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Anatomical analysis of preangular mandibular notch in humans

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The authors have analysed in detail the mandibular preangular notch on the basis of 273 human cadaver mandibles. They have revealed that the pregonial notch is present in almost 90% of cases and that it is generally asymmetric and elliptical in shape. The depth and length of the anterior part of the notch is greater in males. Moreover, the preangular notch depth is greater on the right side (regardless of sex). Knowledge of the preangular notch anatomy can be useful for surgeons during reconstructive and plastic procedures on the mandibular shaft. (Folia Morphol 2012; 71, 2: 100–104)

Key words: mandible anatomy, pregonial notch, antegonial notch, orthognathic surgery

INTRODUCTION

Many different techniques, such as the external or internal access in the oral cavity, have been used to date in the surgical treatment of mandibular deformities, and these procedures were performed in the body ramus as well as in the condylar process of the mandible [7, 9, 17, 21]. In 1848, Hullihen [10] performed the first such corrective procedure on a 20-year-old female with the alveolar part of the mandible deformed as a result of the astringent action of facial scars. The first operation of real prognathism was, however, performed by Blair in 1897, and then described by him in 1906 [21]. At present, the majority of such procedures are performed from the intraoral access, and the method of either the sagittal or oblique cleft of the mandible according to Dal Pont, as well as their subsequent modifications, is the preferred method [10, 11, 21]. It should be emphasised that the use of these surgical techniques is associated with the need to use proper instruments, ensuring not only good visibility of the operative field, but also protecting the blood vessels, nerves, and soft tissues against lesion by burs and gouges [8]. That is just the type of instrument used for cutting the external layer of the compact substance of the body of the mandible at the height of the molar teeth (the cutting line is led vertically from the oblique line to the base of the mandible). However, sometimes after subperiosteal insertion of the lower, unciform part of this instrument under the base of the mandible (in the area of the first molar tooth) (Fig. 1), we have difficulties displacing it backward (to the angle of the mandible). Analysis of cephalograms, taken in each patient before the surgery, shows that in some cases in the area of the base of the mandible there is a notch (of a different size) whose back clivus may block the withdrawal of the surgical instrument. Macintosh [15] calls it

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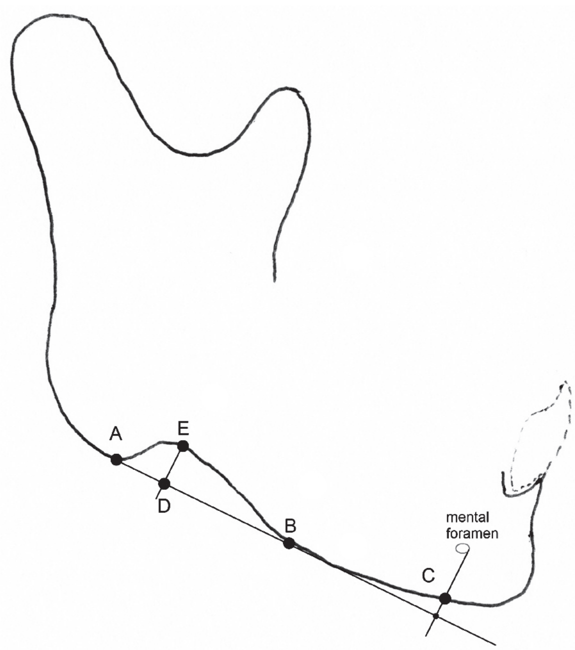

Figure 1. The scheme of the analysed preangular notch of the mandible measurements; A — posterior limitation of the notch; B — anterior limitation of the notch; C — anthropometric point mentale; D — basis of the notch; E — floor of the notch.

the "pregonial notch", and Henderson and Poswillo [9] the "antegonial notch". Apart from them, no other author performing surgical treatment of malocclusion mentioned this anatomical detail. There are only a few rare literature reports, based on scarce material, in which the anatomy of the mandible has been analysed on the basis of X-ray/computed tomography scans [1–3], or they are simply case study anthropological works [6]. The authors of the regular and topographic anatomy handbooks available to us do not mention this anatomical detail either. Some authors [12] even highlight the lack of any anatomical norms and proper anatomical description of the antegonial notch. Therefore, there is no clear anatomical work that precisely describes the notch topography. Considering this, we present the results of our own studies, aimed not only at providing a full description of the detailed position and the size of the mentioned notch, but also estimating the individual variation of the notch as well as dimorphic and bilateral differences. This anatomical analysis can be found useful by maxillofacial surgeons performing surgery procedures in the area of the mandible.

MATERIAL AND METHODS

Detailed measurements of the preangular notch were taken on human (cadaver) mandibles of 173 males and 100 females aged 40 to 50 years (Fig. 1). All measurements were taken using a digital calliper on bone material. Photos were taken using a Sony digital camera set on a tripod, which ensured the same position of each examined mandible against the camera. Mean value and standard deviation of the examined pregonial notch segments were calculated separately for both sexes and sides. The significant difference in the mean values between males and females was estimated using t-student test for independent variability. The bilateral differences within one sex were estimated by t-student test for conditioned variability. Hypotheses were verified at significance level $p = 0.05$.

RESULTS

Topography and osteometry of the notch

In the analysed material (jointly for males and females), bilateral absence of the preangular notch was noticed in 8 cases, i.e. in only 2.9% of the whole material. The preangular notch was absent on the right side in 15 (5.5%) cases, and on the left side in 10 (3.7%) cases.

Almost 90% frequency of the presence of the pregonial mandibular notch means that it is a permanent anatomical detail in adults of both sexes (Figs. 2, 3). As already mentioned, it is of great importance for surgical procedures on the mandible. The absence of this notch in adults should be perceived as a rare anatomical variation (Fig. 4).

From the point of view of surgical procedures performed on the mandible, the precise estimation of the position of the mentioned notch is impor-

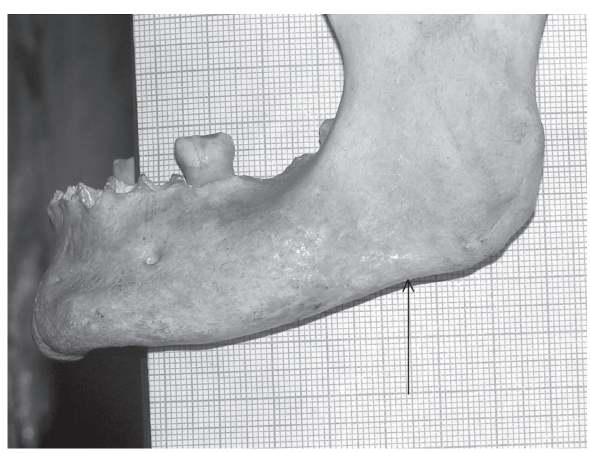

Figure 2. The human mandible. The presence of shallow preangular notch (arrow).

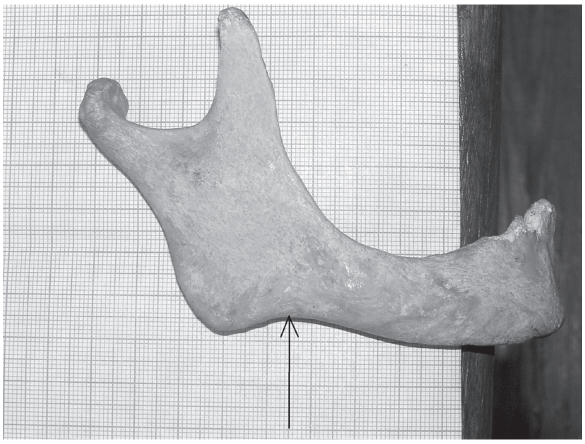

Figure 3. The human mandible. The presence of deep preangular notch (arrow).

Figure 4. The human mandible. The preangular notch absence.

tant. We related the position of the antegonial notch to the anthropometric point mentale (mL). The anterior limitation of the pregonial mandibular notch was located between the anthropometric points pogonion and mentale only in females in 2% of cases. In the examined males, this percentage was within the statistical error and was 0.5%. The mentioned limitation was located at the height of the mental foramen only in 4% of males and in 1% of females. We can therefore assume with over 95% probability that the preangular mandibular notch originates posteriorly, behind the mental foramen of the mandible. As can be seen from the data in Table 1, it is located about 14.5 mm to 16.6 mm behind this foramen. The length of the described notch fluctuates between 32.8 mm and 35.3 mm. The preangular notch is elliptic and asymmetric in shape. The length of its anterior part is about twice that of its posterior portion. The posterior part is substantially steeper, and this is where the limitation of surgical instrument manipulation occurs. Its length ranges from 12.4 mm to 13.0 mm. The depth of the preangular mandibular notch ranges on average from 1.98 mm to 2.58 mm. All the remaining results of the studies are summarized in Table 1.

Dimorphic differences

We observed dimorphic differences, tested by t-student test for independent samples, only at the length of the anterior section of the notch, which is significantly longer in males (on average by 2 mm). Also, the depth of the notch in males is bilaterally

Table 1. The mean values and standard deviation values of the undertaken measurements of the mandible (significant statistically dimorphic differences are in italics; the bilateral differences are underlined; both dimorphic and bilateral differences are in bold)

Measurement	Male (n = 173)		Female (n = 100)	
	x right ± SD	x left ± SD	x right ± SD	x left ± SD
A–B	35.3 ± 9.0	35.2 ± 9.5	33.2 ± 8.9	32.8 ± 9.5
A–C	49.8 ± 4.2	50.3 ± 5.4	48.4 ± 4.9	49.4 ± 4.7
A–D	<u>12.4 ± 4.5</u>	<u>13.0 ± 4.6</u>	12.4 ± 4.3	13.0 ± 5.0
D–B	*22.9 ± 7.8*	*22.1 ± 7.2*	*20.8 ± 7.3*	*19.7 ± 7.1*
B–C	14.5 ± 7.5	14.8 ± 7.3	15.4 ± 7.5	16.6 ± 8.5
D–E	**2.58 ± 1.1**	**2.29 ± 1.0**	**2.29 ± 0.9**	**1.98 ± 0.8**

A–B — length of the notch; A–C — distance from the ml (mentale) point to the posterior limitation of the notch; A–D — length of the posterior part of the notch; D–B — length of the anterior part of the notch; D–E — height of the notch; B–C — distance from the ml point to the anterior limitation of the notch; x — value in millimetres; SD — standard deviation; n — number of cases greater than in females. This difference is significant at confidence level 0.05 and ranges from 0.29 mm on the right side to 0.31 mm on the left side. Detailed data is presented in Table 1. The remaining examined dimensions of the pregonial notch do not differ significantly in both sexes.

Bilateral differences

We observed bilateral differences only in the depth of the preangular notch. It is significantly deeper on the right side than on the left side in both sexes. This difference reaches 0.3 mm, both in males and females.

DISCUSSION

Precise knowledge of the topographic details in the area of the body and ramus of the mandible is indispensable for performing surgical procedures in this area. Cutright et al. [5] proved that even the position of the foramina essential for maxillofacial surgery (infraorbital foramen, supraorbital foramen, and mental foramen) demonstrates high individual variability; differences in the location of these foramina between individuals of white and black race were noticed. Similar results were described by Oguz and Bozkir [18] who analysed the location of the mandibular foramen and the mental foramen in Turkish males aged 30–40 years (the material was therefore very homogenous, both developmentally and ethnically). The mentioned authors demonstrated that the location of the mental foramen in relation to the permanent measure points changes in the range from 0.6 mm to 1.0 mm. In 61.76% of cases, the mental foramen is located on the right side, below the root of the premolar tooth, and in 50% of cases, on the left side. In the remaining cases, it is located between the roots of the 1st and 2nd premolar teeth. Similar results were presented by Yesilyurt et al. [22]. The studies by Serhal et al. [20] in cadavers concerned the location of mandibular canals. It is of crucial importance in order to avoid injuries of the neurovascular fascicle in this canal. The authors showed, using spiral computed tomography, that the position of the canal changes in relation to the margin of the mandible, by as much as 1.36 mm. The cause of topographic variability in the area of the mandible should be sought in the developmental processes that occur in this bone even in late childhood. Buschang and Gandini [4] showed, on the material of 185 children in French-speaking Canada, a statistically important growth of the condylar process and the ramus of the mandible, where the vector of growth is pointed backward and upward. This process is essentially statistically more intense in boys than in girls. At this time, the body of the mandible rotates forward about 20 to 3.30, at the same time moving downward about 9.6 mm to 12.7 mm and forward about 1.9 mm to 2.7 mm. These rapid developmental processes cause a change in the shape of the lower margin of the body of the mandible, thus bringing about the deepening of the preangular mandibular notch [13]. There are some scientific data suggesting an interrelation between a deep preangular notch and stronger development of the mandible in the vertical dimension [14, 19]. On the other hand, Mangla et al. [16] suggest that the antegonial notch depth revealed greater values in the hyperdivergent group, so it is connected with stronger development of the mandible in the anterior-posterior diameter. These works show the need for continuation of anatomical examinations, because the data based only on cephalograms are conflicting. Our study demonstrates that the mentioned notch is present in about 87–88% of cases, with similar frequency in both sexes. We have revealed that the mean depth of the pregonial notch oscillates from 1.98 to 2.58 mm. Ali et al. [1] and Ko et al. [12] provide similar data — in their studies individuals without any abnormalities in the anatomy of the mandible had a notch about 2.6–2.7 mm deep. Dimorphic differences, similarly to those found in the studies by Buschang and Gandini [4], are present in the length of this notch, which is statistically bigger in males than in females. We also demonstrated that the notch is about 0.3 mm deeper on the right side than on the left side, and that this difference is statistically relevant. The analysis carried out by our team shows that the antegonial notch is a permanent and essential anatomical detail in the area of the body of the mandible, and therefore the knowledge about its size and shape is essential for performing surgical procedures in this area in order to avoid an unexpected blockade of surgical instruments against the back, steeply placed edge of the preangular notch.

REFERENCES

1. Ali IM, Yamada K, Hanada K (2005) Mandibular antegonial and ramus notch depths and condylar bone change. J Oral Rehabil, 32: 1–6.
2. Baydas B, Yavuz I, Dagsuyu IM, Bölükbasi B, Ceylan I (2004) An investigation of maxillary and mandibular morphology in different overjet groups. Aust Orthod J, 20: 11–18.

3. Becker MH, Coccaro PJ, Converse JM (1976) Antegonial notching of the mandible: an often overlooked mandibular deformity in congenital and acquired disorders. Radiology, 121: 149–151.
4. Buschang PH, Gandini LG (2002) Mandibular skeletal growth and modelling between 10 and 15 years of age. Eur J Orthod, 24: 69–79.
5. Cutright B, Quillopa N, Schubert W (2003) An anthropometric analysis of the key foramina for maxillofacial surgery. J Oral Maxillofac Surg, 61: 354–357.
6. Dennison J, Healey D, Herbison P (2007) The Polynesian chin and mandible. Anthropol Anz, 65: 241–252.
7. Epker BN, Stella IP, Fish LC (1995) Dentofacial deformities: integrated orthodontic and surgical correction. Mosby-Year Book Inc, St Louis, pp. 54–88.
8. Guernsey LH (1970) Special instrumentation in oral surgery practice. J Oral Surg, 28: 623–630.
9. Henderson D, Poswillo D (1985) A colour atlas and textbook of orthognathic surgery. The surgery of facial skeletal deformity. Wolfe Medical Publications Ltd., Weert, pp. 34–98.
10. Hullihen SP (1849) Case of elongation of the under jaw and distortion of the face and neck, caused by a burn, successfully treated. Reported, with cuts. Am J Dental Sci, 9: 157–165.
11. Kaczkowski H, Cwioro F (1992) Modyfikacja metody skośnego rozszczepiania gałęzi żuchwy według Dal Ponta. Wrocl Stomat, 30: 33–36.
12. Ko EW, Huang CS, Chen YR, Figueroa AA (2005) Cephalometric craniofacial characteristics in patients with temporomandibular joint ankylosis. Chang Gung Med J, 28: 456–466.
13. Kolodziej RP, Southard TE, Southard KA, Casko JS, Jakobsen JR (2002) Evaluation of antegonial notch depth for growth prediction. Am J Orthod Dentofacial Orthop, 121: 357–363.
14. Lambrechts AHD, Harris AMP, Rossouw PE, Stander I (1996) Dimensional differences in the craniofacial morphologies of groups with deep and shallow mandibular antegonial notching. Angle Orthod, 66: 265–272.
15. Macintosh J (1981) Experience with the sagittal osteotomy of the mandibular ramus. A 13-year review. J Max Surg, 9: 151–165.
16. Mangla R, Singh N, Dua V, Padmanabhan P, Khanna M (2011) Evaluation of mandibular morphology in different facial types. Contemp Clin Dent, 2:200–206.
17. Lupori JP, Kewitt GF, Van Sickels JE (2000) Bilateral sagittal split osteotomy advancement and setback. In: Betts NJ, Turvey TA eds. Orthognathic surgery. Vol. 2. Oral and maxillofacial surgery. WB Sanders, New York, pp. 227–277.
18. Oguz O, Bozkir MG (2002) Evaluation of location of mandibular and mental foramina in dry, young adult human male, dentulous mandibles. West Indian Med J, 51: 14–16.
19. Salem OH, Al-Sehaibany F, Preston CB (2003) Aspects of mandibular morphology, with specific reference to the antegonial notch and the curve of Spee. J Clin Pediatr Dent, 27: 261–265.
20. Serhal CB, van Steenberghe D, Quirynen M, Jacobs R (2001) Localisation of the mandibular canal using conventional spiral tomography: a human cadaver study. Clin Oral Implants Res, 12: 230–236.
21. Sukaczew WW (1984) Atlas rekonstruktiwnych operacji na czelustiach. Medicina, Moskva, pp. 20–245.
22. Yesilyurt Y, Aydlnllglu A, Kavakll A, Ekinci N, Eroglu C, Haclaliogullarl M, Diyarbaklrll S (2008) Local differences of the position of the mental foramen. Folia Morphol, 67: 32–35.