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Research Article

PRIMARY STABILIZATION OF DENTAL IMPLANTS ACCORDING TO BONE STRUCTURE

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ABSTRACT

On the study research was aimed to increase the treatment outcome and reduce the number of complications of dental implant surgery based on using navigating system that is error free and gives high prognosis of getting primary stability of an implant. The prospective study involved 12 patients aged 30 to 65 years. The patients were treated as outpatients at the Department of Oral surgery and dental implantology of the Tashkent state dental institute. Dental implant navigation system is worthy of recommendation. In accordance with the developed criteria for evaluating the effectiveness, it was found that the statically computer-assisted approach improves the accuracy of implant placement.

KEYWORDS

Surgical guide, R2GATE system, primary stability, 3D templates.

INTRODUCTION

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Today's is one of the most dynamic sections of dentistry dealing with the treatment of edentulous of various origins is dental implant surgery. Since the fundamental discoveries at the institutes of Lund and Gothenburg, clinicians and scientists have been continuously working to find the optimal size, micro and macrostructure, the optimal number of implants to be installed, surgical protocols, the timing of implantation with subsequent prosthetics. The indications for the use of dental implants have expanded. [8]

To increase the treatment outcome and reduce the number of complications, many approaches based on different principles and varying degrees of complexity have been proposed.

Data collection, planning, implementation of high-precision interventions using Navigating systems are currently the leading directions in dentistry [1].

It is known that the prognosis of the result of a dental implant operation directly depends on many factors, such as the location of the implant relative to adjacent teeth, other implants, anatomical structures (mandibular canal, maxillary sinus), characteristics of bone tissue in the area of the implant [2]. Under favorable conditions, the intervention does not cause any special problems for the doctor and risks for the patient. However, in those clinical situations where the operating conditions are unfavorable, there are extended defects in the dentition, or complete adentia of the jaw, the risk of complications increases [3].

The manufacture of an orthopedic structure and the rehabilitation of the patient is the main goal of the intervention, it requires high accuracy in the installation of implants. For this, classical surgical templates are traditionally used, which are an orthopedic guideline for implantation, indicating only the axial direction preferred by the orthopedist for installing a future crown or support for various kinds of structures. [1,6]

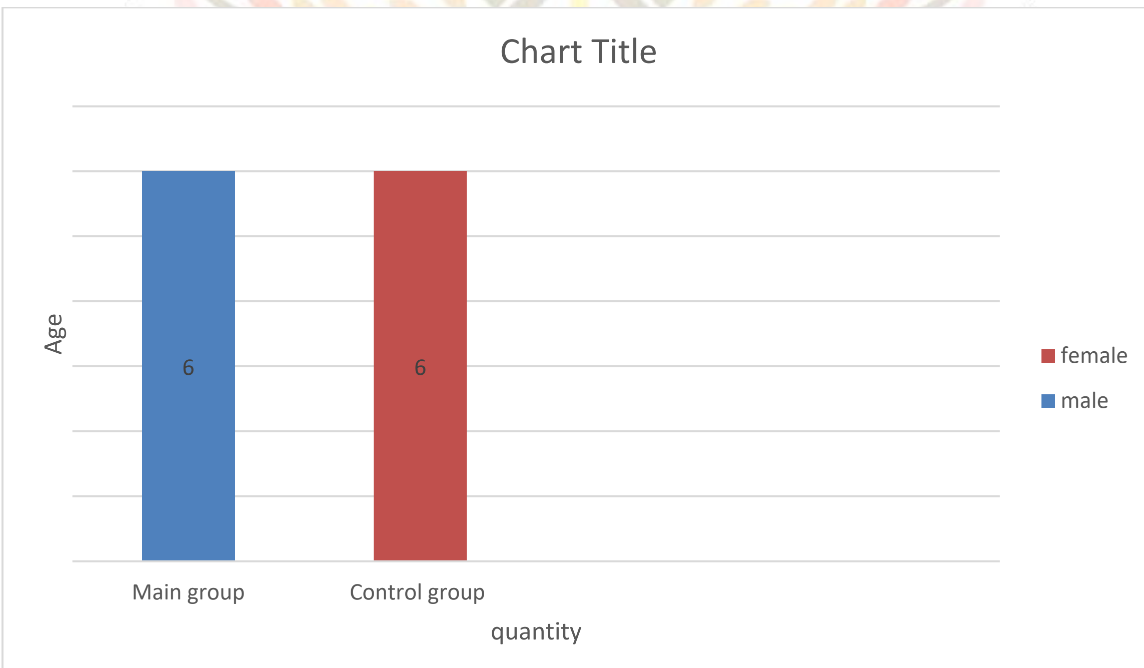
The main disadvantages of the classic guides is that its manufacture does not take into account the topography of the bone base (the physical parameters of the alveolar process, its angular direction, the presence of anatomical formations). This means that the doctor intraoperatively changes the parameters set by the template, which leads to complexity at the stage of prosthetics and increases the risk of complications in the long-term period, up to the loss of the implant and adjacent bone[4,6].

It is known that the use of navigation systems and positioner templates to increase the accuracy of intraosseous implantation is not a new development. Specialists used this method earlier, using software, computing and technical means available at that time [9,11]

At the moment, the potential of the total volume of the above-mentioned tools allows you to perform calculations and produce positioner templates with high accuracy. Some major manufacturers of endosseous implant systems use the principle of automated design systems in data collection, calculations and production of surgical templates. However, the software is not open to add-ons, and the systems are designed to be used only with the manufacturer's implants, or updates to the database of physical virtual models are carried out by the software manufacturer, which limits the practitioner's choice and preferences. In addition, the programs have a weak diagnostic potential, as well as limited computational and functional capabilities [5,6]

MATERIALS AND METHODS

The prospective study involved 12 patients aged 30 to 65 years. The patients were treated as outpatients at the Department of Oral surgery and dental implantology of the Tashkent state dental institute. Of these, 6 patients in whom treatment planning and surgery for the installation of osseointegrated implants were carried out using the traditional free-hand method constituted the control group. 6 patients made up the main group, where statically virtually assisted surgery was used to plan and perform the operation (Fig. 1).



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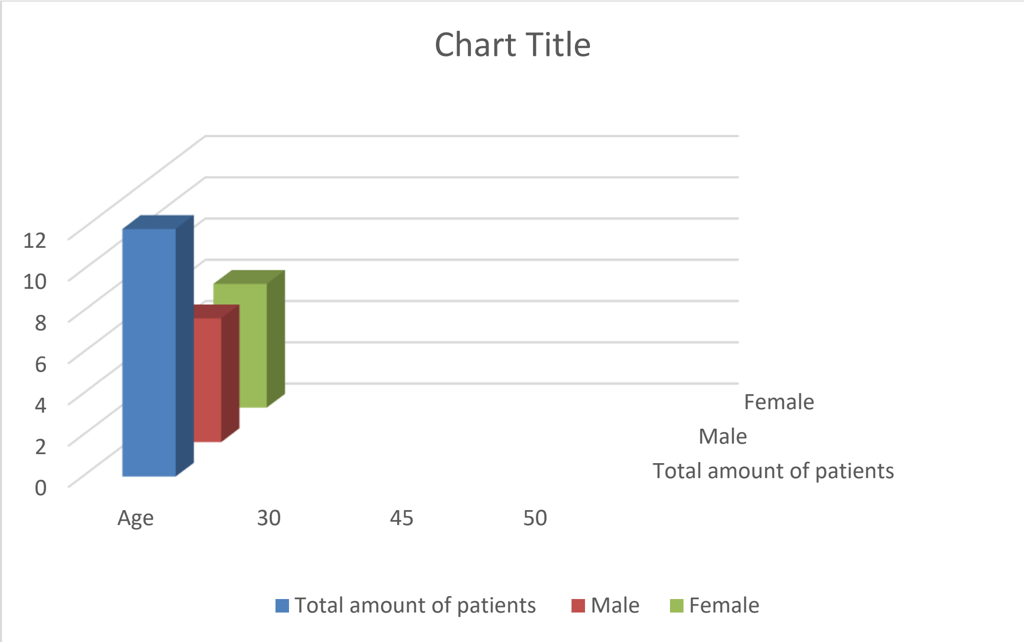

Fig.1. Distribution of patients by groups

The study included somatically healthy patients or those with a compensated somatic status, with a diagnosis of primary or secondary, partial or complete adentia of the upper or lower jaw, who were shown orthopedic rehabilitation with the support of the structure on osseointegrable implants. The exclusion criteria were contraindications to dental implantation.

At the stage of patient selection, a set of diagnostic measures was carried out to determine the presence of indications and contraindications for dental implantation.

A general clinical examination was carried out, the examination of patients began with a survey: identified complaints, timing and causes of tooth loss, anamnesis of life, as well as the presence of somatic pathology. The external examination included visual assessment of the face, palpation of regional lymph nodes and soft tissues of the face. In the oral cavity, the teeth, mucosa were examined membranes of the oral cavity, gums, alveolar processes and palate, were evaluated the state of oral hygiene, determined the form of bite, localization dentition defects. After clinical and instrumental examination patients were recommended treatment plans that included dental implantation. In order to plan implant treatment within the framework of the presented research, all patients underwent cone-beam computed tomography with a scanning field 10*8.5 cm on Pax i3D-Smart device (Vatech, South Korea). The image capture area included the mandible and maxilla, as well as the alveolar bays of the maxillary sinuses. Tomographic data were obtained in the form DICOM files on CDs, flash drives or email, which were subsequently processed in a specialized program Ez3D Plus. When performing computed tomography, this device simultaneously automatically reproduced panoramic zonograms of the jaws (OPTG), which were analyzed in comparison with CBCT to evaluate the effectiveness of the latter. It is important to note that obtaining two x-rays at once studies in a single scan has significantly optimized radiation exposure to the patient.

On cone-beam computed tomography, the state of the dentoalveolar system and maxillary sinuses was assessed in the axial, coronary and sagittal planes in multiplanar mode, as well as on panoramic reformats.

Standard laboratory diagnostics before dental implantation was carried out in the Department of Oral surgery and dental implantology of the Tashkent state dental institute: general and biochemical blood tests, markers of hepatitis A, B and C, syphilis, HIV. All patients signed a voluntary informed consent protocol drawn up in accordance with the Helsinki Declaration of the World Medical Association.

Among patients in the control group, there were 6 women and 6 men. The main group consisted of 6 men and 6 women. The distribution of patients by sex and age is presented in Table.

Table 1.

Distribution of patients by sex and age in the control group

Age	30	45	50
Male	2	2	2
Female	2	2	2

RESULTS AND DISCUSSIONS

The findings of 5 tests obtained using the implant navigation system (Table 1) In total, 10 implant positions were matched to preoperative planning in vitro. In the 5 tests, we observed that increasing the frequency of use of the system shortened the operating time. The total, longitudinal, and angular errors obtained according to the deviation definition in the 5 tests are listed in Table 2.

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Table 1 Deviation of the total, longitudinal, and angular errors in the 5 drilling tests.

	1st		2nd		3rd		4th		5th		P-value[a]	Multiple comparison
	Mean ± SD	95%CI	Mean ± SD	95%CI	Mean ± SD	95%CI	Mean ± SD	95%CI	Mean ± SD	95%CI		
Total error	1.36 ± 0.56	1.18–1.55	1.12 ± 0.52	0.94–1.30	1.26 ± 0.45	1.07–1.44	1.33 ± 0.41	1.15–1.51	1.29 ± 0.55	1.11–1.47	0.3940	
Longitudinal error	1.66 ± 0.99	1.38–1.92	0.98 ± 0.81	0.70–1.25	1.14 ± 0.53	0.87–1.41	0.84 ± 0.75	0.57–1.11	0.77 ± 0.63	0.50–1.05	<0.0001[b]	1st vs 4th (0.0335) 1st vs 5th (0.0142)
Angular error	3.68 ± 1.28	3.24–4.12	3.08 ± 1.37	2.63–3.51	3.05 ± 1.08	2.60–3.48	2.77 ± 1.05	2.33–3.21	2.67 ± 1.26	2.24–3.11	0.0164[b]	1st vs 2nd (0.0060) 1st vs 4th (0.0005) 1st vs 5th (0.0001)
Elapsed time	90		78		72		67		56			

CI: Confidence level.
[a] Using one-way ANOVA.
[b] Tukey–Kramer HSD.

Table 2 Deviation of total, longitudinal, and angular errors between the maxillary and mandible.

	Maxillary		Mandible		P-value
	Mean ± SD	95%CI	Mean	95%CI	
Total error (mm)	1.33 ± 0.43	1.21–1.45	1.21 ± 0.56	1.09–1.32	0.1501
Longitudinal error (mm)	0.87 ± 0.68	0.69–1.05	1.29 ± 0.88	1.11–1.46	0.0012[a]
Angular error (degrees)	3.18 ± 1.21	2.89–3.46	2.92 ± 1.28	2.64–3.21	0.2147

CI: Confidence level.
[a] Students' *t* test.

The average deviation of total, longitudinal, and angular errors of boreholes created using the R2GATE system were respectively 1.36 ±0.56 mm,1.66 ± 0.99 mm, and 3.68 ±1.28 in the first test; 1.26 ±0.45 mm, 1.14 ±0.53 mm, and3.05 ±1.08±in the third test; and 1.33 ±0.41 mm,0.84 ±0.75 mm, and 2.77 ±1.05±in the fourth test. By the fifth test, the average deviation provided information on the implantation accuracy; these corresponding values in the fifth test were 1.29 ±0.55 mm, 0.77 ±0.63 mm, and2.67 ±1.26±. In addition, the result of the comparison among the 5 tests revealed that the longitudinal and angular errors, but not the total error, differed signifificantly among the 5 tests (P <0.0001 for the longitudinal error and PZ0.0164 for the angular error). The one way R2GATE and Tukeye Kramer HSD tests also revealed that the longitudinal and angular errors differed significantly among the 5 tests. The deviation of the total, longitudinal, and angular errors in the maxilla and mandible (Table 2) , longitudinal, and angular errors were respectively 1.33 ±0.43 mm, 0.87 ±0.68 mm, and 3.18 ±1.21±in the maxilla and 1.21 ±0.56 mm,1.29 ±0.88 mm, and 2.92 ±1.28±in the mandible. The same level of accuracy could be obtained between the maxilla and mandible by using the R2GATE dental navigation system.

CONCLUSION

Analysis and comparison of resource costs in the manufacture of surgical templates in the study groups revealed that the use of the proposed method is much more effective for obtaining primary stabilization and future orthopedic design due to advance virtual planning. The R2GATE dental implant navigation system is worthy of recommendation. In accordance with the developed criteria for evaluating the effectiveness, it was found that the statically computer-assisted approach improves the accuracy of implant placement, but requires more time to manufacture the positioner template.

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