ORIGINAL ARTICLE

RESULTS OF TREATMENT OF EDENTULOUS PATIENTS WITH DENTURES, MADE OF «VERTEX THERMOSENSE» (THERMOPLASTIC MATERIAL)

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ABSTRACT

The aim: The work is devoted to studying the results of treatment of edentulous patients with dentures, made of thermoplastic material "Vertex ThermoSense".

Materials and methods: The non-acrylic thermoplastic plastic "Vertex ThermoSense" was used in our research work. The quality evaluation was carried out with the help of an objective-subjective test "BOFSAS", determination of biopotentials of masticatory muscles with the help of electromyography and determination of masticatory efficiency according to I.S. Rubinov.

Results: It can be noted that the use of the basic thermoplastic material "Vertex ThermoSense" allows to achieve better fixation and stabilization of complete removable prostheses. It is subjectively confirmed by the "BOFSAS" test, objectively - by data of electromyographic studies and time the masticatory test of I.S. Rubinov.

Conclusion: We can conclude that adaptation to dentures, made of the basic thermoplastic material "Vertex ThermoSense", goes in short terms and it is almost painless, based on the results of our studies.

KEY WORDS: "Vertex ThermoSense", thermoplastic dental materials, complete absence of teeth, electromyography

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INTRODUCTION

Providing high-quality dental care to patients with complete absence of teeth is one of the most important problems in prosthetic dentistry.

Most often, complete loss of teeth occurs as a result of caries and its complications, periodontitis, trauma, and less often it occurs as a result of congenital absence of teeth.

Complete absence of teeth occurs in 15% of people aged 40 and older according to the data of E.Ya. Vares, [1]. The need for full removable dentures is 42.2% among the elderly and senile population according to V.A. Lobunets [2]. There has been a persistent unidirectional trend towards an increase in the percentage of elderly people in Ukraine who need removable prosthetics: from 21.4% in 2013 to 22.8% in 2018 [3].

The complete absence of teeth leads to a number of general and local complications, such as functional and morphological changes in the masticatory system [4].

Much attention is paid to the anatomical and topographic features of the structure of the edentulous jaws and the clinical and laboratory stages of manufacturing full removable dentures in the literature. However, the physiological bases of using these types of prostheses have been studied lesser, as well as the indicators of recovery of the chewing function after using dentures [5].

Restoration of the chewing efficiency degree is one of the most important criteria for assessing the functional state of the dentition and the quality of dentures [6, 7]. Chewing efficacy can be determined by classical methods [8, 9] and using also by modern technologies [10].

The manufacturing of high-quality complete dentures is dependent on the properties of the base material. Acrylic plastics of hot polymerization are the main group of materials for manufacturing removable dentures [11, 12].

The development and research of new basic dental materials has been carried out for many years. Prosthetic dentists prefer acrylic-free thermoplastic plastics to manufacture complete removable dentures, because they do not have the disadvantages of acrylic base plastics and make it possible to improve the functional qualities of removable dentures [13, 14].

THE AIM

To study the results of treatment of patients with complete absence of teeth with prostheses made of thermoplastic material "Vertex ThermoSense" using various functional research methods.

MATERIALS AND METHODS

We made 38 complete removable dentures from polyamide thermoplastic material "Vertex ThermoSense" for 19 patients, who had already been using removable constructions for 3-5 years.

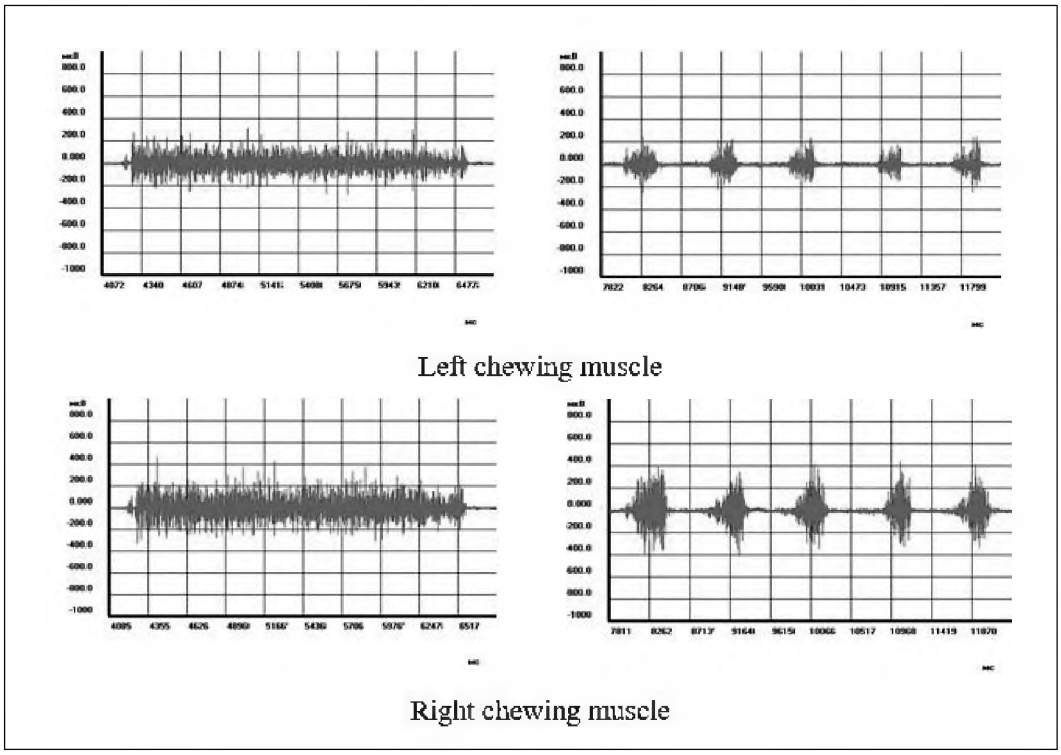

Fig. 1. Electromyogram of the actual chewing muscles of patient B. (intact chewing apparatus)

Table I. Average indicators of the electrical activity of the masticatory muscles in the control group (M±m) (n=25)

EMG indicators	Left chewing muscle	Right chewing muscle
Compression amplitude	608,96±8,50	641,58±10,01
Oscillation frequency	244,29±4,88	262,24±3,45
Amplitude of chewing	597,08±9,33	643,92±9,11
Oscillation frequency	247,56±2,85	262,25±2,66
Activity time	476,61±7,41	489,32±7,24
Rest time	464,74±6,92	477,62±6,66
Coefficient «K»	1,02±0,01	1,02±0,01

Note: ($p < 0,05$).

Evaluation of the quality of all the constructions was made by using the objective-subjective test "BOFSAS". Determination of the biopotentials of the masticatory muscles was made by using electromyography and also we made the determination of the chewing efficiency according to I.S. Rubinov.

The "BOFSAS" test is objectively subjective and allows determine the degree of patient satisfaction with the dentures. It allows to determine the amount of necessary corrections of prostheses. This test was proposed by the authors to assess the quality of prostheses, but it can also be used to assess the quality of complete removable dentures. We use the following criteria: "B" – is the state of the base and its compliance with the boundaries of the prosthetic bed; "O" – is the teeth closing and the correctness of the central occlusion definition; "F" – fixation of the prosthesis, when the lower jaw is at rest; "S" – stabilization of the prosthesis during various chewing movements; "A" – adaptation to the prosthesis based on the patient's subjective feelings; "S" – patient's satisfaction with the prosthesis.

The quality of the dentures was rated as "satisfactory" and "unsatisfactory". Satisfactory quality included such quantities as: free placement of the prosthesis, precise fit to the mucous membrane of the prosthetic bed, correct determination of the central position of the lower jaw, multiple occlusal contacts, good fixation and stabilization of the prosthesis, fairly quick adaptation to the prosthesis and patient's satisfaction.

A deviation from at least one of the parameters was considered as "unsatisfactory" and required to manufacture a new denture.

We studied the biopotentials of the actual masticatory muscles using electromyography in addition to the objective-subjective test "BOFSAS". This research method allows us to characterize the act of chewing and is one of the most objective methods for studying the state of the neuromuscular apparatus.

We assessed the following indicators with the help of electromyography: a) the amplitude of fluctuations in biocurrents on both sides of the isometric line and its average

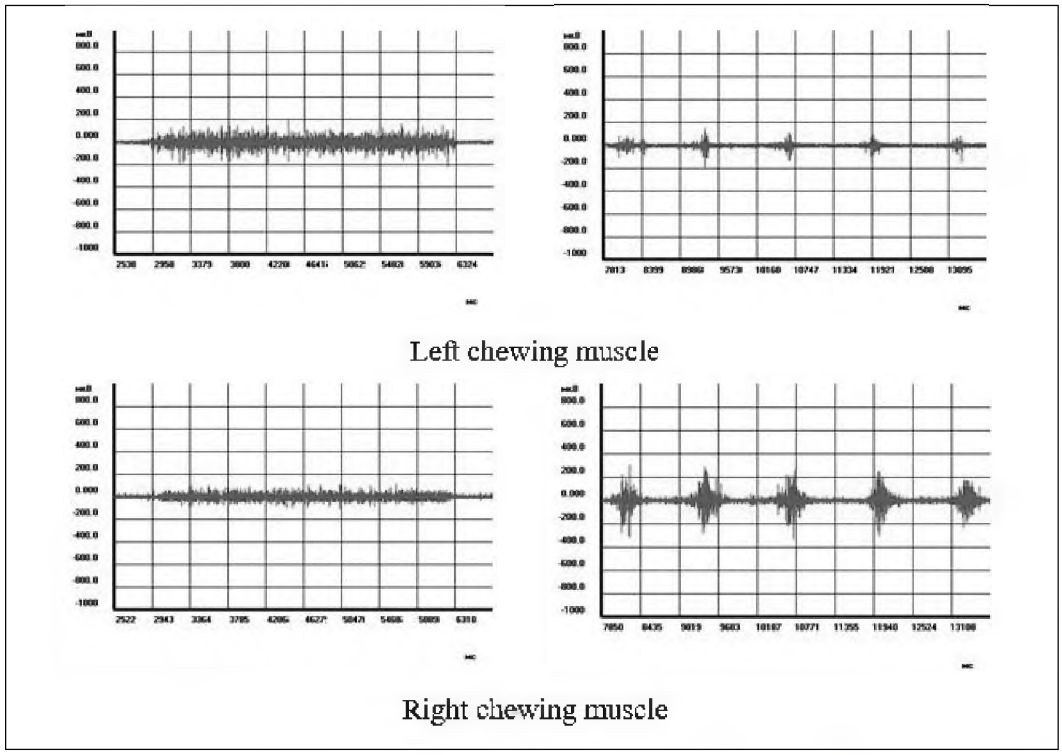

Fig. 2. Electromyogram of the actual chewing muscles of patient G. (before prosthetic treatment)

Table II. Average values of indicators of electrical activity of masticatory muscles in patients before prostetic treatment (M±m) (n=19).

EMG indicators	Left chewing muscle	Right chewing muscle
Compression amplitude	156,04±5,98	181,70±6,04
Oscillation frequency	353,94±9,12	378,48±8,91
Amplitude of chewing	234,37±25,3	236,34±8,48
Oscillation frequency	304,61±6,85	331,52±9,32
Activity time	653,49±13,23	672,97±11,44
Rest time	510,13±6,57	524,23±8,55
Coefficient «K»	2,45±0,09	2,36±0,09

Note: all indicators of the clinical group are statistically significantly different from the control ($p < 0,05$).

value (in μV) - as an indicator of the excitatory processes strength; b) the frequency of oscillations of biopotentials as an indicator of the concentration of electrical activity in time; c) the duration of the phases of electrical activity and relative bioelectric rest (in ms) - as an indicator of the activity of motor units; d) the ratio of the duration of the phases of activity and periods of rest (coefficient "K") - as an indicator of the ratio between excitatory and inhibitory processes.

We have done underwent functional tests to all the persons - "volitional compression" and "voluntary chewing". There is a rapid onset of high-amplitude oscillations with gradual fading towards the end of the test, normally, with volitional compression. Bioelectrical activity is not recorded in the state of relative physiological rest of the lower jaw, respectively, an isometric line is observed on the electromyogram. The "voluntary chewing" test is characterized by a clear sequence of bursts of activity with periods of rest. Bioelectrical activity is characterized by a rather high amplitude at the beginning of the chewing period with a gradual decrease towards the end as the density of the food stimulus decreases.

We assessed the restoration of the chewing function using the classical physiological test according to I.S. Rubinov in our research work. It refers to dynamic methods for determining chewing efficiency.

We offered patients to chew one hazelnut (it's weight was 0.8±0.05 g.) before the appearance of the swallowing reflex. The time they spent on this was recorded. Patients spat the chewed mass into a cup, rinsed their mouth with water and spit into the same cup. We washed the mass, dried it and sieved it through a sieve with round holes 2.4 mm in diameter, after which the resulting residue was weighed.

RESULTS

We can conclude that almost all the constructions we made were of good quality after carrying out the subjective-objective test "BOFSAS". Only one correction was applied. And only one prosthesis for the lower jaw needed two corrections.

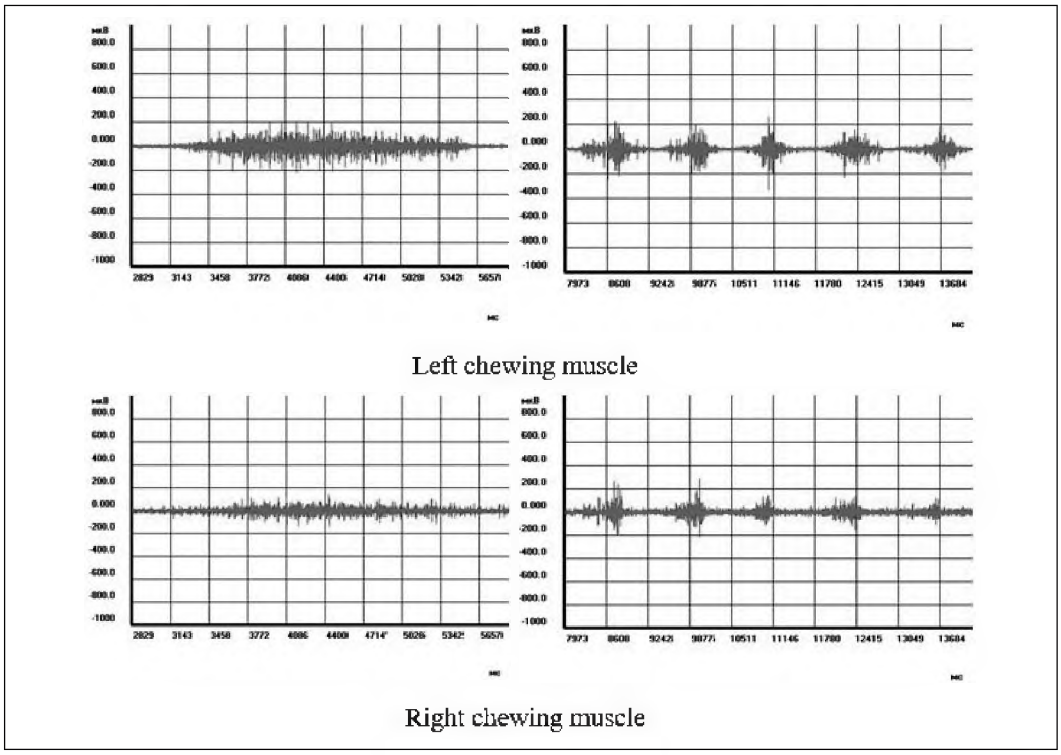

Fig. 3. Electromyogram of the actual chewing muscles of patient Ch. (After 1 month of using dentures made of "Vertex ThermoSense")

Table III. Average values of indicators of electrical activity of masticatory muscles in patients after 1 month of using dentures made of "Vertex ThermoSense" (M±m) (n=19).

EMG indicators	Left chewing muscle	Right chewing muscle
Compression amplitude	309,96±10,26	364,96±11,62
Oscillation frequency	229,50±7,82	244,54±8,31
Amplitude of chewing	322,58±11,69	378,56±12,30
Oscillation frequency	246,74±7,91	262,34±9,26
Activity time	439,52±14,27	452,38±16,51
Rest time	341,45±11,88	353,19±11,39
Coefficient «K»	1,28±0,06	1,28±0,06

Note: all indicators of the clinical group are statistically significantly different from the control ($p < 0,05$).

Electromyographic studies were performed in patients both before the start of treatment and in the long term after using prosthetics.

To assess the electromyogram of patients before and after prosthetics, we separately formed a control group, which consisted of 25 people with intact dentition. The electromyographic norm of the functional state of both masticatory muscles is shown in Figure 1.

Quantitative analysis and statistical analysis of electromyogram indicators of patients in the control group are presented in Table I.

People, who use full removable dentures for a long time have data, wich really differ from data of people with intact dentition. The electromyographic picture of such a patient is shown in Fig. 2.

The quantitive analysis of electromyograms of the patients before prosthetic treatment is shown in table II.

Also we made electromyograms of the patients after a month of using prostheses, six months and a year.

Electromyograms of patients using prostheses made of polyamide thermoplastic material "Vertex ThermoSense" for a month are shown in Figure 3.

A quantitative analysis of electromyograms obtained from patients after a month of using dentures made of "Vertex ThermoSense" is shown in table III.

Electromyograms of patients who used dentures made of polyamide thermoplastic "Vertex ThermoSense" during the year are shown in Figure 4.

A quantitative analysis of electromyograms obtained in patients using dentures for 1 year is shown in table IV.

We determined the chewing efficiency according to I.S. Rubinov. Our results indicate that the weight of the residue in patients of the control group (with intact dentition), in patients before treatment (those, who had old dentures), and in patients, who used new dentures (made of "Vertex ThermoSense") was approximately the same and amounted to 0.05-0.08 gr. However, the time of patient's chewing before the swallowing reflex appeared varied widely.

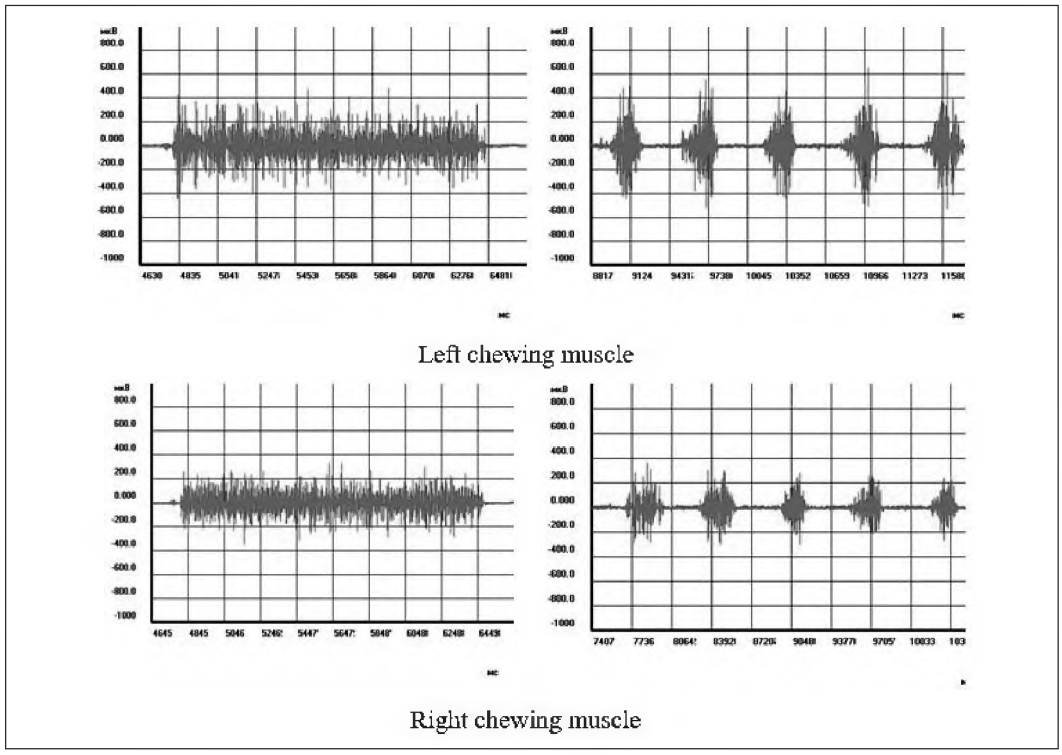

Fig. 4. Electromyogram of the actual chewing muscles of patient Ch. (After 1 year of using dentures made of "Vertex ThermoSense")

Table IV. Average values of the indicators of electrical activity of the masticatory muscles in patients after 1 year of using prostheses made of "Vertex ThermoSense" (M±m) (n=19).

EMG indicators	Left chewing muscle	Right chewing muscle
Compression amplitude	587,90±8,87	612,94±9,24
Oscillation frequency	251,59±3,44	256,25±3,96
Amplitude of chewing	606,97±10,34	627,57±10,16
Oscillation frequency	253,40±3,84	261,47±3,65
Activity time	467,73±7,11	481,70±7,46
Rest time	452,79±6,73	464,18±7,46
Coefficient «K»	1,06±0,02	1,05±0,02

Note: all indicators of the clinical group are statistically significantly different from the control ($p < 0,05$).

Thus, the average time of chewing in patients with intact dentures was approximately 12.97±0.13 seconds, and the average time of chewing in patients before using new dentures, made of "Vertex ThermoSense" (with old dentures) was approximately 45.16±0.41 seconds.

DISCUSSION

The table 1 shows that the force of excitatory processes in the masticatory muscles is quite large and ranges from 608.96±8.50 μV to 641.58±10.01 μV with volitional compression of the jaws. A similar dependence of the frequency and magnitude of the amplitude of biocurrents is observed during performing a test of free chewing.

The analysis of time parameters of electromyograms did not reveal a statistically significant difference in the length of individual phases of activity and rest. The value of the coefficient "K" evidences about this. The coefficient "K" approaches to "one" in people with intact dentition.

We can say that the compression amplitude is decreased to 156.04±5.98 μV with "voluntary compression" and to 234.37±25.3 μV with "voluntary chewing", which significantly differs from the norm based on the data in the table 2. The coefficient "K" should be as close to "one" as possible, but it amounted to 2.45±0.09 in edentulous patients.

We can say that the compression amplitude increased to 364.96±11.62 μV with "voluntary compression" and up to 378.56±12.30 μV with "voluntary chewing" based on the indicators presented in the table 3. The coefficient "K" decreased to 1.28±0.06 compared to 2.45±0.09 before using dentures (normally should be as close to "one" as possible).

It can be seen from the results of the table 4 that after 1 year of using the structures, the amplitude for voluntary compression is 612.94±9.24 μV, which is close to the norm. The amplitude of chewing also approaches the norm and is 627.57±10.16 μV. The coefficient "K" has significantly decreased and it is 1.05±0.02.

The time required for patients to chew in 1 month after they used new dentures, made of "Vertex ThermoSense",

is 27.49±0.59 seconds, and after 1 year of using these dentures - 19.80±0.89 seconds.

CONCLUSIONS

Our studies show that the use of the base thermoplastic material "Vertex ThermoSense" allows to achieve good fixation and stabilization of complete removable dentures. It is confirmed by the "BOFSAS" test (subjectively), and, according to the data of electromyographic studies and time indicators during the chewing test according to I.S. Rubinov (objectively). We can conclude that adaptation to dentures, made of "Vertex ThermoSense" takes place in a shorter time and almost without corrections.

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Conflict of interest:

The Authors declare no conflict of interest.

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