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ANATOMICAL AND TOPOGRAPHICAL FEATURES OF THE STRUCTURE OF THE ALVEOLAR PART OF THE MANDIBLE IN PATIENTS WITH PARTIAL ADENTIA

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The study shows that the thickness of the mucous membrane at the apex of the cellular part of the mandible in patients with defects of the dentition increased in the direction of the teeth that limited this defect. The apex of the cellular part, clearly visible in the oral cavity, did not always coincide with the radiological image of the cellular part, but was formed by a thickened mucous membrane in this area. The shape of the bone base of the cell part repeated the "clinical" type of lateral surfaces and the shape of the apex of the ridge in 87.5±6.8 % of people. Discrepancies were found in types IV and VII of lateral surfaces of the cell process.

Key words: cellular part of the mandible, mucous membrane, patients, partial adentia.

І. Р. Ступницький, М. М. Рожко, Р. М. Ступницький, Ю.І. Силенко, Г.А. Єрошенко АНАТОМО-ТОПОГРАФІЧНІ ОСОБЛИВОСТІ БУДОВИ КОМІРКОВОЇ ЧАСТИНИ НИЖНЬОЇ ЩЕЛЕПИ У ПАЦІЄНТІВ З ЧАСТКОВОЮ ВІДСУТНІСТЮ ЗУБІВ

Проведене дослідження свідчить про те, що товщина слизової оболонки на верхівці коміркової частини нижньої щелепи у пацієнтів з включеними дефектами зубного ряду збільшувалася у напрямку зубів, які обмежували даний дефект. Верхівка коміркової частини, чітко видима в ротовій порожнині, не завжди співпадала з рентгенологічним зображенням коміркової частини, а була утворена потовщеною у даній ділянці слизовою оболонкою. Форма кісткової основи коміркової частини повторювала «клінічний» тип бокових поверхонь і форму верхівки гребеня у 87,5±6,8 % осіб. Неспівпадіння виявлено при IV та VII типах бокових поверхонь коміркового відростка.

Ключові слова: коміркова частина нижньої щелепи, слизова оболонка, пацієнти, часткова відсутність зубів.

The authors elucidate prosthodontic treatment of partial adentia usually limiting to the general characteristics of the mucosa, the site of the defect (movable, immovable; pliable, non-pliable), and recommendations for adjustment of the inner surface of the denture base, with regard of prosthodontic treatment with removable dentures [4, 6] and modeling of the intermediate part with regard of prosthodontic treatment with fixed dentures, thereby, almost ignoring the identification of the shape of the alveolar processes at the site of the defects before prosthodontic treatment and the establishment of its influence on the effectiveness of prosthetic treatment. Admittedly, the contours of the bone base of the alveolar process, the thickness of the mucosa, the state of the bone tissue are not taken into account.

The choice of denture construct in patients with partial adentia largely depends on the shape and volume of atrophy of the alveolar process and the state of the covering mucosa [1-3].

The anatomical structure of the jaws, especially the lower one, is characterized by considerable variability, so patients with dentition defects are required careful study of the shape, height of the alveolar processes and thickness of the mucosa not only visually in the oral cavity, but also using the study casts.

The purpose of the work was to study the features of the shape, dimensions and thickness of the alveolar process of the mandible in cross section and at the edentulous sites as the prerequisite for successful planning of prosthodontic treatment.

Methods and Material. In order to determine the dimensions of the alveolar process and study the shape of its cross section at the edentulous sites, 43 plaster study casts of the mandible of subjects with partial adentia have been analyzed. The results of measurements of 89 cross sections of plaster study casts showed that in bounded edentulous spaces, the width of the alveolar process at its base and at ½ height gradually increased in the distal direction, and at the alveolar crest it was the largest at the first molar (3.9±1.4 mm) and the smallest at the second premolar (3.4±0.9 mm) (table 1).

Table 1

The dimensions of the edentulous portion of the alveolar process in the bounded edentulous spaces

Edentulous site	The width of the alveolar process, mm			The height of the alveolar process, mm
	At the base	½ height	At the apex	
4	9.3±1.3	6.3±1.3	3.5±1.2	7.4±2.1
5	9.8±1.1	6.4±1.2	3.4±0.9	7.3±2.4
6	10.9±1.8	7.4±1.7	3.9±1.4	6.7±2.5
7	12.4±2.2	7.9±1.6	3.6±1.1	5.4±1.9

The height of the alveolar process in the bounded edentulous spaces reduced from 7.4 ± 2.1 mm at the first premolar to 5.4 ± 1.9 mm at the second molar. The minimal value of the height at the first premolar was 4.6 mm, at the second premolar was 4.2 mm, at the first molar was 2.1 mm, at the second molar was 0.6 mm, and the maximum value was 10.9 mm, 11.1 mm, 12.3 mm and 8.4 mm, respectively.

The analysis of the cross sections of the study casts of patients with dentition defects has established the following shapes of the lateral surfaces of the edentulous sites of the alveolar parts of the mandible, which we classified into 8 types: Type I (semi-oval), Type II (triangular), Type III (trapezoidal), Type IV (tricuspid with high middle cusp), Type V (with two concave surfaces), Type VI (combination of Type I and II), Type VII (combination of Type II and IV), Type VIII (combination of Type I and V) (fig. 1).

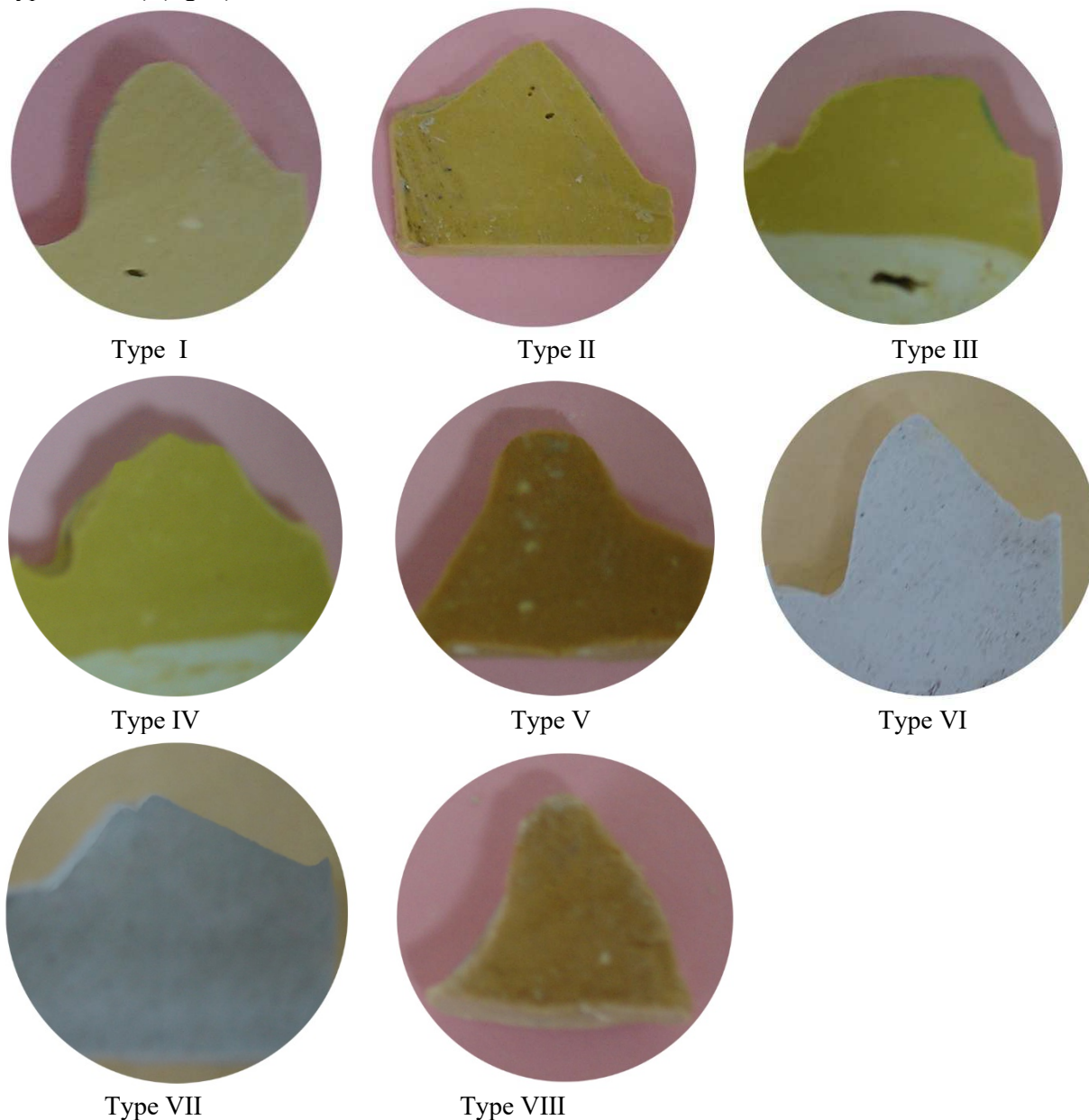


Fig. 1. Types of the lateral surfaces of the edentulous sites of the alveolar parts of the mandible.

It has been found that the most common types of edentulous sites of the alveolar processes in the bounded edentulous space were Type II (29.21 %), Type VI (20.23 %), Type I (15.73 %) and Type VIII (13.48 %). Type IV and VII were detected with the same incidence (6.74 % each). Types III and V of the cross sections of the alveolar parts were rarely found (5.62 % and 2.25 % of cases, respectively) (table 2).

The findings of our studies have established that Type II, VI and VIII of the alveolar parts were more common at the premolars. Type III and IV was not detected at all at this site. All shapes of the alveolar parts were found at the molars. The most common was Type I, II, and VI.

The analysis of the cross sections of the plaster study casts of patients with dentition defects revealed three shapes of the alveolar crest: cuspidate, convex and flat.

Table 2

**The incidence of detection of the designated types of the lateral surfaces of the alveolar parts
in the bounded edentulous spaces**

Edentulous site	Types of the lateral surfaces of the alveolar part, %							
	I	II	III	IV	V	VI	VII	VIII
4	–	1.12	–	–	–	3.37	1.12	3.38
5	3.37	7.86	–	–	1.13	4.50	1.12	4.49
6	11.24	11.24	4.49	2.25	1.12	8.99	2.25	4.49
7	1.12	8.99	1.13	4.49	–	3.37	2.25	1.12
Total	15.73±3.9*	29.21±4.8*	5.62±2.4	6.74±2.7	2.25±1.6	20.23±4.3*	6.74±2.7	13.48±3.6*

Note: * $p < 0.05$ – reliability of difference compared to Type III, IV, V and VII of the lateral surfaces of the alveolar process.

In the bounded edentulous spaces, at the premolars, the most common shape was convex (14.6 %), cuspidate (12.36 %) and flat (4.5 %). At the molars, on the contrary, the cuspidate shape of the alveolar crest was more often observed (28.09 %), whereas convex (25.85 %) and flat (14.60 %) shape was less often found (table 3).

Thus, in patients with the bounded edentulous spaces, the prevalence of cuspidate and convex shape of the alveolar part was the same (40.45% each) and was by 2.1 times more frequently observed compared to the flat shape.

Table 3

The shapes of the alveolar crest in the bounded edentulous spaces

Edentulous site	The shape of the alveolar crest							
	Cuspidate		Convex		Flat		Total	
	n	%	n	%	n	%	n	%
4	4	4.49	2	2.25	2	2.25	8	8.99±3.0
5	7	7.87	11	12.35	2	2.25	20	22.47±4.4
6	17	19.10	16	17.98	8	8.99	41	46.07±5.3
7	8	8.99	7	7.87	5	5.61	20	22.47±4.4
Total	36	40.45±5.2*	36	40.45±5.2*	17	19.10±4.2	89	100

Note: * $p < 0.05$ – reliable difference compared to the flat shape of the alveolar crest.

The study of the cross sections of the plaster study casts, on which a perpendicular line was drawn from the alveolar crest to the base of the study cast basis, showed that the alveolar crest could have different locations in the vestibulo-oral direction. Based on this, we have identified three variants of location of the alveolar crest: vestibular, medial and oral (fig. 2).

In the bounded edentulous spaces, at the premolars, medial location of the alveolar crest has been found in 15.73% of subjects and oral location was found by 4.49% less often, whereas vestibular location was by 3.5 times less frequently noted. At the molars, oral location of the alveolar crest was most often confirmed in 36 (40.45%) subjects, medial location was by 1.4 times less frequent, and the vestibular location was not detected at all (table 4).

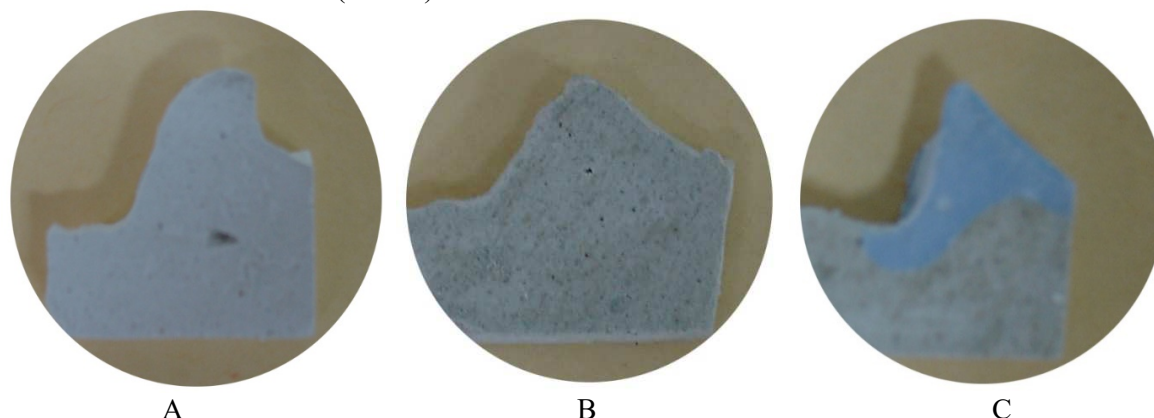


Fig. 2 Variants of location of the alveolar crest: A – vestibular; B – medial; C – oral.

Thus, oral location of the alveolar crest of patients with the bounded edentulous spaces was detected most often (51.69 %).

The analysis of the findings of the study has shown that the dimensions of the alveolar part in the vestibulo-oral and apical-coronary directions in patients with partial adentia have individual features.

Table 4

Location of the alveolar crest in the bounded edentulous spaces

Edentulous site	Location of the alveolar crest							
	Vestibular		Medial		Oral		Total	
	n	%	n	%	n	%	n	%
4	2	2.25	4	4.49	2	2.25	8	8.99±3.0
5	2	2.24	10	11.24	8	8.99	20	22.47±4.4
6	–	–	17	19.10	24	26.97	41	46.07±5.3
7	–	–	8	8.99	12	13.48	20	22.47±4.4
Total	4	4.49±2.2	39	43.82±5.3	46	51.69±5.3*	89	100

Note: * $p < 0.05$ – reliable difference compared to the vestibular and medial location of the alveolar crest.

Apparently, at the premolars, Type II lateral surfaces ($8.98 \pm 3.0\%$), convex shape of the alveolar crest ($14.60 \pm 3.7\%$) and its medial location ($15.73 \pm 3.9\%$) was the most common; at the molars, Type II lateral surfaces ($20.23 \pm 4.3\%$), cuspidate shape of the alveolar crest ($28.09 \pm 4.8\%$) and its oral location ($40.45 \pm 5.2\%$) was the most common. At the premolars, alveolar processes were narrower but higher, whereas at the molars they were wider and lower. This should be taken into account when planning manufacture of a removable or fixed denture.

However, the analysis of the study casts gives a general view on the state of the tissues of the prosthetic bed: the “clinical” shape and dimensions of the alveolar part. That is, we obtain data on the relief of the mucous membrane, but not directly on the bone base of the alveolar part. Consequently, it is necessary to study whether the relief of the mucous membrane corresponds to the bone contours of the alveolar process [7–9].

Measurement of the thickness of the mucous membrane of the alveolar part was performed in 34 patients with partial adentia on the mandible according to the method described in the patent No. u200604457 [5].

In patients with the bounded edentulous spaces, the thickness of the mucous membrane at the alveolar crest at the first premolar was at the average of 2.5 ± 0.3 mm; at the second premolar – 2.4 ± 0.7 mm, at the first molar – 2.4 ± 0.5 mm, at the second molar – 2.6 ± 0.6 mm. Thus, the mucous membrane was the thinnest in the middle of the distance between the teeth, which limited the dentition defect. Thus, the inverse dependence of the thickness of the mucous membrane on the distance at which it was located from the teeth, limiting the dentition defect, was established.



Fig. 3a. Transversal section of the mandible of the 27-year-old patient V. at the tooth 36.



Fig. 3b. Transversal section of the mandible of the 31-year-old patient D. at the tooth 46. The bone contour is displaced orally relative to the “clinical” alveolar crest.



Fig. 3c. Transversal section of the mandible of the 57-year-old patient K. at the tooth 45. The bone contour is located beneath the “clinical” alveolar crest.

The analysis of 24 digital X-ray transverse sections of the mandible in patients with different types of lateral surfaces of the alveolar processes, performed in the area of masticatory teeth, showed that the thickness of the mucosa at the vestibular fold (Fig. 3a) was at the average of 2.1 ± 0.3 mm, and on the lingual side – 1.8 ± 0.5 mm. At $\frac{1}{4}$ the height of the alveolar process, the mucous membrane thinned by 0.1–0.5 mm, and then gradually thickened to the alveolar crest. In 15 (62.5±9.9 %) patients, the mucous membrane of the alveolar part at the edentulous site was by 0.3–0.5 mm thicker on the vestibular side, in the rest - on the oral side. In all cases, the thickness of the mucous membrane at the alveolar crest (on the average of 2.6 ± 0.5 mm) was greater than at the vestibular fold and corresponded to the thickness measured at the alveolar crest according to orthopantomograms.

The analysis of the radiographs showed that in 41.7 ± 10.1 % of cases the bone contour of the alveolar part was displaced by 0.8-1.2 mm orally relative to the “clinical” one, formed by the mucous membrane, and in the rest of the subjects their location coincided (fig. 3b, 3c).

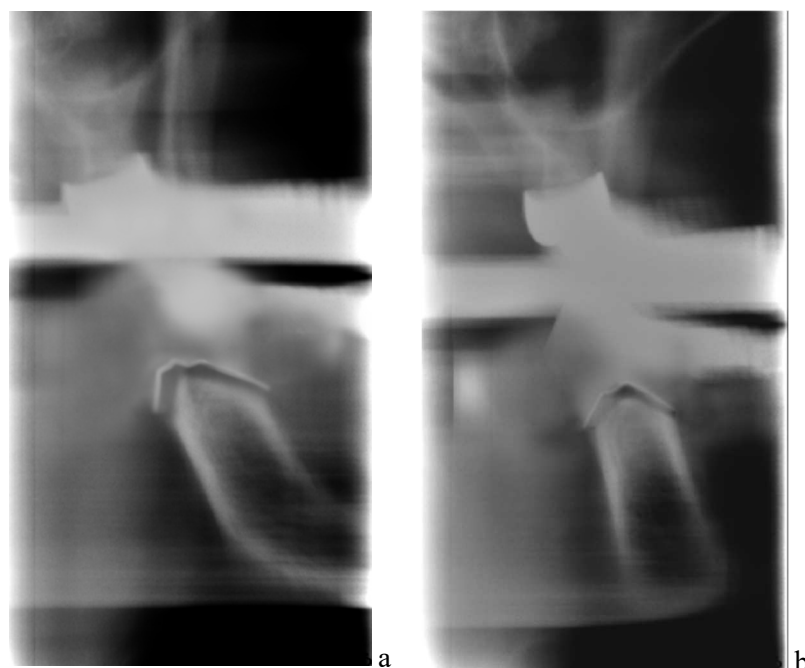


Fig. 4. Transverse section of the mandible. Mismatch of the shape of the bone base with the clinical slope of the alveolar part: a - patient S., 54 years old, area of the tooth 35, type IV slope; b - patient V., 48 years old, area of the tooth 47, type VII slope.

In general, the shape of the bony base of the alveolar process was similar to the “clinical” type of the lateral surfaces and the shape of the alveolar crest in 21 (87.5±6.8%) subjects. The mismatch was found in Type IV and VII of the lateral surfaces of the alveolar part. In these cases, the bony contour of the crest had a triangular cross section, its peak was located beneath the high middle cusp and the lateral cusps of the tricuspid (IV) and bicuspid (VII) types of the lateral surfaces of the “clinical” alveolar process were formed by a thickened mucosa (fig. 4).

Thus, the studies show that the thickness of the mucous membrane at the alveolar crest of the mandible in patients with the bounded edentulous spaces increased in the direction of the teeth, which limited this defect. The alveolar crest, clearly visible in the oral cavity, did not always coincide with the radiological image of the alveolar part, but was formed by a thickened mucous membrane in this area. The shape of the bone base of the alveolar part was similar to the “clinical” type of the lateral surfaces and the shape of the alveolar crest in 87.5 ± 6.8 % of the subjects which is narrowed with data from other researchers [7, 9]. Mismatch was found in Type IV and VII of the lateral surfaces of the alveolar process. It has been found that the most common types of edentulous sites of the alveolar processes in the bounded edentulous space were Type II (29.21 %), Type VI (20.23 %), Type I (15.73 %) and Type VIII (13.48 %). Type IV and VII were detected with the same incidence (6.74 % each). Types III and V of the cross sections of the alveolar parts were rarely found (5.62 % and 2.25 % of cases, respectively), which is narrowed with data from other researchers [10, 11]. In the bounded edentulous spaces, at the premolars, medial location of the alveolar crest has been found in 15.73 % of subjects and oral location was found by 4.49% less often, whereas vestibular location was by 3.5 times less frequently noted. At the molars, oral location of the alveolar crest was most often confirmed in 36 (40.45 %) subjects, medial location was by 1.4 times less frequent, and the vestibular location was not detected at all.

Conclusions

1. At the premolars, Type II lateral surfaces (8.98 ± 3.0 %), convex shape of the alveolar crest (14.60 ± 3.7 %) and its middle location (15.73 ± 3.9 %) was the most common; at the molars, Type II lateral surfaces (20.23 ± 4.3 %), cuspidate shape of the alveolar crest (28.09 ± 4.8 %) and its oral location (40.45 ± 5.2 %) was the most common. At the premolars, alveolar processes were narrower but higher,

whereas at the molars they were wider and lower. This should be taken into account when planning a removable or fixed prosthetic denture.

2. Thus, the studies show that the thickness of the mucous membrane at the alveolar crest of the mandible in patients with the bounded edentulous spaces increased in the direction of the teeth, which limited this defect. The alveolar crest, clearly visible in the oral cavity, did not always coincide with the radiological image of the alveolar part, but was formed by a thickened mucous membrane in this area. The shape of the bone base of the alveolar part was similar the “clinical” type of the lateral surfaces and the shape of the alveolar crest in 87.5 ± 6.8 % of the subjects. Mismatch was found in Type IV and VII of the lateral surfaces of the alveolar process.

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