

# Clinical substantiation of the sparing and less invasive implant prosthetics of the edentulous lower jaw method

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## SUMMARY

**Objective.** Proof of the effective implant prosthetics treatment of patients with the edentulous lower jaw by minimally invasive method.

**Materials and methods.** As a sample of clinical research, 68 senior patients (30 men and 38 women) were diagnosed with edentulous lower jaws. The methods of the study included estimating the implant retention by frequency-resonance analysis of Osstell ISQ, the degree of retention and stabilization of the tissue supported and implant-supported dentures (author's method: patent for invention No. 2640375 of 28.12.2017) and a sociologic questionnaire "Profile of the influence of dental health OHIP-14".

**Results.** For the first time strength indicators of the retention and stabilization degree of implant-retained mandibular overdentures with attachment to one and two implants were determined. A linear relationship was shown between the degree of fixation of the prosthesis and the change in the quality of life (a statistically significant correlation was  $p=0.022$ ,  $r=0.52$  in the first group and  $p=0.0015$ ;  $r=0.75$  in the second group). The implants stability during the year increased in the first group in  $2.57\pm 1.59\%$ , and in the second group in  $2.08\pm 1.40\%$ . After a year using implant-retained mandibular overdentures, the life quality level concerning dental health in patients from the first and second groups remained the same (there were no statistically significant differences,  $p_{1-2}=0.8392$ ).

**Conclusions.** The performed survey of prosthetic treatment patients with the edentulous lower jaw showed the effect use of a sparing method of implantation prosthetics. The fixation quality achieved with a single support-retaining implant was sufficient to improve the functional and comfortable using of the lower jaw prosthesis. It was found that the stability of implants statistically did not significantly depend on the number of used implants ( $p>0.05$ ).

**Key words:** implant prosthetics, edentulous lower jaw.

## INTRODUCTION

The main findings characterizing the effective prosthodontic treatment are: the effectiveness of chewing, the fixation quality of the removable prosthesis and the change of the life quality concerning dental health (2, 16). The use of implants to fix removable dentures proved to increase all the above mentioned indicators, for example, chewing efficiency is increased by 19-44% (8, 15, 17). However, the use of a implants set (3 to 8)

is often not available for aged patients because of the considerable atrophy of the alveolar part in the lateral areas, a large number of accompanying somatic diseases, expensive treatment and the fear of surgery trauma (1, 2). A compromise solution of this problem for an aged patient is the fitting of a single implant (5, 6, 11, 18). This method is the most sparing of all currently used methods for implantation prosthetics. The question is: if it is possible to do with a single implant to provide effective fixation of a removable denture leaning on an atrophied, edentulous lower jaw, and weather the leaning of the removable prosthesis on a single implant can result in the lost of its osseointegration?

**Objective.** Proof of the effect orthopedic treatment of patients with complete loss of teeth on the lower jaw by minimally invasive method of implantation prosthetics.

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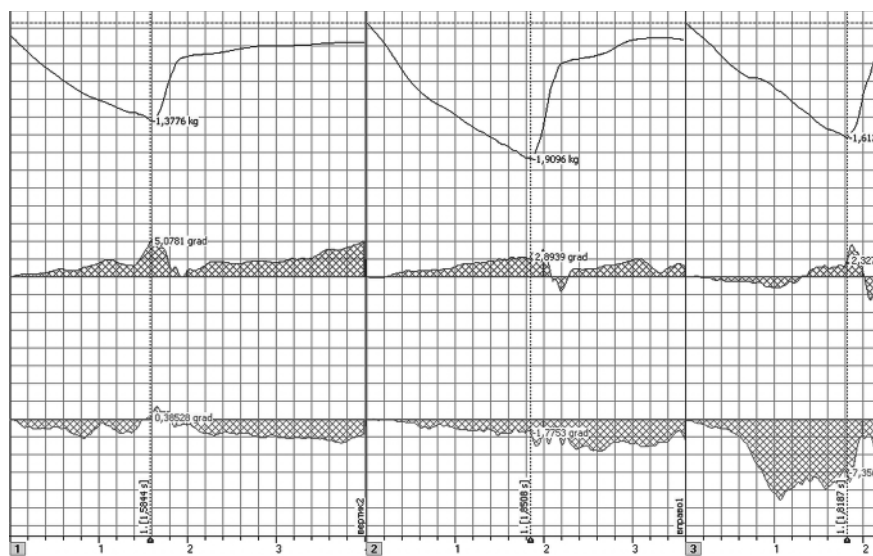
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**Fig 1.** Performing measurements of the implant stability with the Osstell ISQ device

**Fig 2.** Measurement of the fixation degree of the removable denture



**Fig 3.** Charts of the change in applied force and the inclination angle of the prosthesis before the moment of detachment

**MATERIALS AND METHODS**

As a subject of clinical studies, 68 senior patients (30 men and 38 women) aged from 59 to

86 (middle aged 68.1±8.36) were diagnosed with an edentulous mandible (III-IV type atrophy of the lower jaw according to Oxman). Patients were divided into 3 groups: 1-st group (22 people)-fixation of the prosthesis on a single implant, 2-nd group (21 people) – fixation of the prosthesis on two implants, 3-rd group (control group-25 people) – patients were treated with routine dentures.

The research included clinical, sociological and statistical research methods. The clinical methods concerned evaluation of the implant stability by the method of frequency-resonance analysis Osstell ISQ. The degree of implants stability was determined by the data of ISQ in accordance with the manufacturer's recommendations (10). The measurements were performed in patients from the first and second groups after osseointegration of the implant (after 4 months) and after a year of using the implants as a leaning for removable prostheses (Fig. 1).

The degree of retention and stabilization of the tissue supported and implant-retained overdentures (author's method: patent for invention No. 2640375 of 09.12.2016) was assessed in all patients. The force necessary to detach the removable prosthesis from the prosthetic couch during its removal was measured with the help of a strain gage sensor installed in the device (Fig. 2). Changes in the tear force and tilt of the prosthesis during removal and at the time of separation were fixed in time and displayed on the monitor in the form of graphs and / or integral estimates of strength and angles (Fig. 3). Measurement of the force index was carried out in grams. The angle of deflection of the prosthesis was measured in degrees. Measurements were carried out in 3 months and in a year of using the removable prosthesis in patients from groups 1, 2 and 3.

The sociological approach was carried out using the questionnaire

**Table 1.** Results of the implant stability measurement by the method of resonance-frequency analysis (ISQ) (M±δ)

Patient group	Implant stability in 4 months after implantation	Implant stability in a year after prosthetics
group 1	75.9±4.31	77.2±3.92
group 2	76.1±3.58	77.3±3.53
p, level significance	p=0.89	p=0.52
Hospital stay	18.26 (7.12)	21.50 (7.24)

**Table 2.** Results of measuring the retention degree of a removable prosthesis in treatment process (M±δ)

Patient group	Retention before treatment	Retention in 3 months after treatment	Retention in 12 months after treatment
group 1	337.2±34.99	1462.5±204.22	1338.8±222.58
group 2	323.7±59.0	1704.5±102.19	1623.4±107.88
group 3	319.3±43.16	406.12±77.69	383.4±78.1
p. level significance	p=0.40	p<0.001	p<0.001

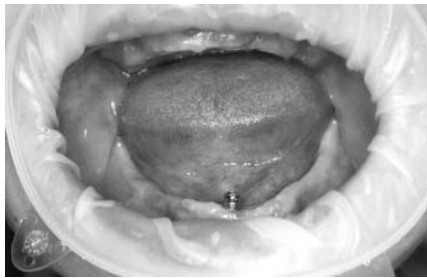


Fig 4. Patient with «Locator» attachment

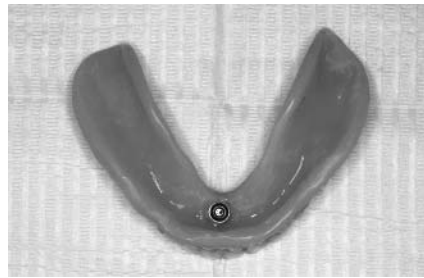


Fig 5. Intaglio surface of denture housing the retentive fixation part



Fig 6. Definitive prosthesis in situ

"Profile of the influence of dental health OHIP-14" (7). The questioning of the life quality level was conducted before and after prosthetics.

For statistical counting, the Microsoft Office Excel and SAS (Statistical Analysis System) application packages ver. 9.4 were used in the MS Windows environment. Qualitative data were described by frequencies and percentages, quantitative-using the average and standard deviations ( $M \pm \delta$ ). The evaluating of the linear relationship between the quantitative data was carried out by calculating the Pearson correlation coefficient. The correlation was considered weak if  $r < 0.3$ ; moderate – ( $0.3 < r < 0.6$ ) and high – ( $0.6 < r \leq 1$ ). To determine the effect of treatment methods (in groups), the ANOVA (single-factor analysis of variance) was used for independent samples, with post-hoc analysis with the help of Tukey criterion. Evaluation of indication dynamics before and after treatment for all patients in general, and separately in groups, was carried out using ANOVA repeated analysis for dependent samples.

**RESULTS**

Implant stability results are presented in Table 1. Statistically significant dynamics in each group ( $F=25.47$ ;  $p < 0.001$ ) was seen, and there were no differences in dynamics between groups ( $F=0.001$ ;  $p=0.93$ ). The average implant stability in 12 months began to

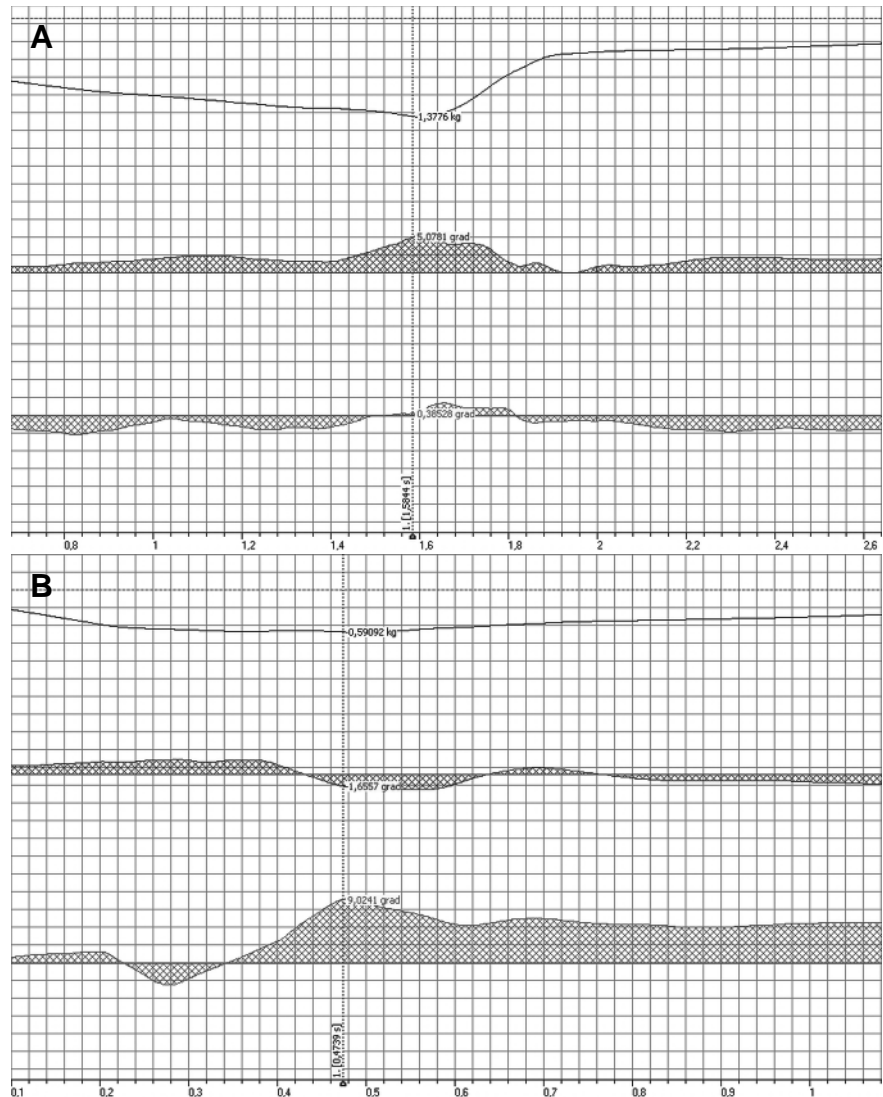


Fig 7. Retention (A) and stabilization (B) degree of the implant prosthesis

Table 3. Results of measuring the stabilization force of a removable prosthesis during treatment ( $M \pm \delta$ )

Patient group	Stabilization before treatment	Stabilization in 3 months after treatment	Stabilization in 12 months after treatment
group 1	212.9±20.05	613.0±144.88	516.3±133.94
group 2	210.5±29.97	761.5±71.65	687.1±60.22
group 3	215.6±32.69	253.7±67.75	224.6±73.29
p, level significance	p=0.83	p<0.001	p<0.001

increase by  $2.57 \pm 1.59\%$  in the first group and by  $2.08 \pm 1.40\%$  in the second group.

The degree of retention and stabilization measuring results of the overdentures are presented in Tables 2, 3. Changes in the indices were more marked in patients with implant-retained overdentures in comparison with the patients with routine dentures. The calculation of the Pearson correlation coefficient revealed a linear relationship between the indices of the degree the prosthesis retention and the change in the life quality after a year of survey (statistically significant correlation  $p=0.022$ ;  $r=0.52$  in the first group;  $p=0.0015$  in the second group;  $r=-0.75$ ).

The results of studying the patients life quality concerning dental health with total loss of teeth after routine and implant-retained overdentures are presented in Table 4. After 1 year of using implant-supported overdentures, the level of the life quality concerning dental health in patients of the first and second group remained the same (no statistically significant differences,  $p_{1-2}=0.8392$ ). Indicators of the life quality concerning dental health, before treatment and in a year after treatment, changed in the first group by  $57.8 \pm 6.09\%$ , by the second group by  $59.2 \pm 4.87\%$  and in the third group by  $34.9 \pm 5.99\%$ .

To illustrate the above mentioned findings, we apply the case report. Patient N., a female Caucasian, aged 67, complained of the lower prosthesis poor fixation. Diagnosis: total loss of teeth on the lower jaw, type III atrophy of the lower jaw according to Oxman. «Biomet 3i» implant was fitted along the midline of the lower jaw with a diameter 4 mm and length 11 mm. In 4 months, an implant prosthesis was carried out by a denture with fastening on «Locator» (Fig. 4-6). After implantation, the degree of prosthesis retention was 1377 g with the inclination angle of the prosthesis from the initial position in the sagittal plane of  $5^\circ$ , and in the transversal plane –  $0.3^\circ$ . The degree of stabilization was 590 g with the angle of the prosthesis inclination from the initial position in the sagittal plane of  $1,7^\circ$ , and in the transversal plane –  $9^\circ$  (Fig. 7). The stability of the

implant in the bone tissue during the year did not change and accounted 75 ISQ units. The patient's life quality after the treatment was improved to 29 points, which corresponded to the average level of life quality concerning dental health.

## DISCUSSION

The high average stability values of the implants from both groups confirm the correct choice of the protocol for the two-stage implant installation with late loading in the conditions of involute processes in the anterior part of the atrophied lower toothless jaw in the elderly patients. The obtained findings coincide with the previous studies (4, 12, 13).

The use of implantation prosthetics with the support of two implants proved to increase the indices of the fixation degree of the removable prosthesis. However, the fixation achieved with a single support-retaining implant was sufficient enough to improve the quality functions and comfortable using of the lower jaw denture, the results of measuring the life quality concerning dental health were evident. Similar results were obtained by foreign authors, having proved that there was no significant difference in the patients satisfaction with implant-retained overdentures based on the different number of implants (3, 9, 14).

## CONCLUSIONS

1. The stability of implants statistically did not significantly depend on the number of used implants ( $p>0.05$ ).
2. The additional fastening of implant mandibular denture made it possible to significantly increase the degree of fixation of conventional prostheses. The degree of fixation achieved with a single support-retaining implant was sufficient enough to improve the functions and usage of the lower denture.

3. The satisfaction of patients with mandibular overdentures supported by one or two implants statistically did not differ a lot (after 3 months of using prostheses  $p=0.367$  and after 12 months  $p=0.839$ ).

## STATEMENT OF CONFLICT OF INTEREST

The authors state no conflict of interest.

**Table 4.** The results of the questionnaire OHIP-14 ( $M \pm \delta$ )

Patient group	Life quality before prosthetics	Life quality in 3 months after prosthetics	Life quality in 12 months after prosthetics
group 1	41.5±3.70	26±2.8	17.4±2.22
group 2	42.4±2.87	25.3±3.12	17.2±1.90
group 3	41.8±3.51	34.2±2.42	27.1±1.54
p, level significance	$p_{1-2}=0.296$ $p_{1-3}=0.569$ $p_{2-3}=0.606$	$p_{1-2}=0.367$ $p_{2-3}<0.001$ $p_{1-3}<0.001$	$p_{1-2}=0.839$ $p_{2-3}<0.001$ $p_{1-3}<0.001$

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