula for estimating means in finite populations, assuming a confidence level of 95% ($Z=1.96$), an estimated standard deviation of 0.95 mm, and a maximum sampling error of 0.14 mm. The minimum required sample was 112 CBCT scans.

A systematic random sampling procedure was performed to select the study sample. Only scans meeting all inclusion criteria were considered eligible.

The inclusion criteria were:

- CBCT scans showing fully developed mandibular first and second molars.
- Complete mandibular dentition in the posterior region.
- Patients aged 20 years or older.
- Images with a spatial resolution of 200 μm .

The exclusion criteria were:

- Mandibular molars presenting pronounced apical dilaceration or supernumerary roots.
- Infraoccluded mandibular molars.
- Mandibular bone injuries or fractures involving the molar region.
- Previous radicular surgery.
- Moderate or severe periodontitis.
- Active orthodontic treatment.
- Previous surgical procedures affecting the posterior mandibular region.

IMAGING PROTOCOL AND DATA COLLECTION

A total of 448 mandibular molars were evaluated, including 224 first molars and 224 second molars.

CBCT images were obtained using a Planmeca ProMax® 3D imaging system (Planmeca Oy, Helsinki, Finland) and analyzed using Romexis Viewer software version 5.3.5.80 (Planmeca Oy, Helsinki, Finland). All images included in the study had a voxel size of 200 µm.

Image evaluation was performed by a specialist in Oral and Maxillofacial Radiology. Multiplanar reconstructions were used for all measurements. The coronal and sagittal reference planes were adjusted according to the long axis of each tooth to standardize image orientation.

The cementenamel junction (CEJ) was consistently identifiable in all CBCT scans included in the study. The exclusion of teeth with moderate or severe periodontal disease and the use of multiplanar CBCT reconstructions facilitated reliable identification of this anatomical landmark across all age groups, including participants aged 50 years and older.

Alveolar bone thickness was measured on both buccal and lingual aspects of the mesial and distal roots of mandibular first and second molars. Measurements were obtained perpendicular to

the long axis of the tooth from the external root surface to the external cortical surface of the alveolar bone.

Three anatomical levels were evaluated:

- Coronal level: 4 mm apical to the cemento-enamel junction (CEJ).
- Middle level: midpoint of the total root length.
- Apical level: at the root apex.

All measurements were recorded in millimeters.

VARIABLES

The primary outcome variable was alveolar bone thickness, measured in millimeters on the buccal and lingual surfaces of the mesial and distal roots of mandibular first and second molars at coronal, middle, and apical levels.

The explanatory variables were age and sex. Age was categorized into three groups: 20-34 years, 35-49 years, and ≥50 years. Sex was classified as male or female.

STATISTICAL ANALYSIS

Data were analyzed using descriptive and inferential statistics. Continuous variables were summarized using mean, standard deviation, and median values.

Because the distribution of the measurements did not satisfy the assumptions required for parametric analyses, non-parametric tests were applied. Differences among age groups were evaluated using the Kruskal-Wallis test. Comparisons according to sex were performed using the Mann-Whitney U test.

Statistical significance was established at $p < 0.05$.

RESULTS

A total of 112 CBCT scans were included in the study, comprising 47 male (42.0%) and 65 female (58.0%) participants. The age distribution consisted of 66 individuals aged 20-34 years, 30 aged 35-49 years, and 16 aged 50 years or older. Overall, 448 mandibular molars were evaluated, including 224 first molars and 224 second molars (Table 1).

Age-related differences in alveolar bone thickness were mainly observed in second molars (Table 2 and Table 3). On the buccal surface, younger individuals (20-34 years) showed significantly greater bone thickness at the coronal and middle levels of both mesial and distal roots compared with older age groups (p values ranged from 0.001 to 0.004). No significant age-related

differences were observed at the apical level. For the lingual surface, significant differences were detected at the apical level of the distal root of the first molar ($p < 0.001$), as well as at the middle and apical levels of the second molar, where older individuals exhibited greater bone thickness.

Sex-related comparisons revealed few significant differences (Table 4 and Table 5). On the buccal surface of the first molar, males presented slightly greater coronal bone thickness than females at both mesial ($p = 0.014$) and distal roots ($p = 0.013$). No significant sex-related differences were observed in the remaining buccal measurements or in any lingual measurements of either the first or second molars.

Table 1. Characteristics of the study sample.

Variable	n (%)
Male	47 (42.0)
Female	65 (58.0)
20-34 years	66 (58.9)
35-49 years	30 (26.8)
≥50 years	16 (14.3)
Total CBCT scans	112
Total mandibular first molars	224
Total mandibular second molars	224
Total molars analyzed	448

CBCT: cone-beam computed tomography.

Table 2. Buccal alveolar bone thickness (mm) of mandibular first and second molars according to age group

Tooth / Root level	20–34 years Mean ± SD	35–49 years Mean ± SD	≥50 years Mean ± SD	p-value
First molar – Mesial root				
Coronal	0.60 ± 0.19	0.56 ± 1.86	0.69 ± 0.37	0.373
Middle	0.98 ± 0.42	0.83 ± 0.30	1.00 ± 0.53	0.275
Apical	4.47 ± 1.31	4.01 ± 1.30	4.79 ± 1.20	0.069
First molar – Distal root				
Coronal	0.94 ± 0.42	0.79 ± 0.31	0.80 ± 0.34	0.199
Middle	1.62 ± 0.84	1.29 ± 0.55	1.12 ± 0.42	0.061
Apical	5.82 ± 1.68	5.22 ± 1.62	5.16 ± 1.39	0.099
Second molar – Mesial root				
Coronal	1.81 ± 1.04	1.39 ± 0.63	1.04 ± 0.35	0.004
Middle	3.65 ± 1.77	2.84 ± 1.17	2.16 ± 1.01	0.002
Apical	9.06 ± 1.76	8.58 ± 1.73	8.49 ± 2.09	0.309
Second molar – Distal root				
Coronal	3.24 ± 1.91	2.25 ± 1.22	1.75 ± 1.02	0.002
Middle	5.03 ± 2.07	4.07 ± 1.41	3.23 ± 1.79	0.001
Apical	9.37 ± 1.68	8.84 ± 1.43	9.17 ± 1.98	0.316

SD=standard deviation. Values expressed in millimeters (mm). Kruskal–Wallis test. Significant p-values are shown in bold ($p < 0.05$).

Table 3. Lingual alveolar bone thickness (mm) of mandibular first and second molars according to age group

Tooth / Root level	20–34 years Mean ± SD	35–49 years Mean ± SD	≥50 years Mean ± SD	p-value
First molar – Mesial root				
Coronal	2.13 ± 0.85	2.07 ± 0.72	1.71 ± 0.67	0.220
Middle	3.45 ± 1.10	3.56 ± 1.05	3.66 ± 0.99	0.544
Apical	7.32 ± 1.44	7.40 ± 1.75	7.67 ± 1.52	0.555
First molar – Distal root				
Coronal	2.88 ± 0.86	2.73 ± 0.76	2.48 ± 0.87	0.268
Middle	3.94 ± 0.96	3.98 ± 1.01	4.39 ± 1.18	0.293
Apical	6.45 ± 1.44	6.90 ± 1.96	8.12 ± 1.81	<0.001
Second molar – Mesial root				
Coronal	2.64 ± 0.80	2.65 ± 0.64	2.67 ± 0.92	0.911
Middle	3.05 ± 0.86	3.32 ± 0.90	3.64 ± 1.15	0.052
Apical	3.94 ± 1.26	4.21 ± 1.57	5.62 ± 1.69	0.003
Second molar – Distal root				
Coronal	2.88 ± 0.82	3.02 ± 0.79	3.07 ± 1.02	0.541
Middle	2.86 ± 1.08	3.23 ± 0.87	3.68 ± 1.22	0.026
Apical	3.49 ± 1.22	3.61 ± 1.49	5.00 ± 2.01	0.022

SD=standard deviation. Values expressed in millimeters (mm). Kruskal–Wallis test. Significant p-values are shown in bold ($p < 0.05$).

Table 4. Buccal alveolar bone thickness (mm) of mandibular first and second molars according to sex.

Tooth / Root level	Male Mean $\pm$ SD	Female Mean $\pm$ SD	p-value
First molar – Mesial root			
Coronal	0.66 $\pm$ 0.26	0.56 $\pm$ 1.85	0.014
Middle	0.98 $\pm$ 0.40	0.91 $\pm$ 0.42	0.247
Apical	4.31 $\pm$ 1.37	4.46 $\pm$ 1.27	0.739
First molar – Distal root			
Coronal	0.96 $\pm$ 0.38	0.82 $\pm$ 0.39	0.013
Middle	1.46 $\pm$ 0.62	1.46 $\pm$ 0.83	0.431
Apical	5.53 $\pm$ 1.65	5.59 $\pm$ 1.65	0.934
Second molar – Mesial root			
Coronal	1.64 $\pm$ 0.94	1.54 $\pm$ 0.91	0.498
Middle	3.08 $\pm$ 1.64	3.32 $\pm$ 1.62	0.346
Apical	8.91 $\pm$ 2.16	8.81 $\pm$ 1.51	0.577
Second molar – Distal root			
Coronal	2.69 $\pm$ 1.48	2.81 $\pm$ 1.92	0.841
Middle	4.38 $\pm$ 1.95	4.62 $\pm$ 2.01	0.608
Apical	9.34 $\pm$ 1.83	9.09 $\pm$ 1.54	0.282

SD=standard deviation. Values expressed in millimeters (mm). Mann–Whitney U test. Significant p-values are shown in bold ($p < 0.05$).

Table 5. Lingual alveolar bone thickness (mm) of mandibular first and second molars according to sex.

Tooth / Root level	Male Mean $\pm$ SD	Female Mean $\pm$ SD	p-value
First molar – Mesial root			
Coronal	1.96 $\pm$ 0.76	2.12 $\pm$ 0.82	0.297
Middle	3.48 $\pm$ 1.06	3.53 $\pm$ 1.08	0.880
Apical	7.56 $\pm$ 1.56	7.27 $\pm$ 1.51	0.370
First molar – Distal root			
Coronal	2.74 $\pm$ 0.89	2.81 $\pm$ 0.80	0.579
Middle	4.09 $\pm$ 1.07	3.96 $\pm$ 0.97	0.447
Apical	7.01 $\pm$ 1.75	6.66 $\pm$ 1.71	0.138
Second molar – Mesial root			
Coronal	2.61 $\pm$ 0.83	2.68 $\pm$ 0.74	0.384
Middle	3.22 $\pm$ 0.89	3.20 $\pm$ 0.97	0.946
Apical	4.40 $\pm$ 1.66	4.14 $\pm$ 1.39	0.536
Second molar – Distal root			
Coronal	3.11 $\pm$ 0.88	2.82 $\pm$ 0.79	0.108
Middle	3.22 $\pm$ 0.99	2.96 $\pm$ 1.14	0.282
Apical	3.79 $\pm$ 1.62	3.70 $\pm$ 1.42	0.908

SD=standard deviation. Values expressed in millimeters (mm). Mann–Whitney U test.

DISCUSSION

This study evaluated buccal and lingual alveolar bone thickness in mandibular first and second molars using CBCT in a Peruvian adult population. The main findings were that age-related differences were more evident than sex-related differences. Younger individuals exhibited greater buccal bone thickness in several regions of the second molars, whereas older individuals showed greater lingual bone thickness in selected middle and apical regions. Sex-related differences were limited and observed only in the coronal buccal region of the first molar.

The anatomical distribution of alveolar bone thickness observed in this study is consistent with previous CBCT investigations reporting substantial variation according to tooth type, root location, and measurement level. Aldahlawi et al., Kunte et al., and Yanik and Nalbantoglu demonstrated that mandibular molars present marked differences in cortical bone dimensions depending on the evaluated surface and root region, highlighting the importance of site-specific assessment for surgical and implant planning (7,8,9).

Age was associated with significant variations in alveolar bone thickness, particularly in second molars. Younger individuals exhibited greater buccal bone thickness at coronal and middle levels, whereas older individuals exhibited greater lingual thickness in selected middle and apical regions. Although the biological mechanisms underlying these findings cannot be determined from a cross-sectional design, they may reflect age-related changes in alveolar bone morphology and remodeling patterns. Similar age-related variations in alveolar bone dimensions have been reported in CBCT studies evaluating mandibular bone morphology (10,11).

Most measurements did not differ according to sex. Although statistically significant differences

were identified in the coronal buccal thickness of the mesial and distal roots of the first molar, the magnitude of these differences was small. Therefore, their clinical relevance is uncertain. This finding contrasts with some studies that reported greater cortical bone thickness in males, possibly reflecting population-specific anatomical characteristics or methodological differences among investigations (10,11).

From a clinical perspective, knowledge of site-specific alveolar bone thickness may contribute to safer treatment planning in the posterior mandible. Areas presenting thinner cortical bone may be more susceptible to surgical complications, whereas regions with greater bone availability may provide more favorable conditions for implant placement, endodontic surgery, and orthodontic procedures. CBCT evaluation allows clinicians to identify these anatomical variations before treatment and adapt surgical or biomechanical strategies accordingly.

From a clinical perspective, the age-related reduction in buccal alveolar bone thickness observed in some mandibular molar regions may influence guided treatment planning for surgical and implant procedures. In cases with limited buccal bone support, clinicians should carefully evaluate the feasibility of immediate implant placement, as reduced cortical thickness may compromise primary implant stability and increase the likelihood of requiring bone regeneration or other bone augmentation procedures. Likewise, these anatomical variations should be considered during endodontic surgery and orthodontic treatment planning to minimize the risk of cortical perforation and other surgical complications.

CLINICAL IMPLICATIONS

The findings of this study provide relevant anatomical data for clinicians performing surgical, orthodontic, or implant procedures in the

posterior mandible. Knowledge of site-specific differences in buccal and lingual bone thickness, particularly in relation to tooth type, age and sex, can assist in minimizing surgical risks and optimizing treatment planning.

LIMITATIONS

This study has several limitations. First, its cross-sectional design precludes the establishment of causal relationships between demographic variables and alveolar bone thickness. Second, the sample was obtained from a single radiology center, which may limit the generalizability of the findings to other populations. Finally, variables such as occlusal function, facial pattern, and bone density were not evaluated and may have influenced the observed anatomical variations. Furthermore, measurement reproducibility could not be formally assessed because the analysis was performed retrospectively using a pre-existing imaging database.

Additionally, the CBCT images were acquired using a voxel size of 200 μm . Although this spatial resolution is appropriate for clinical assessment of alveolar bone morphology, cortical plates approaching the voxel dimension may be affected by partial volume averaging artifacts. Consequently, exceptionally thin buccal cortical bone may have been underestimated or measured with reduced accuracy. Therefore, measurements obtained in these regions should be interpreted with appropriate caution.

Another limitation of this study is that formal intra- and inter-examiner reproducibility could not be assessed. Because this investigation was conducted retrospectively using a pre-existing imaging database generated as part of a previously completed undergraduate research project, the additional standardized measurements

required for calculating the Intraclass Correlation Coefficient (ICC) could not be performed during the review process. Future CBCT studies should incorporate reproducibility analyses, including intra- and, whenever possible, inter-examiner ICC assessments, to further strengthen the reliability of linear measurements.

STRENGTHS

This study provides detailed CBCT-based measurements of buccal and lingual alveolar bone thickness in mandibular first and second molars within a Peruvian population. The evaluation of both mesial and distal roots at coronal, middle, and apical levels offers clinically relevant anatomical information that may support surgical, orthodontic, and implant-related decision-making. In addition, the inclusion of age- and sex-based analyses contributes to the limited evidence available from Latin American populations.

CONCLUSION

Alveolar bone thickness in mandibular molars varies according to age and anatomical location. Younger individuals exhibited greater buccal bone thickness in several regions of the second molars, particularly at coronal and middle root levels, whereas older individuals showed greater lingual bone thickness at selected middle and apical levels. Sex-related differences were limited and restricted to specific coronal buccal measurements of the first molar, suggesting a minimal influence of sex on alveolar bone thickness patterns.

These findings provide clinically relevant anatomical information for treatment planning in the posterior mandible and may contribute to safer surgical, orthodontic, and implant-related procedures in Peruvian and other Latin American populations.

DECLARATIONS

AUTHOR CONTRIBUTION STATEMENT: Conceptualization: H.L.C.A. and M.F.G.G.; Investigation: H.L.C.A. and C.A.J.P.; Data curation: H.L.C.A.; Formal analysis: H.L.C.A., H.I.A.V., C.M.S. and F.T.C.Z.; Methodology: H.L.C.A., M.F.G.G., H.I.A.V. and F.T.C.Z.; Writing – original draft: H.L.C.A.; Writing – review & editing: M.F.G.G., C.A.J.P., V.E.G.Z., H.I.A.V., C.M.S. and F.T.C.Z.; Supervision: M.F.G.G. and V.E.G.Z.; Validation: M.F.G.G., C.A.J.P. and V.E.G.Z.; Critical revision of the manuscript: H.I.A.V., C.M.S.; Data interpretation, Project administration, Manuscript preparation for journal submission: F.T.C.Z. All authors read and approved the final version of the manuscript and agree to be accountable for all aspects of the work.

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INFORMED CONSENT: Patient informed consent was waived due to the retrospective nature of the study and the use of anonymized imaging records.

ETHICAL APPROVAL: This study was approved by the Institutional Research Ethics Committee of the Universidad Nacional de Trujillo, Peru (Approval Code: P.I.B. EST.-022-2024). The study was conducted in accordance with the ethical principles of the Declaration of Helsinki and its subsequent amendments. All patient data were anonymized prior to analysis.

REPORTING GUIDELINES: This manuscript adheres to the STROBE checklist for observational cross-sectional studies. The completed checklist is provided as Supplementary Material 1.

CONFLICTS OF INTEREST: The authors declare no conflicts of interest related to this study.

DATA AVAILABILITY: The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

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SUPPLEMENTARY MATERIAL

Item No.		Recommendation	Page No.	Relevant text from manuscript
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1	"A descriptive cross-sectional study was conducted using 112 CBCT scans obtained from a radiology center between 2022 and 2023." (Abstract)
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	1	"Buccal and lingual alveolar bone thicknesses were measured in mandibular molars using CBCT. Bone dimensions varied by molar type and age group, but not by sex. These findings provide region-specific anatomical data relevant for implant and surgical procedures."
Introduction				
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	2	"The mandibular alveolar bone plays a crucial role in supporting teeth and ensuring the stability of various dental treatments... However, most studies have been performed in non-Latin American populations. Ethnic, genetic, and environmental factors may influence alveolar bone characteristics; thus, population-specific data are essential."
Objectives	3	State specific objectives, including any prespecified hypotheses	3	"Therefore, the aim of this study was to evaluate buccal and lingual alveolar bone thickness in mandibular first and second molars using CBCT and to assess possible differences according to age and sex in a Peruvian population."
Methods				
Study design	4	Present key elements of study design early in the paper	3	"This was a descriptive, observational, cross-sectional study based on CBCT scans obtained from patients treated at a Maxillofacial Radiology Center."
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	3	"CBCT scans were obtained at a Maxillofacial Radiology Center, between 2022 and 2023."
Participants	6	(a) Cohort study—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up Case-control study—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls Cross-sectional study—Give the eligibility criteria, and the sources and methods of selection of participants (b) Cohort study—For matched studies, give matching criteria and number of exposed and unexposed Case-control study—For matched studies, give matching criteria and the number of controls per case	3-4	"The inclusion criteria were: CBCT scans showing fully developed mandibular first and second molars ..."
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	4	"Buccal and lingual bone thickness was the main outcome, measured at three levels (coronal, mid-root, apical) in mesial and distal roots of mandibular molars. Age and sex were considered stratification variables."
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	4	"Bone thickness was measured using the CBCT viewer's linear tools from the external surface of the cortical plate to the root surface."
Bias	9	Describe any efforts to address potential sources of bias	3,4	"A systematic random sampling procedure was applied to reduce selection bias..."
Study size	10	Explain how the study size was arrived at	3	"A sample size of 112 scans was calculated using the formula for estimating means in finite populations... with a 95% confidence level, standard deviation of 0.95 mm, and maximum error of 0.14 mm."

Item No.		Recommendation	Page No.	Relevant text from manuscript
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	4-5	"Quantitative variables (bone thickness in millimeters) were summarized using means and standard deviations. Analyses were stratified according to age group and sex."
	12	(a) Describe all statistical methods, including those used to control for confounding	5	"Because the distribution of the measurements did not satisfy the assumptions required for parametric analyses, non-parametric tests were applied. Differences among age groups were evaluated using the Kruskal–Wallis test. Comparisons according to sex were performed using the Mann–Whitney U test. A p-value < 0.05 was considered statistically significant."
Results	Participants	(b) Describe any methods used to examine subgroups and interactions	5	"Subgroup analyses were conducted by stratifying patients into three age groups (20–34, 35–49, and ≥50 years) and by sex (male, female)."
		(c) Explain how missing data were addressed	-	"No missing data were reported. All CBCT scans included in the analysis met the inclusion criteria and provided complete measurements."
		(d) Cohort study—If applicable, explain how loss to follow-up was addressed	3	"A systematic random sampling procedure was performed to select the study sample."
		Case-control study—If applicable, explain how matching of cases and controls was addressed		
		Cross-sectional study—If applicable, describe analytical methods taking account of sampling strategy		
Descriptive data	13*	(e) Describe any sensitivity analyses		
		(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	5	"A total of 448 mandibular molars were evaluated from 112 CBCT scans. These included 224 first molars and 224 second molars."
		(b) Give reasons for non-participation at each stage	-	"Not applicable – all selected scans met eligibility criteria and were included in the final analysis."
		(c) Consider use of a flow diagram	-	"A flow diagram was not deemed necessary due to the simplicity of the retrospective selection process and the absence of losses or exclusions after eligibility assessment."
		(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	5	"Participants were stratified into three age groups: 20–34 years, 35–49 years, and ≥50 years. There were 47 male and 65 female patients. All included patients had fully developed mandibular first and second molars."
Outcome data	14*	(b) Indicate number of participants with missing data for each variable of interest	-	"No missing data were reported for any of the variables measured."
		(c) Cohort study—Summarise follow-up time (eg, average and total amount)	-	Not applicable
		Cohort study—Report numbers of outcome events or summary measures over time		
		Case-control study—Report numbers in each exposure category, or summary measures of exposure		
	15*	Cross-sectional study—Report numbers of outcome events or summary measures	5-6	"Summary measures of buccal and lingual alveolar bone thickness were reported as means and standard deviations for mandibular first and second molars. Measurements were presented according to root location, measurement level, age group, and sex (Tables 2–5)."

	Item No.	Recommendation	Page No.	Relevant text from manuscript
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included (b) Report category boundaries when continuous variables were categorized (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	5; Tables 2–5	"Unadjusted comparisons across groups were performed using the Kruskal–Wallis test. Differences were reported with p-values to indicate statistical significance. No confounder-adjusted models were applied." "Patients were grouped into three age categories: 20–34, 35–49, and ≥50 years, based on standard adult age stratification in dental studies." "Not applicable – no risk estimates were calculated in this anatomical observational study."
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	5–6	"Additional analyses were performed to compare bone thickness between sexes and age groups, showing significant differences in specific root areas and levels."
Discussion				
Key results	18	Summarise key results with reference to study objectives	6	"Alveolar bone thickness in mandibular molars varies according to age and anatomical location. Younger individuals exhibited greater buccal bone thickness in several regions of the second molars, particularly at coronal and middle root levels, whereas older individuals showed greater lingual bone thickness at selected middle and apical levels."
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	6	"This study has several limitations. First, its cross-sectional design precludes the establishment of causal relationships between demographic variables and alveolar bone thickness. Second, the sample was obtained from a single radiology center, which may limit the generalizability of the findings to other populations. Finally, variables such as occlusal function, facial pattern, and bone density were not evaluated and may have influenced the observed anatomical variations. Additionally, measurement reproducibility could not be formally assessed because the analysis was performed retrospectively using a pre-existing imaging database."
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	6–7	"Findings support the clinical relevance of anatomical variability in the posterior mandible and highlight the need for preoperative CBCT assessment in implant and surgical procedures. These results are consistent with studies in other populations, although further research is needed in broader Latin American cohorts."
Generalisability	21	Discuss the generalisability (external validity) of the study results	7	"Although the study provides valuable regional reference values, results should be interpreted with caution when extrapolating to populations with different ethnic, dietary, or anatomical backgrounds."
Other information				
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	Title Page & Declarations	"This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors."

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.