

## SURGICAL 3D NAVIGATION TEMPLATES IN IMMEDIATE DENTAL IMPLANT: EFFECTIVENESS OF APPLICATION

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**Abstract.** *Treatment of edentulism has always been relevant, but the requirements for treatment techniques constantly grow. A few decades ago it was sufficient to compensate the defect of a missing tooth, currently it is necessary to perform prosthetics adequately, aesthetically, atraumatically and promptly. To solve all these problems, modern computer techniques are increasingly being used in dentistry nowadays. The use of 3D printers, intraoral scanners and new treatment options allows performing prosthetics in the area of a missing tooth on the day of extraction [1; 2].*

*Our study demonstrates that treatment of edentulism using tooth extraction and immediate dental implant technique has a number of advantages compared to the classical two-stage technology. In addition, the use of a 3D surgical navigation template significantly improves the accuracy of implant positioning, which leads to reduced complications.*

**Keywords:** *dental implantation, surgical 3D template, surgical navigation template, implantation plan, implantation complications, edentulism treatment.*

**Introduction.** Depending on the sequence of manipulations, there are several schemes for implant treatment of edentulism [1]. The first scheme is conventional consisting of two stages: at the first surgical stage an implant is placed which is followed by an integration period of 3 to 6 months (the second stage). After implant integration, the third surgical stage follows - a gingiva former is inserted; after formation and healing of the gingiva, impressions and prosthetics can be performed.

According to the second scheme, the first stage includes tooth extraction, then a healing period, and in 3-6 months, implantation and installation of a gum former is carried out within one surgical stage, followed by an integration period of 3 to 6 months, and prosthetics. According to the third scheme, the first stage includes tooth extraction, implantation and installation of a gum former within one operation. This is followed by an integration period of 3-6 months and prosthetics.

When comparing the above schemes, it is apparent that the latter scheme is more cost-effective both financially and in terms of time, since it is not necessary to wait several months for implantation after tooth extrac-

tion, respectively, the treatment period is reduced by 3-6 months [3]. Moreover, the manipulation becomes less traumatic by combining three surgical stages into one, the number of incisions and operations is reduced, the fact positively affecting the soft tissues surrounding the implant. When using 3D navigation templates during one-stage implantation, it allows achieving maximum positioning accuracy [4; 5].

**Challenges of dental implants.** Currently one of the most demanding issues of dental implantology is a long period of treatment. In fact, with the technique of delayed implantation, the entire course of treatment (from the moment the tooth is removed to its prosthetics) takes from 3 to 6 months. In addition, atrophic processes are triggered in the periodontal tissues after tooth extraction. Sufficient bone volume is an important condition for reliable attachment of the implant to the bone. Therefore, dental implants in most cases are preceded by the stage of the bone augmentation using bone grafting [6]. It should be noted that the process is different in case of immediate implants: the implant is installed immediately after a natural tooth extraction. However, this method of implantation is pos-

sible only under certain conditions, among which are the state of the dental system and the general somatic health of a patient.

Indications for immediate dental implantation [7]:

1. Tooth dystopia and indications for its removal for the purpose of prosthetics.
2. Periodontitis II and III degree with the vertical bone atrophy.
3. High motivation and desire of a patient for early surgery outcomes.
4. Elimination of the incorrect therapeutic (endodontic) treatment effects.
5. Violation of the integrity of the tooth crown.
6. Tooth injuries without bone damage.
7. Fractures of the tooth root.

Diagnosis and implantation planning are critical factors for achieving high results in implant placement and restoration of integrity and functional activity at the site of the extracted tooth [8]. Diagnostic procedures include radiography, preferably using CT (computed tomography). Based on the diagnosis, the doctor decides on further interventions. The main advantages of single-stage implantation include:

1. Reduced number of interventions and visits.
2. Prompt restoration of the functions of the chewing and speech apparatus;
3. Decreased atrophy of the alveolar process;
4. Restored aesthetics after implantation [2].

As known, the bone tissue undergoes atrophy after tooth extraction and loss of its supporting function and load in this area. At the same time, most of the atrophic processes occur in the first four years of the absence of a tooth. During the first year approximately 25% of the outer cortical plate atrophies, during the next 3 years 40% of the outer cortical plate atrophies. These changes result in the outer cortical plate shift more towards a lingual or buccal position, which manifests itself as an aesthetic defect: the concave hard and soft tissues [9].

In addition to the loss of the bone tissue in width, there is also an atrophy in height. Loss of bone tissue in height leads further to problems such as the limited choice of implant

length. In some cases, in particular with a shallow vestibule of the mouth, atrophy in height leads to a change in the depth of the vestibule. In this case, attachment of mimic muscles directly to the atrophied crest of the alveolar process can be observed. With further implantation these signs can result in ischemia and chronic injury of the soft tissues of the gingival cuff leading to the soft tissues inflammation followed by atrophy and resorption of the bone tissue surrounding the implant (mucositis and peri-implantitis). The worse the conditions before implantation, the greater the likelihood of complications during and after implantation [10].

Currently, there are different types of operations to increase the volume of the bone tissue and to improve the implant treatment outcomes. The most common options are bone grafting in the upper and lower jaws, augmentation with bone blocks, autogenous bone chips, xenogenic bone materials, etc. [6]. Open and closed sinus lifting is most often performed on the upper jaw. In addition, with insufficient bone height in the lower jaw, mobilization and lateralization of the neurovascular bundle in the mandibular canal is carried out. However, due to a large number of neurological complications, such as persistent sensory disturbance in the area of innervation, neuralgia and paresthesia, this operation is less popular among implantologists [5].

Based on the above, it can be concluded that delayed implantation leads to significant bone tissue atrophy, which in turn worsens the implant treatment outcomes creating a shortage of bone volume [10].

**The aim of the study** was to compare clinical outcomes of immediate dental implantation using surgical 3D navigation templates and the "free hand" (FH) technique, and to evaluate effectiveness of the surgical templates application for immediate implantation.

**Materials and methods.** Clinical outcomes of immediate implantation and its long-term results were analyzed in 20 patients aged 28 to 82 years. The patients were divided into two groups. In patients of the first group tooth extraction and immediate implant placement were performed using the "free

hand” technique. In patients of the second group tooth extraction and immediate implant placement were performed using a surgical 3D navigation template. A comparative analysis of the two groups performance included the following criteria: duration of the surgery, invasiveness, positioning accuracy, pain intensity in the postoperative period, degree of primary stability and osseointegration according to ISQ (Implant Stability Quotient - Implant Stability Coefficient) at the time of surgery and in 3-6 months.

**Results.** The results of immediate dental implantation in the first and second groups are as follows. In the second group, with the use of surgical templates, the duration of the operation reduced by 30%, the length of the incision and the area of gingival peeling decreased by 100% (the template allows installing an implant without additional incisions for visualization); this reduced the degree of invasiveness of the surgical intervention and significantly reduced postoperative

pain. In the first group, all patients manifested deviations from the originally planned position. In the second group, deviations from the originally planned position were registered in 30% of patients. ISQ parameters in patients of the first group were lower by 3-17 units compared with patients of the second group, the fact indicating a lower primary stability of the implants. In 3-6 months, patients of the first group had ISQ scores 5-10 units lower than those of the second group. At the same time, in both groups, the ISQ values were above 70 units, which is the evidence of high implant stability.

**Conclusion.** The use of surgical 3D navigation templates increases the efficiency of the immediate dental implant operation, which is supported by the reduced duration of the operation, increased accuracy of implant positioning, decreased invasiveness of surgical intervention, decreased postoperative pain and increased primary stability.

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### **ЭФФЕКТИВНОСТЬ ПРИМЕНЕНИЯ ХИРУРГИЧЕСКИХ НАВИГАЦИОННЫХ 3D ШАБЛОНОВ ПРИ ПРОВЕДЕНИИ ОПЕРАЦИИ ОДНОМОМЕНТНОЙ ДЕНТАЛЬНОЙ ИМПЛАНТАЦИИ**

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***Аннотация.** Тема лечения адентии остается актуальной всегда, но с каждым годом требования к методам лечения растут. Если несколько десятилетий назад было достаточно восполнить дефект отсутствующего зуба, то сегодня протезировать при отсутствии зуба нужно правильно, эстетично, атравматично и в максимально короткие сроки. Для решения всех этих задач в стоматологии все чаще применяются современные компьютерные технологии. Применение 3D принтеров, внутриротовых сканнеров и новых методов лечения позволяют протезировать в области отсутствующего зуба уже в день удаления [1; 2].*

*Проведенное исследование показало, что лечение адентии методом одномоментного удаления зуба и денальной имплантации имеет ряд преимуществ по сравнению с классическим двухэтапным методом. Также, применение хирургического навигационного 3D шаблона значительно повышает точность позиционирования имплантата, что приводит к уменьшению процента осложнений.*

***Ключевые слова:** денальная имплантация, хирургический 3D шаблон, хирургический навигационный шаблон, планирование имплантации, осложнения имплантации, лечение адентии.*