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Original Research Article

Biometric Study about the Course of the Mandibular Canal Involving 100 CBCT

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Abstract: ***Introduction:*** The retromolar area is a commonly utilized donor site for autogenous bone grafts in oral and maxillofacial surgery. However, the close proximity of the mandibular canal (MC) poses a risk of neurovascular injury. A thorough understanding of anatomical variations in the position of the MC with respect to sex and age is essential to ensure safe surgical interventions. This study aimed to assess the position of the MC using cone-beam computed tomography (CBCT) and to identify potential safe zones for bone harvesting in the retromolar region. ***Materials and Methods:*** A total of 100 CBCT scans were analyzed. Key measurements included the vertical distance from the cementoenamel junction to the MC, canal depth at the transition zone between the mandibular ramus and body, and the buccal bone thickness overlying the MC. The data were categorized by sex and age group and statistically compared. ***Results:*** Male subjects demonstrated significantly greater buccal bone thickness (mean difference: 1.5 mm) and canal depth compared to females. Younger individuals (Group 1) presented with increased bone thickness and greater canal depth at the level of the first molar. At the second molar level, canal depth was significantly higher in males. ***Conclusion:*** The transition zone between the mandibular ramus and body emerges as the most favorable area for safe retromolar bone harvesting, owing to its increased canal depth and lingual positioning of the MC. However, no absolute safe zone was identified, underscoring the importance of patient-specific radiological assessment prior to grafting procedures.

Keywords: mandibular canal; cone-beam computed tomography (CBCT); retromolar graft; autogenous bone harvesting; first mandibular molar, second mandibular molar.

I -INTRODUCTION

Implantology is a discipline that offers both to the patients and practitioners a new therapeutic possibility. It is constantly trying to push the limits of its uses by evolving in terms of materials and implant techniques. Bone is the key to successful implantation. But it's not always sufficient for implant placement. This is where bone graft comes in to provide hard tissue at a site where there is a deficit. Several types of material can be grafted but autogenous bone remains the gold standard [1]. For the dental surgeon, autogenous bone can only be harvested from intra-oral sites, the two main ones are: the symphyseal site and the retro-molar site.

The retromolar site is very interesting because it can provide a large quantity of bone to fill most deficits. However, as with all mandibular surgery, the surgeon will come up against anatomical landmarks, mainly the mandibular canal (MC) and the roots of the molars. These structures must first be identified using sectional imaging and software that enables three-dimensional reconstruction, such as the dentascanner and cone beam computed tomography (CBCT) [2].

The aim of this study was to evaluate the position of the mandibular canal according to age and sex based on 100 CBCTs, and to study its relationship with the roots of the molars and the external cortex in order to determine the safe zone for retro-molar bone harvesting.

II-MATERIALS AND METHODS

This retrospective study was conducted on 100 CBCTs of Tunisian patients consulting the Out- patients and Implantology Department at the Dental Clinic of Monastir (Tunisia) between April 2020 and July 2022. All patients under- went CBCT examinations bilaterally.

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Inclusion Criteria:

- Presence of first and second permanent molars
- The teeth are in orthoposition
- No history of orthognathic surgery
- Age over 18.

Exclusion Criteria:

- Version of the mandibular molars
- Bilateral posterior edentulism (Kennedy Applegate CL I)

These CBCTs were obtained by using settings Sirona Galileos unit (Sirona, Germany) and the images were analyzed using Galileos Viewer software (1.9). Scanning parameters were 85 kVp, 24 seconds, 5-7 mA, a voxel size of 0.15 mm or 0.3 mm and a field of view of 15 cm × 15 cm with exposure times of 6 seconds and radiation dose of 29 µSv.

Measured Parameters:

Four points were taken as references, at which we took the measurements (Figure 1):

- The lingula [1].
- The transition zone between the mandibular branch and the mandibular body (distinguished on X-ray by the loss of the anterior edge of the mandibular branch and the presence of a pointed eminence at the upper edge of the mandibular body) [2].
- The distal root of the second molar [3].
- The distal root of the first molar [4].

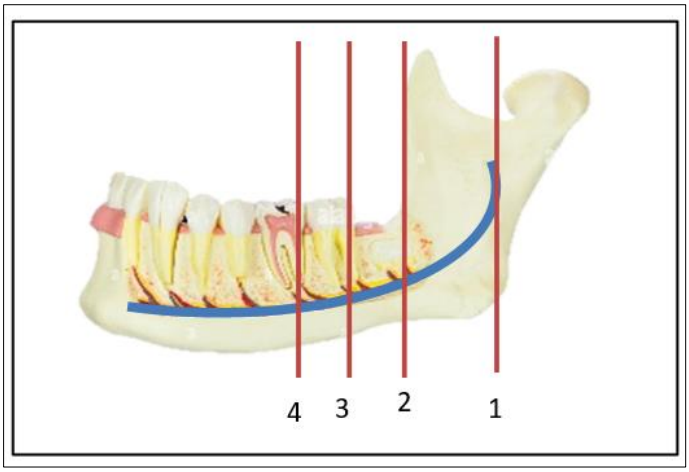

Figure 1: principal plans for measurements

For the coronal section passing through the lingula, we measured the smallest thickness between the mandibular foramen and the external cortex (Figure 2).

Figure 2: sagittal section passing at the lingula

For the transition zone coronal sections (Figure 3), we measured the depth of the MC according to the tip of the bone crest, as well as the distance between the MC and the external cortex.

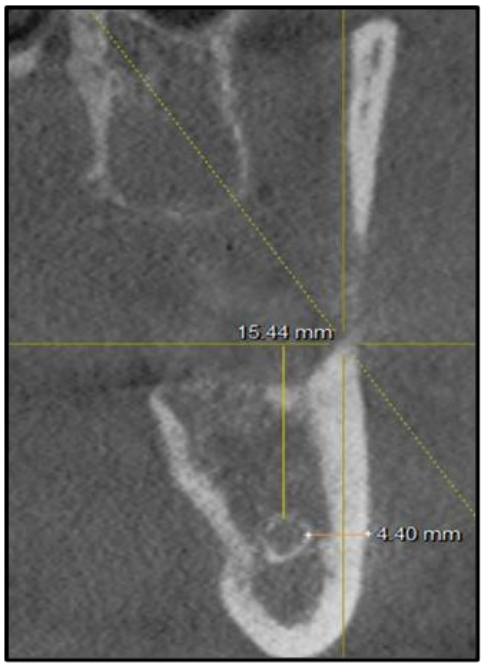

Figure 3: sagittal section passing by the transition zone

For the sections passing through the distal roots of the second and first molars, we took two measurements (Figure 4). We measured the depth of the MC according to the enamel-cement junction (ECJ) line, and then the distance of this canal from the external cortex.

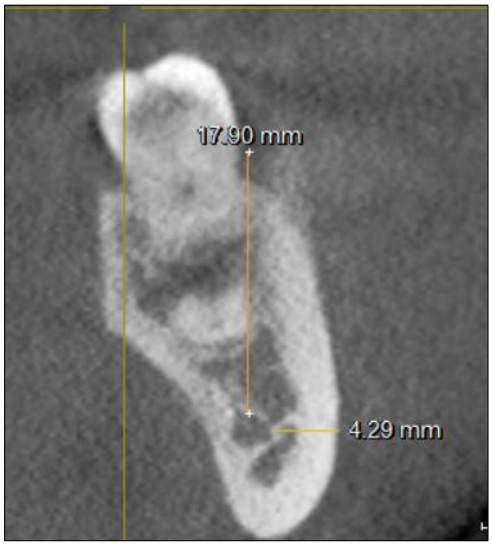

Figure 4: coronal section passing by the distal root of the molars

III- RESULTS

One hundred CBCT (from 100 patients) were included in this study, with an average age of 35 years ranging from 18 to 72 years.

42% of patients were male (mean age 37.62 ±12.01) and 58% female (mean age 33.07 ±12.08), giving a sex ratio of 0.72.

The simple was categorized into 3 groups: Of the 100 patients included, 56 were under 35 years (group 1), 37 between 35 and 54 years (group 2) years and 7 over 55 years (group 3).

The findings of our study are resumed in tables: 1,2,3,4,5 and 6

1) The depth of the MC:

Table 1: The depth of the MC according to sites

Depth	Transition zone	Second molar site	First molar site
Min	5,4	9,6	10,45
Max	32,32	26,35	27,7
moy	20,69	17,26	19,30
Ecart type	4,21	3 ,35	3,17

We have to mention that the results obtained at the lingula and transition zone cannot be compared with those obtained at the molars, because the reference points were not the same (the bony crest for the transition zone and the enamel-cement junction line for the molars). However, the depth decreases from the transition zone to the 2nd molar and then increases between the 2nd and 1st mandibular molars. The MC is deeper in the 1nd molar than in the 2st.

Sex Influence:

Table 2: Significance of different sites according to sex

Depth	Transition zone	Second molar site	First molar site
Male	22,67	18,12	20,06
Female	19,26	16,63	18,74
P (< 0.05)	**0,00002***	**0,01***	**0,02***

At all the studied sites, the men's group had a deeper MC than the women's group. This difference was significant and averaged at least 2 mm.

Age Influence:

Table 3: Significance of different sites according to groups

Depth	Transition zone	Second molar site	First molar site
Group 1 VS group 2	0,11*	0,10*	0,07*
Group 2 VS group 3	0,10*	0,34*	0,50*
Group 1 VS group 3	**0,04***	0,17*	0,21*

There was a significant difference at the transition zone, where group 1 had a higher depth than group 3. In general, the depth decreased with age. Group 1 had the greatest depth, followed by group 3. There were no particularities in the first and second molars.

2) The bone thickness:

Table 4: Bone thickness according to sites

The thickness	Lingula	Transition zone	Second molar site	First molar site
Min	1,5	2	3,43	1,6
max	7,18	13	9,2	8,25
moy	4,47	4,32	5,89	5,30
Ecart type	1,22	1,50	1,31	1,33

In general, the thickness decreases from the lingula to the transition zone, then increases at the transition zone site up to the second molar, then decreases towards the first molar.

Sex Influence:

Table 5: Significance of different sites according to sex

Thickness	Lingula	Transition zone	Second molar site	First molar site
Female	4,52	4,21	5,53	5,16
male	4,40	4,47	6,39	5,51
P	0,31*	0,20*	**0,0005***	0,10*

At this level, we can see that the women's group had a greater thickness of available bone at the lingula. Then, at the transition zone and the molars sites, the male group had greater thickness, with a significant difference at the second molar site.

Age Influence:

Table 6: Significance of different sites according to groups

thickness	Lingula	Transition zone	Second molar site	First molar site
Group 1 VS group 2	0,14*	0,30*	0,15*	**0,03***
Group 2 VS group 3	0,19*	0,42*	0,33*	0,48*
Group 1 VS group 3	0,34*	0,40*	0,29*	0,16*

The only significant difference was the difference in thickness between groups 1 and 2 on the first molar. Group 1 had a greater thickness at this site than the other groups.

IV-DISCUSSION

Bone harvesting is one of the arsenals used to treat bone defects. So, it would be possible to carry out functional and aesthetic implant-supported prosthetic restorations with a favourable clinical implant/crown ratio. According to the extent of the bone deficit and the quality of the residual bone, the treatment plan could include: autogenous graft, an allograft, a xenograft or synthetic materials, or a combination of products [3-5]. Before implantation, certain guidelines must be respected. The bone width: representing the diameter of the implant and 1 mm on either side is required. When implants are placed in an aesthetic sector, the thickness of the vestibular table must be 2 mm. In the corono-apical plane in the maxilla, the height must correspond to the height of the implant. A penetration of 1 to 2 mm into the sinus is tolerated. In the mandible, the crestal height required is equal to the length of the implant + 2 mm. If these conditions are not met, bone must be added [6-7]. The aim will be to build a living bone into which the implants will osseointegrate in a functional position with an aesthetic result over a long period, while supporting the soft tissues and re-establishing a correct crestal morphology [8].

Intra-oral sites represent the accessible sources of bone for the dental surgeon Prior to any bone harvesting, antibiotics must be administered either two days before the procedure. Antibiotics are continued seven or ten days after the bone graft is taken. If the patient is allergic to penicillin, clindamycin may be prescribed. In addition, a chlorhexidine-based mouthwash is prescribed, as well as analgesics [9]. Anaesthesia is usually administered locally, with local or general sedation if necessary. General anaesthesia is indicated for large reconstructions involving several donor sites, and if the operating time exceeds three hours [10].

1. Thickness

According to a study by Drikes *et al*., [11], the middle course of the mandibular canal first comes into contact with the external cortex (from the lingula to the angle, which may be explained by the short distance between the two cortices) and then continues lingually (in the mandibular body) then returning vestibularly before exiting through the mental foramen *This configuration has been confirmed by our study*

Farnsworth David *et al*., [12], studied the thickness of cortical bone in the mandible. They found that the cortical bone in the mandibular region, in the vestibular region, was the thickest of all the areas studied, thicker posteriorly and thinner anteriorly. This can be explained by a greater functional demand on the posterior teeth. *Those result also have been confirmed by our study; there is a significant difference in the second molar site.*

Leong [13], *et al*., and Khoury [9], tried to find a distance where enough bone could be removed without damaging the nerve. For Leong, a safe distance between the external cortex and the mandibular canal would be between 2.5 and 3 mm. Khoury's estimate is slightly higher, between 3 and 3.5 mm. *Our study would be more in line with Leong's study.*

In our study, at the level of the first molar, the thickness was significantly greater for group 1 (the young population in the sample) than for group 3. There is therefore an influence of age on the situation of the mandibular canal. This may be due to physiological bone resorption, which resorbs the vestibular cortical bone. In the transition zone, the canal is, on average, too close to the external cortex to perform an osteotomy. However, the average is not sufficient to determine a safe zone.

2. Depth:

Kovisto *et al*., in 2011 [14], studied the proximity of the mandibular canal to the mandibular tooth apex. They found that the apexes of mandibular second molars were closer to the mandibular canal than those of mandibular first molars or second premolars. They also found that the roots of the first and second mandibular molars were closer to the mandibular canal in females.

Leong *et al*., [13], studied the position of the MC in relation to the enamel-cement junction line. The mean was 12.24 mm (+/- 0.58). The distance was slightly greater in the first molars. The measurements were made directly on 34 jaws of Caucasian cadavers.

Leong *et al*., [13], studied it in relation to the ECJ line, as we did. Their values are lower than those found in our study, with an average of 12.82 mm for the first molar and 11.67 mm for the second molar. However, their study did not specify the sex or age of the cadavers

used, which could perhaps explain these differences. In addition, we did not use the same references for the measurements. In our study, the perpendiculars to the basilar edge were reconstructed to make the coronal sections used for the measurements, whereas in their study no reference plane is specified, even though according to their diagram the reference plane would be a perpendicular to the occlusal plane of the molars. The values are not similar, *but there is a common trend with our study, in which the depth is greater in the first molar than in the second molar.*

We were able to demonstrate the influence of gender on the depth of the MC.

The depth was greater at all sites in the male group. This difference suggests that more bone could be harvested from male patients.

As in our study, Kovisto *et al*., [14], found a difference in the position of the mandibular canal between men and women. In their study, the mandibular canal was located closer to the mandibular molar apexes in the female group. The mandibular canal was always located further from the apexes, and therefore lower in the bone, in the men's group, which is consistent with our study.

There is also an influence of age on the depth: Group 1, representing the young population in the sample, has more bone than the other 2 groups. This may be explained by the physiological resorption of the mandibular crest with age in areas where teeth are absent. In this case too, we would need to look at the ratio with the general height of the mandible, to see if there is indeed only crestal resorption of the mandible or if it is a question of a lower position of the mandibular canal in the young group.

According to literature it exists 3 configurations for retromolar autogenous bone harvesting [15],

1. Vertical hight situation at the anterior edge of the mandibular ramus
2. The retromolar region with a rectangular shaped graft inclined anteriorly.
3. A horizontal shaped graft at the molars site

According to our study, the most secure area for retromolar harvesting procedure is a inclined shaped graft at the transition zone because the mandibular canal at this point is deeper and closer to the lingual cortical

V- CONCLUSION

According to our study, we can conclude that the situation of the mandibular canal varies according to several parameters (sex, age).

The results show that:

- The men's group had a significantly greater thickness of available bone than the women's group (average of 1.5mm).
- The younger population in the sample (group 1) had significantly greater bone thickness than the older population.
- The male group had significantly greater depth at the second molar site.

The young population (group 1) had a significantly greater depth at the first molar site.

However, there is no safety zone common to the entire sample that would allow us to harvest a graft based on purely clinical guidelines. Hence the importance of prior radiological exploration to determine the exact position of MC in the 3 planes of the space.

Nevertheless, we have noted variations in the position of the mandibular canal as a function of sex and age in a Tunisian sample.

Conflict of Interest: none was mentioned by any of the authors and this paper was approved by them

REFERENCES

1. Jeong HG, Lee JY, Kim YK, et al.Evaluation of the safety zone for harvesting bone from the mandibular ramus using CBCT: a retrospective study.Imaging Sci Dent. 2020 Sep;50(3):217–224.doi: 10.5624/isd.2020.50.3.217PMID: 33062072
2. Shah SP, Mehta D. Mandibular retromolar foramen and canal – a systematic review and meta-analysis. Annals of Maxillofacial Surgery. 2020 Jul–Dec;10(2):444–449. doi:10.4103/ams.ams_19_20. Epub 2020 Jun 18. PMID: 33708593.
3. Hernández-Alfaro F. Bone grafting in oral implantology, techniques and clinical applications. *London: Quintessence Book, 2006*
4. Garg AK. Bone, biology, harvesting, grafting for dental implants, rationale and clinical applications. *Chicago: Quintessence publishing, 2004.*
5. Khoury F. Greffe osseuse en implantologie. *Paris : Quintessence International, 2011*
6. Bartolucci E. Réussir les implants dentaires.Paris : Elsevier Masson, 2006
7. Davarpanah M, Szmukler-Moncler S. Manuel d'implantologie clinique, concepts, protocoles et innovations récentes, 2ème édition.Rueil-Malmaison: Editions CdP, 2008
8. Tulasne JF, Andréani JF. Les greffes osseuses en implantologie. *Quintessence international, 2004.*
9. Khoury F, Antoun H, Missika P. Bone augmentation in oral implantology. *Hanover Park : Quintessence Publishing, 2007*
10. Guyot L. Techniques en chirurgie maxillo-faciale et plastique de la face. *PARIS. Springer, 2010.*
11. Drikes S, Delcampe P, Sabin P, Lavis J-F, Cordier G, Vacher C, Péron J-M. Étude tomodensitométrique du trajet intra-mandibulaire du nerf alvéolaire inférieur. Rev Stomatol Chir Maxillofac. 2008 déc;109(6):358–62. doi: 10.1016/j.stomax.2008.04.010.

12. Farnsworth D, Rossouw PE, Ceen RF, Buschang PH. Cortical bone thickness at common miniscrew implant placement sites. *Am J Orthod Dentofacial Orthop. 2011;139(4):495-503*
13. Leong DJ, Li J, Moreno I, Wang HL. Distance between external cortical bone and mandibular canal for harvesting ramus graft: a human cadaver study. J Periodontol. 2010 Feb;81(2):239–243. doi:10.1902/jop.2009.090417. PubMed PMID: 20151802
14. Kovisto T, Ahmad M, Bowles WR. Proximity of the mandibular canal to the tooth apex. *J Endod. 2011;37(3):311-5.*
15. Gaudy JF. Atlas d'anatomie implantaire. *Paris : Elsevier Masson, 2006.*

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