

Research letter

Morphometric variability of mandible linear characteristics depending on level of teeth alveolus position

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Abstract: *The goal* was to define morphometric variability of altitude and thickness parameters of alveolar part of a mandible depending on level of teeth alveolus position.

Material and Methods — The study was carried out using 70 passported skulls with mandibles of adults aged 21-60 years and 30 isolated mandibles excluding sex and age from scientific craniological collection of fundamental museum of human anatomy department of Saratov State Medical University n.a. V.I. Razumovsky (Saratov, Russia). Craniometrical method was used to study parameters of both sides of a mandible: altitude – from base of mandible to level of apex of medial incisors, canine, 1st and 2nd premolars, 1st, 2nd and 3rd molars; thickness – in vestibular-lingual direction at the same levels.

Results and Conclusion — The highest altitude was marked at levels of incisors and 3rd molar, the smallest one – at level of 1st and 2nd molars; maximum mandible thickness was defined at level of 2nd molar, minimum – at levels of canine and 1st–2nd premolars on both sides of mandible; average thickness was revealed at levels of incisors, 1st and 2nd molars and had the same statistical values. Bilateral variability of thickness was significantly dominating on the right side and only at levels of 1st–2nd premolars and 1st molar. Average values of altitude and thickness from both sides of mandible and at all levels had medium degree of variability.

Keywords: mandible, variability, mandible altitude, mandible thickness, teeth alveolus

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Introduction

Preservation of anatomical integrity and functioning of mandible as well as restoration of its bone structures damaged due to pathological processes, injuries and operations, requiring surgical and further prosthetic treatment have been considered as important problems in maxillofacial surgery up to the present time [1, 2]. Thus, anatomical features of mandible structure have been in the focus of clinically based studies for planning and carrying out orthopedic treatment, in particular – intraosseous dental implantation [3-5]. Development of procedures for selecting area and consistent pattern of placing implant in mandible in various clinical situations has been associated with individual anatomical peculiarity of its alveolar part.

Along with advances in studying forms and spatial organization of skull structures [6], there have been put new requirements to knowledge of size, shapes, age and sex variability of mandible and their relationship with skull as a whole [7, 8]. There is no enough data on alveolar part of mandible in literature, most of the facts have fragmented or partial character [9, 10]. While morphometric characteristics of alveolar part and its relationship with other structures of mandible are used in computer modeling of mandible and virtual dental implants for further selection of implants

placement area, treatment planning and management [11, 12]. Thereby, information about anatomical variability of mandible alveolar part is considered to be the necessary anatomical basis for clinical dentistry and still remains relevant.

The goal was to define morphometric variability of altitude and thickness parameters of alveolar part of a mandible depending on level of teeth alveolus position.

Material and Methods

The study was carried out using 70 passported skulls with mandibles of adults aged 21-60 years and 30 isolated mandibles excluding sex and age, without mechanic injuries and systemic disorders of skeleton from scientific craniological collection of fundamental museum of human anatomy department of Saratov State Medical University n.a. V.I. Razumovsky (Saratov, Russia). Craniometrical method by means of technical calipers with scale division of 0.01 mm, according to common method in craniology, the present study of parameters of both sides of a mandible was carried out: altitude – from base of mandible to level of apex of medial incisors, canine, 1st and 2nd premolars, 1st, 2nd and 3rd molars; thickness – in vestibular-lingual direction at the same levels.

Table 1. Variability of altitude of mandible depending on level of teeth alveolus position

Levels of measuring		Variation and statistic parameters					
		Min-Max	M±m	σ	CV, %	P1	P2
Medial incisors		1.5-3.7	2.9±0.04	0.4	15.0		
Canine	R	1.3-3.6	2.8±0.05	0.4	16.0	>0.05	>0.05,
	L	1.0-3.5	2.7±0.05	0.5	19.0		
1 st , 2 nd premolars	R	1.0-3.5	2.7±0.05	0.5	19.0	>0.05	<0.001,
	L	1.0-3.5	2.7±0.05	0.5	19.0		
1 st molar	R	1.1-3.2	2.4±0.04	0.4	17.0	>0.05	>0.05,
	L	1-3.2.0	2.4±0.04	0.4	18.0		
2 nd molar	R	1.9-3.1	2.5±0.10	0.3	13.0	>0.05	>0.05,
	L	1.1-3.1	2.4±0.10	0.5	22.0		
3 rd molar	R	2.5-3.3	2.9±0.10	0.3	10.0	>0.05	<0.001,
	L	2.2-3.3	2.8±0.10	0.3	13.0		

R, right; L, left; P1, reliability between sides of a parameter; P2, reliability between levels of measuring.

Table 2. Variability of thickness of mandible depending on level of teeth alveolus position

Levels of measuring		Variation and statistic parameters					
		Min-Max	M±m	σ	CV, %	P1	P2
Medial incisors		1.0-2.0	1.4±0.02	0.2	14.0		
Canine	R	0.9-1.9	1.3±0.02	0.2	15.0	>0.05	<0.05,
	L	0.9-1.8	1.3±0.02	0.1	14.0		
1 st , 2 nd premolars	R	0.7-2.0	1.3±0.03	0.2	21.0	<0.05	>0.05,
	L	0.7-1.9	1.2±0.02	0.1	19.0		
1 st molar	R	0.8-2.0	1.5±0.02	0.2	17.0	<0.01	<0.001,
	L	0.8-2.0	1.4±0.02	0.1	17.0		
2 nd molar	R	1.2-1.9	1.6±0.10	0.2	13.0	>0.05	<0.01,
	L	1.1-2.0	1.6±0.10	0.1	16.0		
3 rd molar	R	1.1-1.7	1.4±0.10	0.2	14.0	>0.05	<0.001,
	L	1.2-1.9	1.4±0.10	0.1	15.0		

R, right; L, left; P1, reliability between sides of a parameter; P2, reliability between levels of measuring.

Statistic processing of the received data was fulfilled using the applied program «Statistica 6.0» for Windows. The following variation and static elements were determined for all craniometric parameters: mean (M), standard error of mean (m), standard deviation (σ), coefficient of variation (CV, %), minimum (Min), maximum (Max). Due to insignificant differences in variants from normal ones, reliability determination (P) of average values was carried out by means of Student's t-criterion. Differences were considered statistically reliable at P<0.05.

Results

It was revealed that altitude of mandible body between medial incisors was at average 2.9±0.04 mm (M±m) (Table 1). Altitude at level of canines (2.7±0.05 mm) was lower at 0.2 mm than altitude between incisors and it corresponded to interval between 1st and 2nd premolars. Altitude at level of 1st and 2nd molars (2.4±0.1 mm each; P>0.05) had equal value on both sides of mandible and at 0.5 mm lower than at levels of incisors; at 0.2 mm lower than at level of canines and premolars, that was statistically reliable (P<0.001). Altitude of mandible body at level of 3rd molar was more at 0.1 mm on the right side (2.9±0.1 mm) than on the left one. But this difference had no statistical reliability (P>0.05) and corresponded to average value of incisors' level, and at 0.4 mm more than level of 1st and 2nd molars (2.4±0.1 mm; P<0.001); at 0.2 mm – than premolars (2.7±0.05 mm). Altitude of mandible was higher at 0.1 mm on the right side at level of canine, on the left side – 3rd molar

and 2nd molar as compared with opposite side of mandible, but these values had no reliable differences (P>0.05).

Average values of mandible altitude at its different levels and sides had medial degree of variability (CV from 10% to 22%): the highest was at level of 2nd molar on the left side, the lowest – at 3rd molar on the right side.

Thickness of mandible body at level of incisors on an average was 1.4±0.02 mm (M±m) and increased at 0.1 mm (1.3±0.02 mm) at level of canines and premolars (Table 2). Thickness of body between 1st and 2nd premolars (1.3±0.03 mm) and 1st molar (1.5±0.02 mm) was at 0.1 mm more on the right side than on the left one in accordance to given levels (1.2±0.02 mm and 1.4±0.02 mm, P<0.05 and P<0.01).

Thickness of mandible increased at 0.2 mm at level of 1st molar (1.5±0.02 mm; M±m and at 0.3 mm – of 2nd molar (1.6±0.02 mm), as compared with thickness at level of front teeth, reaching for its maximum value. At level of 3rd molar (1.4±0.10) mandible thickness decreased again at 0.2 mm and corresponded to thickness of incisors' level.

Thickness of mandible body at level of 1st molar (1.5±0.02 mm) on the right side was reliably more than at incisors' level at 0.1 mm (1.4±0.02 mm) and was more variable (CV=17%; 14%), but on the left side this index had no statistically significant differences (P>0.05).

Thickness at level of premolars on the left side (1.2±0.02 mm) was reliably thinner at 0.1 mm than at level of canine

(1.3±0.02 mm) of the same side of mandible, but it was more variable (CV=19%; 14%), however on the right side this index had no statistically significant differences ($P>0.05$), but thickness was more variable at level of premolars in comparison with canine's level (CV=21%; 15%).

Average values of thickness parameters of mandible at its different levels and on both of its sides had medial degree of variability (CV from 13% to 21%): maximal was at level of 1st and 2nd premolars on the right side, minimal was at level of 2nd molar on the right side. The most variable thickness on both of the sides was at levels of 1st, 2nd premolars (CV=21%; 19%) in comparison with variability of thickness parameters at other levels of mandible.

Discussion

We defined variability of altitude and thickness parameters of mandible depending on level of teeth alveolus position. It was revealed that altitude on both of the sides of mandible was decreased at 0.5 mm beginning from incisors to 1st and 2nd molars, reaching for its minimal value, and increased again at 0.4 mm at levels of 3rd molar corresponding to altitude of mandible body between medial incisors. The received data did not correspond to research data of L. Kudryavtseva and L. Lyakisheva [13], who have determined maximal altitude of mandible only at level of incisors, and minimal – at level of 3rd tricuspid. Thickness of mandible's alveolar part was decreased at 0.1-0.2 mm beginning from medial incisors to level of canine and 1st – 2nd premolars, it increased at 0.2 mm at level of 1st molar and at 0.3-0.4 mm – of 2nd molar in comparison with premolars; this fact was approved by the authors who revealed maximal thickness of mandible body at level of tricuspid and minimal – at level of premolars [13]. This variability of mandible parameters can be explained by differences in structure and functions of various teeth groups. While due to atrophy of teeth alveolus, transverse dimension of upper edge of mandible's alveolar part is decreasing at 1-2 mm at all levels, except incisors area, altitude decreases at 2.5-6.0 mm at various parts of mandible [10]; this fact is caused by decreasing of chewing load at these sites [10, 14]. Value variability of morphometric parameters of mandible's alveolar part should be taken into consideration in the process of choosing a diameter of entering implants and calculations of limit loads on intraosseous support for perception of chewing pressure [5].

Conclusion

Thus, maximal altitude was at level of incisors and 3rd molar, minimal – at level of 1st and 2nd molar; maximal thickness on both sides of mandible was at level of 2nd molar, minimal – at level of canine and 1st – 2nd premolars; average value of thickness was at level of incisors, 1st and 3rd molars and had the same statistical values. Bilateral variability of thickness was relevantly prevailing on the right side at level of 1st, 2nd premolars and 1st molar. Average values of altitude and thickness on mandible's both sides at all levels had medial degree of variability.

Conflict of interest: none declared.

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