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Research Article

Assessment of Jaw Bone Density Using Cone Beam Computed Tomography for Dental Implant Treatment Planning

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Received: November 08, 2023; **Published:** November 21, 2023

Abstract

Background: Dental implants have become an important option in the treatment plan in dentistry. Implant success is related to bone quality as well as bone density. Bone quality and quantity are typically estimated from radiographs before implant site preparation. A good preoperative assessment of bone density can guide the clinician regarding the implant type and the surgical technique to be used. Cone beam computed tomography (CBCT) can provide an accurate three dimensional high resolution images as well as a direct measurement of bone density expressed in Hounsfield units (HU), a value that offers crucial information about the bone quality, which is a major concern for implant success.

Aim of the Study: To assess the bone density in terms of Hounsfield units of different region of upper and lower jaw by Cone beam computed tomography for dental implant treatment planning.

Materials and Methods: This Cross Sectional Study was conducted with 20 patients having one or more missing tooth, who were selected from the outdoor clinic of Department of Prosthodontics or Department of Oral and Maxillofacial Surgery, BSMMU, Dhaka, Bangladesh and planned for dental implant treatment. After the clinical examination, CBCT images of the maxilla and mandible was obtained by the same operator according to the standardized procedure. Bone density in terms of Hounsfield unit (HU) was measured from anterior and posterior region of both jaws. All the information was recorded in a specifically designed data entry sheet. Data were processed and analyzed by SPSS version 22 (Armonk, NY, USA). Descriptive statistics, independent sample t-test and ANOVA with Post Hoc Tukey were used to analyze and compare the data. P-value less than 0.05 ($p < 0.05$) was considered statistically significant. The summarized data was presented as mean, standard deviation, percentages and ratio on table and diagram.

Results: In this present study, differences in the bone densities of the four regions in the mouth were significant, with the anterior mandible yielding a higher mean bone density value (1615.65 ± 203.64), followed by posterior mandible (1434.15 ± 222.65), anterior maxilla (1421.00 ± 202.85), and the posterior maxilla (1265.05 ± 120.80). However, when considering all four regions in male and female participants, the mean bone density in female was (1494.84 ± 230.12 HU), which was higher than male (1393.37 ± 215.56 HU).

The results of this study also indicated a strong correlation between the four regions of the jaw and the bone density. The mean bone density value from anterior and posterior regions of both jaws were higher than previously reported studies. In this present study, only D1 and D2 types of bone were found in the four different areas of jaws.

Conclusion: The study conclude that, the anterior mandible has the highest jaw bone density followed by posterior mandible, anterior maxilla, and the lowest jaw bone density in the posterior maxilla. It is suggested that a CBCT investigation can provide valuable information of bone density to the clinicians prior to installation of the dental implants.

Keywords: *Dental Implant; Maxilla; Mandible; Cone Beam Computed Tomography; Hounsfield Units; Bone Density; Bone Quality*

Introduction

Dental implants have become an important option in the treatment plan of missing teeth in modern dentistry. However, with the great advanced technique and technology of implantology, several approaches for implant insertion, placement, and treatment planning had been developed [1-3]. One of the most important factors in determining implant success is proper treatment planning. Traditionally pre-operative information for dental implant diagnostics and treatment planning have been obtained from clinical examination, dental study model analysis and two-dimensional (2D) imaging such as intra-oral peri-apical, lateral cephalometric and panoramic radiography [4]. The periapical and panaromic dental imaging are the type of 2D imaging. For 3D imaging cone beam computed tomography (CBCT) is recently widely used for dental and maxillofacial radiographic application. CBCT uses much lower radiography percentage, faster scan time, and safer to use in maxillofacial region than conventional multidetector CT scan. For assessment of bone quality, CBCT image has relatively straightforward because a gray value is proportional with energy attenuation of bone material [5]. As radiography technology develops, computed tomography (CT) and cone-beam computed tomography (CBCT) are becoming more crucial for proper implant placement, particularly in the case of complex reconstructions [6]. A thorough dental history, images, study models, panoramic and periapical radiographs and CBCT of the potential implant sites should all be considered in the case of complex prosthodontics reconstructions by dental implants [7]. The clinical success of dental implants has been linked to both the quantity and the density of the surrounding bone [8]. Cone beam computed tomography (CBCT) is an established method for obtaining bone images before performing dental implant insertion surgery. CBCT technology has a significant impact on oral implantology and is currently the most used tool for assessing bone quantity and quality during dental implant planning. The accuracy of CBCT in determining bone density has been evaluated in multiple studies [9-11]. Parsa., *et al*. 2013 [12]. compared CBCT with both traditional and microcomputed CT, and the results indicated a strong correlation between CT and CBCT, thus confirming that these methods have similar accuracy for bone density assessment. CBCT can provide an accurate three dimensional assessment of anatomical structures as well as a direct measurement of bone density, which is expressed as Hounsfield units (HU), a value that offers crucial information about the bone [8]. The Hounsfield scale represents the tissue's relative density on a calibrated grayscale, based on values for air, water, and bone density. The bone quality is determined by several factors that contribute to bone resistance. However, bone density on the Hounsfield scale is an objective and quantifiable measure of bone quality analysis. For CBCT, Hounsfield unit is proportional to the degree of x-ray attenuation assigned to each pixel to display the image reflecting the tissue density. The gray scale (voxel value) in CBCT indicates the degree of x-ray attenuation, although manufacturers of CBCT and software suppliers present gray scales as the HU [13]. The radiological measurement of bone density describes the ability of bone to attenuate an X-ray beam, ranging from -1000 HU for air to about 3000 HU for enamel [14]. A significant correlation was found between the observed radiodensities of the implant sites and their populationive bone density scores [15]. Further studies [16-19] have established the ranges of HU values corresponding to each bone density class: D1 bone > 1250 HU, D2 bone 850-1250 HU, D3 bone 350-850 HU, D4 bone 150-350 HU and D5 bone<150 HU [28]. A CBCT device is calibrated by the manufacturer to give -1000 HU for air and 0 HU for a water phantom [20]. The most important factor and prerequisite for achieving osseointegration is the stability of the

implant, which depends on the quality of the bone at the implant site, implant design and surgical implantation technique [21,22]. In order to achieve the appropriate conditions for osseointegration (or functional ankylosis), the implant must show proper initial fixation (primary stability) following the implantation [23]. The following factors determine the value of primary implant stability: quantity and quality of bone tissue at the implant site, implant design, and surgical implantation technique. Hence, Bone density is an important prerequisite both in the initial implant stabilization and in the loading profile of the prosthesis. Poor primary stability and higher failure rates are more common among implants placed in low-density bones [11]. Therefore, a good preoperative assessment of bone density can guide the clinician regarding the implant type and the surgical technique to be used [12]. In cases with reduced bone density, primary implant stability can be improved by using implants with more aggressive threads [15]. As the bone heals, the process of osseointegration produces secondary stability, which is responsible for the long-term success of the implant. During the bone remodeling process after implant placement, primary stability decreases while secondary stability increases from new bone formation [13]. Lekholm and Zarb, 1985 suggested [24] a bone classification system based on macrostructure, one in which the morphology and distribution of the cortical and trabecular bone determined the bone quality [24,25]. Bone mineral density quantified as CT values (HU) was originally categorized by Misch into five ranges: D1 bone for a HU value greater than 1250, D2 bone for values between 850 and 1250 HU next to the implant-bone interface, D3 bone for values from 350 to 850 Hu at the implant site, D4 bone from 150 to 350 HU at the site, and D5 bone for less than 150 HU [26]. Based on Misch's classification, Trisi and Rao proved that the histomorphometry of the trabecular bone volume strongly correlates with bone resistance measurements in D1 and D4 bones. However, there was a high degree of variation in terms of the D2 and D3 bones [27]. The quality of bone depends on the anatomical location. The densest bone type is found in the anterior mandible, being followed by the posterior mandible, the anterior maxilla, and the posterior maxilla. The anterior mandible is mainly composed of D2 bone, but also contains D1 bone in about 6% of the population; the posterior mandible is made of D2 bone and D3 bone, and rarely contains D1 bone and D4 bone; the anterior maxilla is mainly made of D3 bone, but also of D2 bone (25% occurrence) and D4 bone (10% occurrence); the posterior maxilla is made of D3 bone and D4 bone, and, occasionally, of D2 bone (10% occurrence) [28]. Implant success is related to bone quality as well as bone density. The aim of the present study is to assess preoperative bone densities in the anterior and posterior maxillary and in the anterior and posterior mandibular regions.

Objectives of the Study

General objective:

- To assess the bone density in terms of Hounsfield units of different region of upper and lower jaw by Cone beam computed tomography for dental implant treatment planning.

Specific objectives:

- To assess the bone density in HU of anterior and posterior region of maxilla.
- To assess the bone density in HU of anterior and posterior region of mandible.
- To compare the bone density of different regions of maxilla and mandible.
- To evaluate the mean bone density in relation to age and sex.

Materials and Methods

This was cross-sectional study. The patients were selected purposively. A total of 20 patients were included in this study as study population. The study was conducted in the Department of Oral and Maxillofacial Surgery and Department of Prosthodontics, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh. At 1st September 2022 to 31st August 2023.

Methodology for CBCT scan

The image scanning protocol was as follows: 1.02 mSv to 1.05 mSv (220 - 235 mGy cm^2), field of view: 12×13 cm sq; 120 kV; 5 mA; exposure time: 7 seconds; and slice thickness: 0.1 mm. The scanner had sufficient image sharpness and contrast for visualization of the structures to be evaluated (mandibular condylar head, articular eminence and mandibular fossa). All scans were viewed in GALILEOS viewer software and by using 3D implant verification tool. Bone density in terms of Hounsfield unit (HU) was measured using the verification tab in the GALILEOS viewer program.

Inclusion criteria

- Patient who need replacement of missing natural tooth.
- Adequate bone volume to accommodate an implant of appropriate dimension.
- Patient aged > 18 years and < 50 years.
- Optimum oral hygiene.
- Non-smokers.

Exclusion criteria

- Uncontrolled periodontal disease.
- Pregnant women.
- Poorly controlled diabetes (HBA1c > 7.5%).
- Immunocompromised patients.
- Those who were contraindicated for any radiographic procedure.

Study procedure

All these study populations were assessed clinically and their detailed medical dental history was recorded. Through history and clinical examination inclusion and exclusion criteria were evaluated. A written informed consent was taken after describing the study procedure and also its advantage and disadvantages. After the clinical examination, radiographic investigations were carried out. CBCT images of the maxilla and mandible was obtained by the same operator using a Dentsply Sirona- Orthophos S (Sirona, USA). All CBCT scans were performed according to a strictly standardized scanning procedure; patients were put in a stand-up vertical posture, stabilized with a headband and chin support, and watched during the scan to ensure that they stayed immobile. The scanner rotated 360° around the participant's head. All images were obtained under the same conditions by the same experienced radiologist using the same device in order to address any bias.

Data collection procedure

After scanning both jaw to see the jaws bone density in Hounsfield unit by GALILEOS viewer software, maxilla and mandible were divided into the following regions:

- Anterior maxillary region (central incisor to canine on both side).
- Posterior maxillary region (First premolar to maxillary tuberosity on both sides).
- Anterior mandibular region (central incisor to canine on both side).
- Posterior mandibular region (First premolar to anterior border of ramus on both sides).

On each image the bone density was measured in four areas - anterior maxilla, posterior maxilla, anterior mandible, posterior mandible and the edentulous side was preferred for each patient. For anterior region, central incisor area was preferred and for posterior region 1st molar tooth area was preferred. In each region, bone density range was seen by HU from crestal bone to apical region and also the bone density in mid root area was seen. Then bone type for each region was calculated according to Misch classification. All the information was recorded in a specifically designed data entry sheet.

Statistical analysis

Computer based statistical analysis was carried out with appropriate technique and systems. Data were processed and analyzed by SPSS version 22 (Armonk, NY, USA). Descriptive statistics, independent sample t-test and ANOVA with Post Hoc Tukey were used to analyze and compare the data. The measurements were retrieved from different patients; therefore, unpaired statistical tests were performed. Cross tabulation has been used to show the distribution of data in relation to age groups and sex. P-value less than 0.05 ($p < 0.05$) was considered statistically significant. The summarized data was presented as mean, standard deviation, percentages and ratio on table and diagram.

Ethical consideration

Ethical clearance for the study was taken from the Institutional Review Board of Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh prior to the commencement of this study. The aims and objectives of the study along with its procedure, risks, stages and benefits of this study were explained to the study participants A written informed consent was taken from all the study participants.

Results

Age	Mean ± SD		Minimum	Maximum
	35.55 ± 10.41		21	49
Sex	Male	Female	Male: Female Ratio	
	12 (60%)	8 (40%)	1.5:1	

Table 1: *Age and sex distribution of participants (N = 20).*

Table 1 showed a total of 20 patients were included in this study. Their mean age was 35.55 ± 10.41 where minimum age of patient was 21 and maximum age was 49 years. Among 20 participants 12 (60%) were male and 8 (40%) were female, where male: female ratio was 1.5:1.

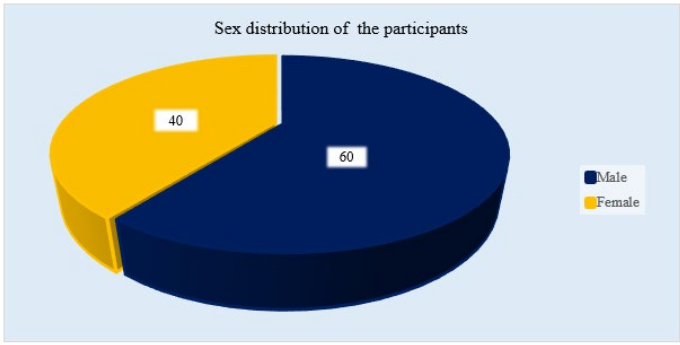

Figure 1: *Pie chart showed sex distribution of the participants (N = 20).*

Gender	Mean ± SD	Minimum	Maximum	t	p
Male	1393.37 ± 215.56	1105	1807	1.9813	0.05189
Female	1494.84 ± 230.12	1177	1924		

Table 2: *Distribution of mean bone density between male and female (N = 20).*

Table 2 showed there were 12 male and 8 female participants in this study. Mean bone density was calculated from all the measurements of four regions and compared by Welch's test. Mean bone density of male was 1393.37(± 215.56) and mean bone density of female was 1494.84 ± 230.12. The difference between mean bone density of male and female is not greater enough to be statistically significant (p = 0.05189).

Region	Mean HU ± SD	f	p
Anterior Maxilla	1421.00 ± 202.85	11.21062	< 0.00001
Posterior Maxilla	1265.05 ± 120.80		
Anterior Mandible	1615.65 ± 203.64		
Posterior Mandible	1434.15 ± 222.65		

Table 3: *Bone density at mid-root area of different regions of jaws (N = 20).*

Table 3 showed bone density was measured in anterior and posterior areas of upper and lower jaws. Hence, bone density was calculated by HU in four different areas. Mean HU at anterior maxilla was 1421.00 ± 202.85, at anterior mandible was mean HU at anterior maxilla was 1421.00 ± 202.85, at posterior maxilla 1615.65 ± 203.64) and at posterior mandible was 1434.15 ± 222.65. Comparison of bone density by ANOVA showed that, there was statistically significant difference in HU among four different regions of jaws (< 0.00001).

Pairwise Comparisons	Mean HU ratio	Q	p
Anterior Maxilla: Posterior Maxilla	1421.00:1265.05	3.65	0.0568
Anterior Maxilla: Anterior Mandible	1421.00:1615.65	4.54	0.0101
Anterior Maxilla: Posterior Mandible	1421.00:1434.15	0.31	0.9963
Anterior Mandible: Posterior Mandible	1615.65:1434.15	4.24	0.0189
Anterior Mandible: Posterior Maxilla	1615.65:1265.05	8.18	0.00000
Posterior Maxilla: Posterior Mandible	1265.05:1434.15	3.95	0.03289

Table 4: *Pairwise comparisons of bone density of different region of jaws (N = 20).*

Table 4 showed bone density was also compared by pairwise comparisons in between two different regions of jaws. When anterior maxilla was compared to posterior maxilla, there was no significant difference in HU (p = 0.0568) and when anterior maxilla was compared to anterior mandible, a significant difference was observed in HU (p = 0.0101). But, when anterior maxilla was compared to

posterior mandible, no significant difference was found in HU (p = 0.9963). Likewise, when anterior mandible was compared to posterior mandible, there was significant difference in HU (p = 0.0189). But when anterior mandible was compared to posterior maxilla, a significant difference was observed in HU (p = 0.00000) and when Posterior maxilla was compared to Posterior Mandible, a significant difference was also found in HU (p = 0.03289). Result indicated that, there was greatest significant difference in HU was observed between anterior mandible and posterior maxilla.

Region	D1	D2	D3	D4
Anterior Maxilla	15 (75%)	5 (25%)	-	-
Posterior Maxilla	4 (20%)	16 (80%)	-	-
Anterior Mandible	18 (90%)	2 (10%)	-	-
Posterior Mandible	14 (70%)	6 (30%)	-	-

Table 5: *Bone quality type of different region of jaws (N = 20).*

Table 5 showed Quality of bone was also assessed in different region of jaws. 75% of participants had D1 type of bone in anterior maxilla and 25% had D2 type bone in anterior maxilla. However, only 20% had D1 type bone in Posterior Maxilla and 80% had D2 type bone. Again, 90% participants had D1 type of bone in Anterior Mandible and 10% had D2 type bone in Anterior Mandible. Likewise, 70% participants had D1 type of bone in Posterior Mandible and 30% had D2 type bone. There was no D3 or D4 type of bone found among the participants. Result indicated that, most of the participants had D2 type of bone in their Posterior Maxilla and D1 type of bone in their anterior mandible.

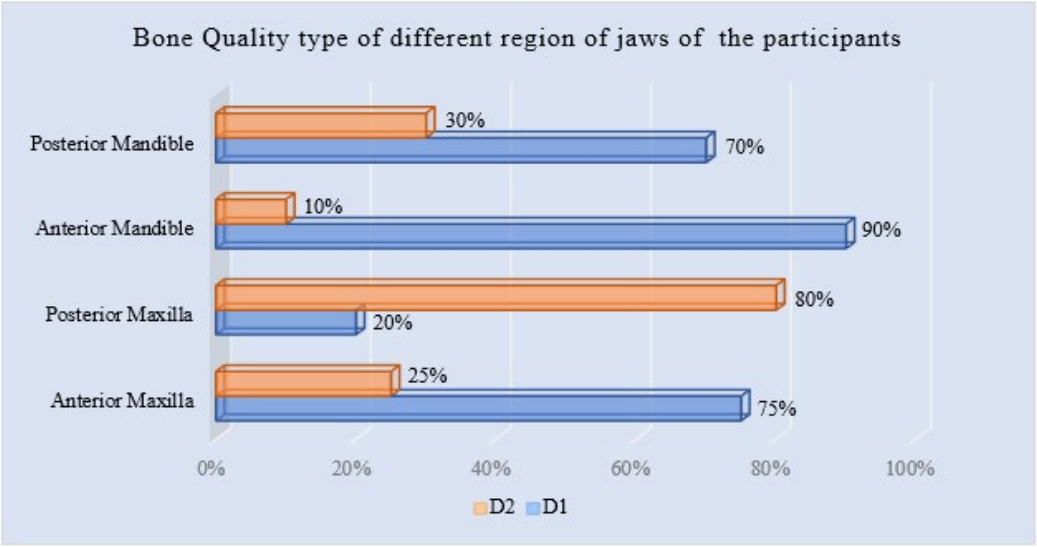

Figure 2: *Bar chart showed bone quality type of different region of jaws wise participants (N = 20).*

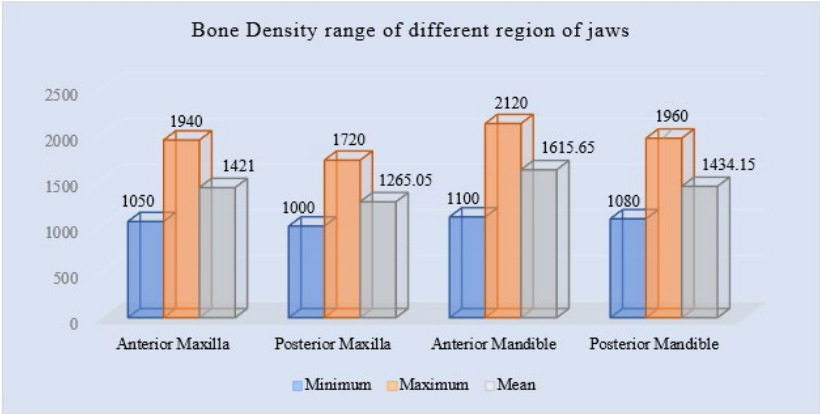

Figure 3: *Column chart showed bone density range of different region of jaws of the participants (N = 20).*

Figure 3 showed bone density was measured throughout the both jaw. Bone density was ranges in HU in different regions of upper and lower jaw. Figure 1 shows that, minimum bone density in anterior maxilla was 1050 HU and maximum 1940HU (mean bone density was1421HU) and minimum bone density in posterior maxilla was 1000HU and maximum 1720HU (mean 1265.05HU). Again, minimum bone density in anterior mandible was 1100HU and maximum 2120HU (mean 1615.65HU) and minimum bone density in posterior mandible was 1080HU and maximum 1960HU (mean 1434.15.05HU). This result indicated that, anterior mandible showed more density of bone and posterior maxilla showed the least.

Discussion

The bone represents a very active tissue that is constantly changing. Bone density differs depending on the jaw topographic area. The bone with the highest density is usually found in the anterior mandible, while the least dense bone is located in the posterior maxilla. Bone density is essential in choosing the type of implant, and it decreases with age. Investigating the bone density of prospective dental implant sites is crucial both for choosing the implant type and for choosing the drilling procedure best suited to ensure implant stability and osseointegration [13]. In this present study bone density of mid-root area of different region of jaws of 20 patients were evaluated by CBCT examination. Bone density was measured with Housefield Unit (HU) at mid root area. Bone density range and type of bone quality were also assessed. In the current study, bone density was significantly lower at the maxillary level compared to the mandibular level. Moreover, it was observed that D1 bone was present both in the maxillary and in the mandibular anterior region as well as the mandibular posterior region. In this present study among 20 participants mean age was 35.55 ± 10.41 where minimum age of patient was 21 and maximum age was 49 years. Among 20 participants 12 (60%) were male and 8 (40%) were female. Mean bone density was greater in female (1494.84 ± 230.12) than mean bone density of male (1393.37 ± 215.56), which is not statistically significant (p = 0.05189). Al-Nakib, (2014) [29] found the mean HU of bone density of males (680.2) was higher than females (581.5), and bone density decreased significantly with increased age. Dahiya., *et al*. (2018) [30] found the mean bone density 690.5 ± 104.12 HU in males and 580.20 ± 120.2 HU in females. In this present study mean bone density in HU at anterior maxilla was 1421.00 ± 202.85, at posterior maxilla was 1265.05 ± 120.80, and at anterior mandible was 1615.65 ± 203.64 and at posterior mandible was 1434.15 ± 222.65. There was statistically significant difference in bone density among four different regions of jaws (P <.00001). Hao., *et al*. (2014) [13] observed that, the bone density in all patients ranged from 42.4 to 895.6 HU with a mean value of 364.95 ± 178 HU. They also observed statistically significant differences ($p < 0.001$) in the mean bone density between the regions of the jaws (AMd and AMx; AMd and PMd; AMd and PMx; AMx and PMx; PMd and PMX). Ahmed., *et al*. (2021) [21] also found a significant difference in bone density with regards to anterior maxilla,

anterior mandible, posterior maxilla and posterior mandible ($p < .001$). Turkyilmaz., *et al*. (2007) [19] also found higher bone density of 927 ± 237 HU, 708 ± 277 HU in anterior mandible and anterior maxilla and less in 721 ± 291 HU, 505 ± 274 HU in posterior mandible, posterior maxilla respectively as compared to this present study. However, mean bone density of all four regions were lower than this current study. In this present study, there was no significant difference in bone density ($p = 0.0568$) between anterior region and posterior region of upper jaw, though anterior region had more bone density. In lower jaw, anterior region there was significant difference in bone density ($p = 0.0189$) between anterior region and posterior region, where anterior region showed more bone density. Al-Nakib (2014) [29] also observed similar result. Ahmed., *et al*. (2021) [21] observed that, the anterior mandible has the highest mean jaw bone density (1093.3425 ± 109.424 HU) followed by anterior maxilla, posterior mandible and the lowest mean jaw bone density of the posterior maxilla (299.66 ± 73.090 HU). In this present study, when comparing upper and lower jaw, a significant difference was observed in bone density ($p = 0.0101$) between anterior region of upper jaw and lower jaw, where anterior region of lower jaw showed greater bone density than anterior region of upper jaw. When comparing anterior and posterior region, in both jaws bone density in anterior region were greater than posterior region. Hassan and Al-Radha (2023) [32] showed a significant difference between the upper and lower jaws in the bone density and among facial and palatal/lingual aspects of both jaws. Al-Nakib (2014) [29] also found that, mandible show significantly higher bone density than maxilla. Hao., *et al*. (2014) [13] also found that, the anterior mandible showed a mean bone density of 679.6 ± 141.67 HU, which was greater than anterior maxilla, (460.25 ± 136.42) HU. Dahiya., *et al.* (2018) [30] found the mean bone density in the posterior mandible was 628.0 ± 20.19 HU. Again, Jalal., *et al*. (2023) [33] observed highest bone density (347 HU) in anterior region followed by the premolar region (275HU) and lastly the molar region (195 HU). In this present study, D1 and D2 [24] bone types were found with significant differences ($p < 0.001$) in the four different areas of jaws. 75% of participants had D1 quality of bon in anterior maxilla, 20% had D1 quality bone in posterior maxilla. 90% participants had D1 quality of bone in anterior mandible and 70% participants had D1 quality of bone in posterior mandible. Hao., *et al*. (2014) [13] found D2 and D3 (74.15%), D1 (8.9%) and D4 (16.95%), respectively in their study participants. Jalal., *et al*. (2023) [33] found that, the most common bone type of upper jaw was D3 and the less type was D1. According to this study, the more successful rate area for implant stability was the anterior of mandible and maxilla due to the high bone density (D1), which is suitable for osseointegration [31]. Though, the type D1 has an increased risk of overheating during installation of the dental implants [34]. In this present study, in the anterior mandible, anterior maxilla, posterior mandible, and posterior maxilla, the mean bone density value is higher than those previous studies. Comparing the present study and other studies, there are large differences between the mean of jaw bone density in terms of Hounsfield Units; in the Kurdish population using CBCT for dental implant treatments, it was (347 HU) for the anterior maxilla, while in other populations showed higher bone density; Pakistani population [21] had 709.75 ± 122.63 HU, Turkey population [19] had 715.8 ± 19 HU, Chinese patients [35] had 530 ± 161 HU, Myanmar population [36] had 439 ± 271 HU and USA [37] had 517 ± 177 HU for the anterior maxilla. Furthermore, the mean bone density at the maxillary posterior region of this present study was also higher than other reported studies. Likewise, in population of UK [15] was found 417.3 ± 227.3 HU, in USA [18] was 333 ± 199 HU, in Pakistan [21] was 299.66 ± 73.09 HU, in Turkish population [19] it was 455.1 ± 122 HU, in Saudi Arabia [38] was 320.05 ± 193.6 HU, in Myanmar population it was 271 ± 143 HU and in Chinese patients [35] was 332 ± 136 HU. However, in this present study mean bone density in anterior maxilla was found 1421.00 ± 202.85 HU and in posterior maxilla was 1265.05 ± 120.80. Comparing the result of present study and other studies, there are also differences between the mean jawbone density in anterior and posterior mandible. In this present study mean bone density in anterior and posterior mandible were 1615.65 ± 203.64 and 1434.15 ± 222.65 which were greater than Kurdish population (554 HU) for anterior mandible and (510 HU) for posterior mandible [33], in Pakistani population [21], for anterior mandible 940.65 ± 112.23 HU and for posterior mandible 880.33 ± 135.66 HU. Likewise, in Turkey population [19] for anterior mandible 865.85 HU and for posterior mandible 620.22 HU and in Chinese population [35] for anterior mandible 765.02 ± 228.23 HU and for posterior mandible 737.58 ± 321.23 HU. Similarly, in Myanmar population [36] for anterior mandible 862.5 HU and for posterior mandible 775.25 HU. Furthermore, the mean bone density at the anterior posterior region of Mandible were found in USA [37] were 982.5 ± 223.55 in anterior mandible and 965.88 ± 328.2 HU in posterior mandible and in Saudi Arabia [38] were 720.05 and 763.68 HU. The discrepancy may result from several factors like the method of measurements, the differences in CBCT scanners. Beside

that the racial differences, nutritional habits and drinking water mineral may play an important role for this variation. Additionally, this discrepancy may result from the differences in patient's age, gender, bone mineral density, which also have been, reported in previous studies.

Conclusion

The study concludes that, there is differences in bone density in different regions of jaw bone. The anterior mandible has the highest jaw bone density followed by posterior mandible, anterior maxilla, and the lowest jaw bone density in the posterior maxilla. In this present study the mean bone density value is higher than those of previous studies. The discrepancy may result from technical or biological factors. It is suggested that a CBCT investigation can provide valuable information of bone density to the clinicians prior to installation of the dental implants.

Limitations of Study

- Small sample size and single centered study.
- Non random sampling method.
- Unavailability of CBCT machine.

Recommendations

- The present study suggests the need for additional research on larger patient samples including other institutions of Bangladesh.
- CBCT machine should be available everywhere in our country, so that jaw bone density of the people of Bangladesh can be measured.

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Volume 22 Issue 12 December 2023