UDC index: 616.311-089.844: 611-018: 615.36-026.565-047.44

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COMPARATIVE ANALYSIS OF INDICATORS OF PRIMARY STABILITY OF IMPLANTS AT ONE-TIME IMPLANTATION.

Resume.

The current demand of patients for rapid, aesthetic and functional dental rehabilitation encourages dentists to seek tools and methods to meet them. Solving the problem of a hopeless tooth in one visit by removal and simultaneous implantation with immediate orthopedic load is the goal of many dental surgeons, and to confirm their qualifications at the same time. But the possibility of rapid restoration of lost teeth requires serious training both by the surgeon and by the manufacturer of the implant system [1,3,6]. Today, in implant treatment, it is important not only to have a sufficient bone supply, the optimal position of the implant and surgical techniques that allow you to develop a high torque during installation,[reference to the first article “Comparative characteristics of the properties of dental implants depending on the design, shape and surface in the experiment”]. This, in turn, requires the manufacturer to develop and improve the quality of the implant surface, which will facilitate the rapid flow of biological processes, and the development of unique types of implant shape, which will withstand significant mechanical loads immediately after installation. That is why the search for and comparison of the qualities of different, constantly evolving implant systems to achieve the above goals, prompted us to this research. Using the torque test and measuring ISQ indicators during dental implantation, we compared some popular implant systems [6,8]. The data obtained by us open the door even wider in understanding the processes of osseointegration of dental implants, and allow for more predictable and rapid treatment of secondary adentia.

Keywords: torque test, ISQ - test, one-step implantation, early orthopedic load.

The aim of the study.

Compare the indicators of primary stability of implants of different implant systems during tooth extraction and immediate dental implantation.

Task:

- to determine the average indicators of the primary stability of the implant (torque) with immediate implantation;

- determine the average ISQ (Implant Stability Quotient);

- to study the dynamics of ISQ changes within 90 days;

- compare the obtained data.

Materials and methods.

The study selected 27 patients of different ages, genders, and social status with two or more hopeless teeth or roots on both jaws without signs of acute inflammation. All patients underwent surgical removal of the tooth with simultaneous dental implantation of different implant systems simultaneously. Only molars of the upper or lower jaw were taken for comparison.

For comparison, samples of currently popular in Ukraine dental implants from different manufacturers and price segments but close in size were selected, namely: dental implants Vitaplant VPKS 5.0x8 mm, dental implants MegaGen AnyRidge 5.5x7 mm and dental implants Alpha Dent Superior Active 5.5x6.75 mm. These implants are positioned by manufacturers as optimal for single-stage implantation with the possibility of early or immediate loading.

To determine the primary stability at the time of surgery, a torque test was used, ie the value of the resistance during implant installation was recorded (in Newtons per cm2) and the ISQ (Implant Stability Quotient) was measured using a Penguin RFA with

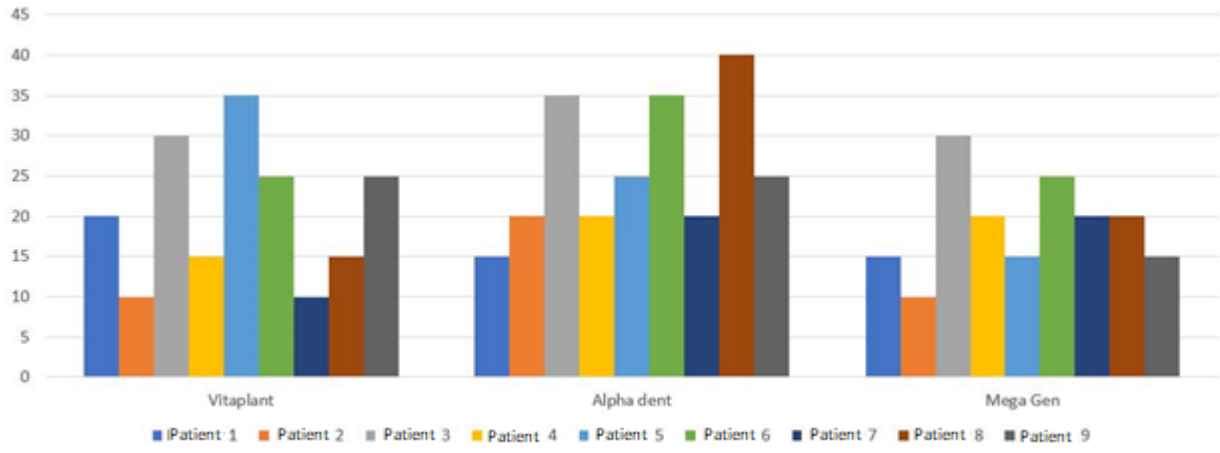
a standard multi-spot. During dental implantation in all cases, a gum shaper was installed immediately. Further observation was performed for 90 days, by control measurements of ISQ values every 14 days.

Research results and their discussion.

1. Determination of the average indicators of the primary stability of the implant (torque) with immediate implantation.

We operated on 27 patients, each of whom, according to different indications, had at least two molars removed at the same time and at least two implants from different manufacturers were installed at the same time (Fig. 1-4). At the time of implant placement, the values of the implant resistance force (in Newtons per cm2) were recorded, and the obtained data are shown in Table (1.

	PATIENT 1	PATIENT 2	PATIENT 3	PATIENT 4	PATIENT 5	PATIENT 6	PATIENT 7	PATIENT 8	PATIENT 9
Vitaplant	20	10	30	15	35	25	10	15	25
Alpha dent	15	20	35	20	25	35	20	40	25
Mega Gen	15	10	30	20	15	25	20	20	15



Tab. 1. The value of the resistance force (torque) in one-step implantation.

The value of the torque is crucial when deciding to install a gum shaper and early orthopedic load [3,4,5]. These values cannot be used as the main argument in judgments about the stability of the implant because there is no possibility to check them in the future. But comparing different implants at the same time during a similar procedure in the same patient, and most importantly recording the results in each case and compiling statistics, you can clearly trace the pattern and sequence of the range of torque values in different implant systems. Which directly indicates the effectiveness of their design and surface shape.

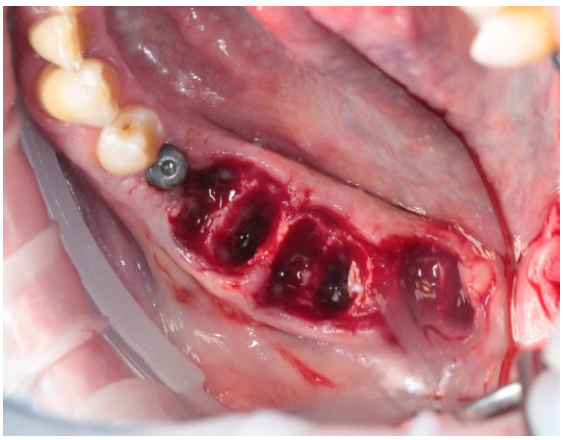


Fig. 1. Atraumatic tooth extraction 46,47,48 with preservation of cortical walls and interradicular septum.

Fig. 2. Simultaneous implantation of various implant systems.

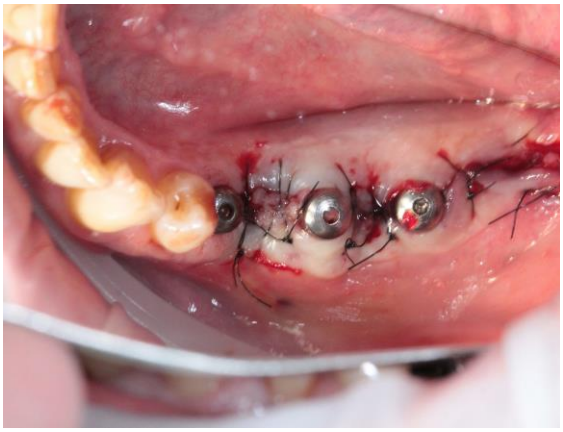


Fig. 3. Installation of gum formers, condition after suturing the wound.

Fig. 4. The condition of the wound on the 14th day after surgery.

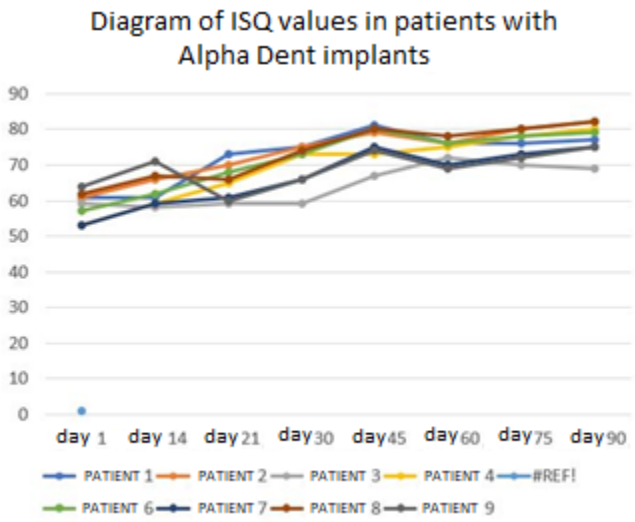
2. Dynamics of ISQ changes within 90 days;

In contrast to the torque values at the time of implantation, the dynamics of changes in osseointegration (implant stability quotient), which we recorded every 14 days, reveals a more interesting picture of osseointegration over 90 days.

For all patients who had dental implants installed by the German company Alpha Dent Implants GmbH, we recorded significantly higher ISQ values (Fig. 5), in contrast to other systems. This is partly due to the design of the standard multi-spot that comes with the Penguin RFA device, as it visually marks its most successful fit in the platform of this line of implants. But the aim of our work is to compare not specific numerical values, but the dynamics of growth of ISQ - as the main criterion for the rate of osseointegration, and this, according to many researchers [2,7,9], is crucial in

comparing different implant systems, because fast the dynamics of osteointegration is an absolute indicator of the successful structural and geometric shape of the implant in combination with the peculiarities of the microstructure of its surface.

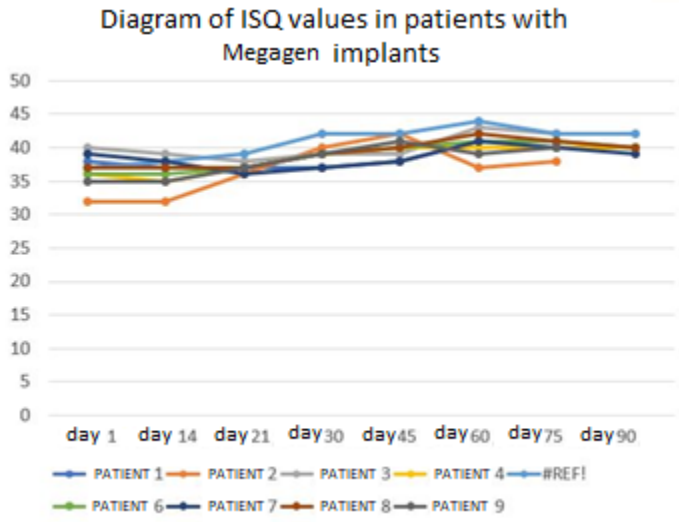
From the obtained data, the growth of ISQ is clearly traced during the first 14 days, which probably indicates the effect of straightening the spongy bone [1]. From 14 to 21 days, a certain regression in stability is recorded, which may indicate the activation of osteoclasts and active restructuring of the bone matrix around the implant. From the 21st to the 45th day we can observe a uniform and rapid dynamic growth of the implant stability. It should be noted that the speed of this stage, most likely, confirms the quality of interaction of the implant surface with osteoblasts which in these terms turn the constructed protein matrix into a full-fledged, though not fully mature bone tissue. 45-60 days are marked by a slight decrease in ISQ, which confirms the completion of osteoclasts and the beginning of active mineralization of the newly formed bone.90 each.



TRACKING DAY	Patient 1	Patient 2	Patient 3	Patient 4	Patient 5	Patient 6	Patient 7	Patient 8	Patient 9
1	61	61	59	53	64	62	53	60	62
14	61	66	58	59	71	68	59	67	67
21	73	70	59	65	60	73	61	75	66
30	75	75	59	73	66	80	66	81	74
45	81	79	67	73	74	76	75	81	80
60	76	76	72	75	69	78	70	77	78
75	76	80	70	78	72	79	73	77	80
90	77	82	69	80	75	62	75	80	82

Fig. 5. Diagram and numerical table of ISQ values obtained within 90 days in patients with simultaneous implantation of Alpha Dent Superior Active 5.5x6.75 mm implants.

Figure 6 shows the ISQ values on Korean implants MegaGen AnyRidge dynamics of which is slightly different from the previous group. From the moment of installation and up to 21 days, stable, slightly regressive dynamics is observed. From days 21 to 45, we observed an increase in ISQ values in all patients. The maximum peak values, in contrast to the data on Alpha Dent, is observed at 60 days, in our opinion, this trend is associated with a wider body of the thread, where the formation of bone between turns takes a little more time. It should be noted that the dynamics of growth of the ISQ indicator on the graphical chart strongly correlates with the data, which leads the manufacturer in its research, which further proves the objectivity of the data.

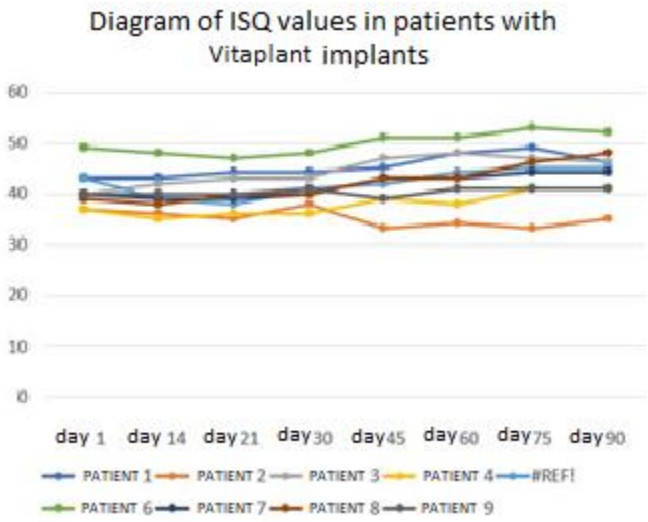


TRACKING DAY	Patient 1	Patient 2	Patient 3	Patient 4	Patient 5	Patient 6	Patient 7	Patient 8	Patient 9
1	38	32	40	36	37	36	39	37	35
14	37	32	39	35	38	36	38	37	35
21	37	36	38	37	39	37	36	37	37
30	37	40	39	39	42	39	37	39	39
45	38	42	39	40	42	40	38	40	41
60	41	37	43	40	44	41	41	42	39
75	41	38	42	40	42	41	40	41	40
90	38	40	39	40	42	40	39	40	39

Fig. 6. Diagram and numerical table of ISQ values obtained within 90 days in patients with simultaneous implantation of MegaGen AnyRidge 5.5x7 mm implants.

Figure 7 shows the data obtained from Vitaplant VPKS 5.0x8 mm. In general, the picture is similar to the previous group of implants. The main difference is only a slightly greater dispersion of data. In the graphical diagram, we observe a greater scatter

of data, which in our opinion is evidence that the geometry of the implant surface is not so much, compared to previous implant systems described above, compresses bone tissue. In other words, in our opinion, the implant is not "aggressive" enough and in I and II bone biotypes behaves less stably. Nevertheless, the data are quite comparable, as the dynamics of ISQ values is almost completely correlated with the previous groups.



TRACKING DAY	Patient 1	Patient 2	Patient 3	Patient 4	Patient 5	Patient 6	Patient 7	Patient 8	Patient 9
1	43	37	40	37	43	49	40	39	40
14	43	36	42	35	39	48	39	38	40
21	44	35	43	36	38	47	39	40	40
30	44	38	43	36	41	48	40	40	41
45	45	33	47	39	42	51	43	43	39
60	48	34	48	38	44	51	43	43	41
75	49	33	47	41	45	53	44	46	41
90	46	35	46	41	45	52	44	48	41

Fig. 7. Diagram and numerical table of ISQ values obtained within 90 days in patients with single implantation Vitaplant VPKS 5.0x8 mm.

Conclusions.

Based on the analysis of the data presented above, comparing different implant systems, we can draw the following conclusions:

1. The average values of the primary stability of the implant (torque) for all implant systems range from 10 to 35 N \ cm2. No decisive statistical differences were recorded. However, it should be noted that under identical conditions, a slightly greater value of the torque can be developed with the help of Alpha Dent Superior Active implants, which also confirms the experiment of the

geometric shape of different structures of dental implants and their ability to counter immersion forces.[reference to the first article “Comparative characteristics of the properties of dental implants depending on the design, shape and surface in the experiment”].

2. The behavior of implants installed in the same period of time, under the same conditions, the same patients were different, which revealed the main differences between different implant systems. If we compare the curves in Figure 8, we can clearly see that the Mega Gen and Vitaplant implants behave almost identically, and the Alpha Dent implant clearly shows a more positive dynamics in engraftment. Under the same initial positions, the latter, significantly increases the stability, and from 45 to 90 days with a slight regression, but is fixed at these values. In our opinion, it is the non-traditional form of the implant in combination with the active hydrophilic surface (wet implant) that made it possible to activate the osteoblast-osteoclast complex in the early stages and achieve such results.

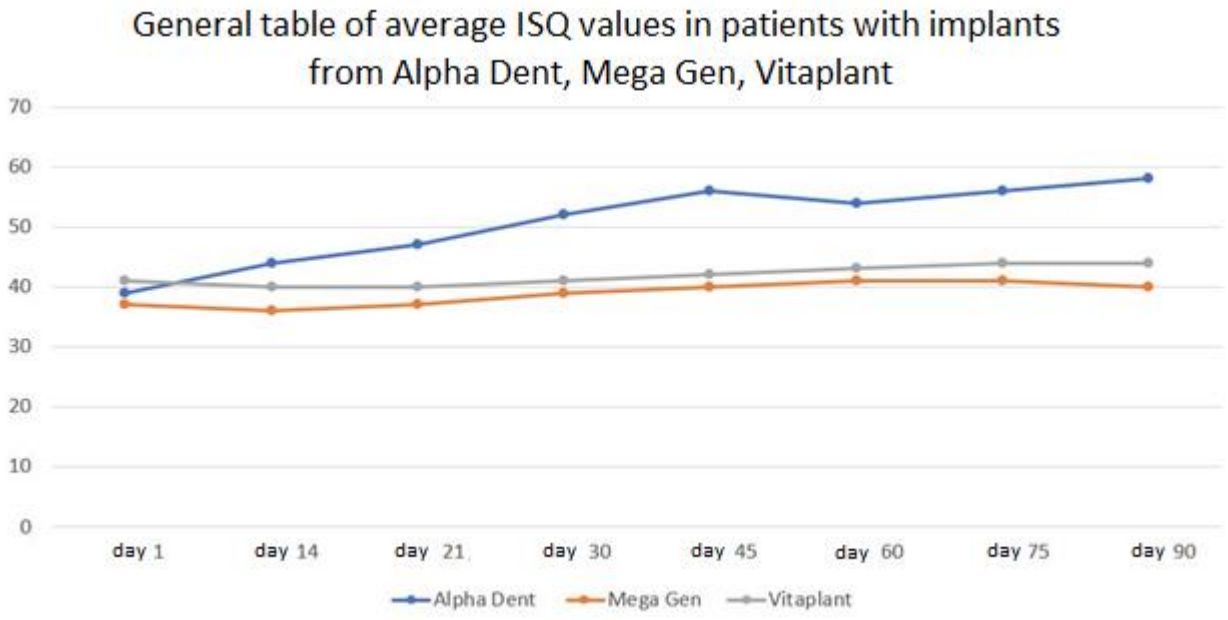


Fig. 8. Diagram of mean ISQ values obtained over 90 days in patients with simultaneous implantation of Vitaplant VPKS, Mega Gen AnyRidge and Alpha Dent Superior Active systems.

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