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ORIGINAL ARTICLE

CLINICAL EFFECTIVENESS OF GUIDED IMPLANT SURGERY IN PATIENTS WITH FULLY EDENTULOUS PATIENTS ATROPHY OF THE LOWER JAW

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Abstract

Objectives: The aim of this study was to evaluate the results of mandibular prosthetics based on 6 implants placed with guided surgery and immediate loading in patients with a completely edentulous mandible.

Materials and Methods: 52 patients participated in this study, referred in need of full arch implant-supported reconstructions in mandible. Jaw bones patients were diagnosed with cone beam computerized tomography. Patients were evaluated according to the results of computed tomography (CT). Computer software was used to create virtual templates for 3Diagnosys, an implant treatment. Surgical guided were made for ostectomy and for implant position using a 3D printer (Stratasys.

Implants were placed flapless implantation metho through the sleeves of the surgical template tightening torque of 35–45 Ncm.

Patients received 312 implants (64 UV functionalised short (≤6 mm) implants, 248 standard implants) 52 implant-supported prosthesis. The following parameters were assessed: implant success, prosthetics survival and changes in peri-implant marginal bone level (MBL), probe depth (PPD), and probe bleeding (BOP).

Results: After 3 months loss of the marginal bone of 0.7 ± 0.35 mm (MBL), after 12 months of observation, there was a slight loss of the marginal bone over time 1.2 ± 0.38 mm (MBL), 1,47 ± 0.42. mm (MBL), after 5 years of observation. After 5 years of observation, the average PPD was 2.42 ± 0.47 mm, the average BOP was 1.32 ± 0.85. Of the 312 implants, 3 failed to osseointegrate, 5 implants failed (peri-implantitis) after 5 years. No serious prosthetic complications have been reported. After 5 years, the effectiveness of implants was 97.4%.

Conclusion: Computer-guided implant surgery and immediate loading of implants in patients with insufficient lower jaw and completely edentulous is a predictable and effective method with a minimum rehabilitation period.

Keywords: *lower jaw implant restoration, computer guided surgery, immediate functional loading*

Introduction

The use of dental implants after toot loos one of the most prospective directions in solving this problem.[1]

The typical surgical approach to dental implants requires two steps, however, it has been proven that with sufficient bone quantity and quality after implants have been placed, they can be loaded immediately. This technique requires coordinated reconstructive and dental laboratory collaboration.[2]

One of the urgent tasks in the use of implants in patients with bone deficiency is the choice of the optimal surgical technique, since various methods are currently proposed for restoring the resorbed jaw bone: autograft reconstruction, GBR, distraction osteogenesis, bone splitting, sandwich plasty, transposition of the inferior alveolar nerve.[3-8] However, biological and technical complications have been reported, as well as side effects associated with the procedure during implant placement [9]

Over the past decade has become popular treatment planning and implant placement using guided surgery.[10-12]

The standard surgical protocol for guided implant placement includes a diagnostic step (clinical and radiographic examination), a planning step, surgical step, and prosthetic step.

The growing demand from patients for the placement of prostheses immediately after implant placement has led to the development of software to allow the planning and production of surgical guides and temporary prostheses with immediate loading of implants.[13-15]

Computed tomography (CT) scans treatment planning allows virtual planning of optimal placement of implants in three-dimensional (3D) orientation, flapless surgery according to aesthetic and functional needs, and a temporary prosthesis can be fabricated prior to surgery to provide immediate function.[16,17]

Computer-guided implant surgery allows for more precise placement of implants in jawbone deficiencies, allowing for flapless surgery, and simplifies prosthetic procedures with immediate functional loading.[18-20]

Given the relevance of the treatment of patients with an atrophied lower jaw, this study aims to evaluate the clinical and radiographic results of mandibular prostheses based on 6 implants, installed with guided surgery and immediate loading.

Material and Methods

52 patients participated in this study, referred in need of full arch implant-supported reconstructions in mandible. All patients presented functional and esthetic complaints. Patients were evaluated according to the results of computed tomography (CT). Computer software was used to create virtual templates for 3Diagnosys, an implant treatment.

General protocol of 3D surgery guide following steps:

1. obtaining a three-dimensional virtual maxillofacial model;
2. virtual implant placement planning;
3. virtual planning of surgical guide;
4. manufacturing of a surgical guide on a 3D printer.

Surgical guided were made for ostectomy and for implant position. The implants were planned to use the existing bone. In the 3 Shape Implant Studio working file, 3D computer modeling and virtual planning of surgical guides were carried out. A surgical guides modeled on a 3 Shape computer program was made of a biocompatible resin material and equipped with depth calibrated drilling sleeves to prepare the osteotomies using a 3D printer (Stratasys) (figures 1-3).

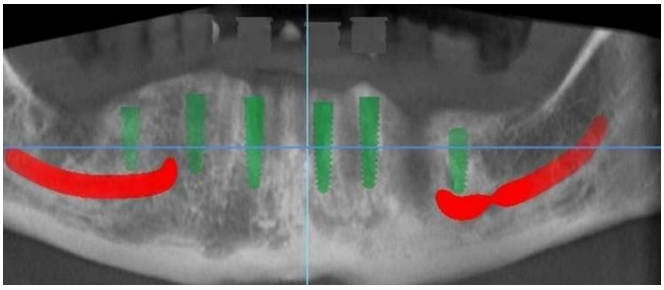

Figure 1. *The virtual positioning of the implants in the CT image software*

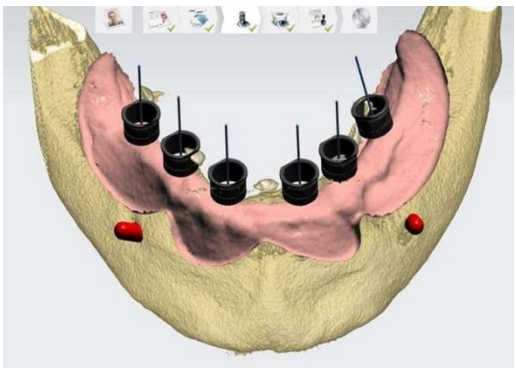

Figure 2. *The virtual positioning of the implants in the software*

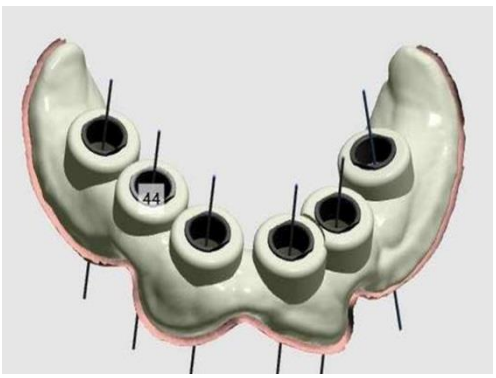

Figure 3. *Computer assisted guided design project in the lower jaw*

After checking in the oral cavity, the surgical guides were finally corrected, disinfected, immersed in a 70% ethanol solution for 20-25 minutes, then, after washing with a chlorhexidine solution, it was placed in a disinfected container and prepared for surgery.

After the surgical template was correctly positioned and stabilized, it was fixed with anchor pins in the correct position and flapless implantation was performed according to the drilling protocol for this type of implant. Implants were placed through the sleeves of the surgical template tightening torque of 35–45 Ncm. To assess the stability of implants, the resonance frequency analysis (RFA) method was used during implant placement, after 2 months. The implants stability was evaluated using Osstell Mentor device. Patients received 312 implants (64 UV functionalised short (≤6 mm) implants, 248 standard implants) 52 implant-supported prosthesis.

An implant-supported temporary prosthesis made of acrylic resin was installed 6 hours after implantation. Implant success was assessed clinically and radiographically using serial CT.

Final dental prosthetics was performed 2 months after implant placement made of metal-ceramic or zircon (figures 4, 5, 6a, 6b).

Figure 4. *Intraoral frontal view after implants placement*

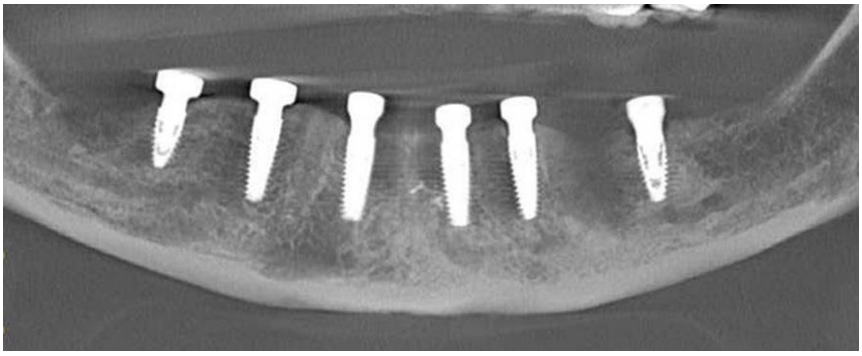

Figure 5. *Control CT image is taken after implant prosthetic rehabilitation*

Figure 6a. *Intraoral frontal view after prosthetic rehabilitation*

Figure 6b. *Extraoral frontal view after prosthetic rehabilitation*

The following parameters were assessed: implant success, prosthetics survival and changes in peri-implant marginal bone level (MBL), probe depth (PPD), and probe bleeding (BOP). Marginal bone level was assessed by digital x-ray were taken immediately (base line for comparison) and 3 months, 1 year, 3 years, and 5 years after implant installation. The patients were returned every 3 months for a maintenance appointment.

Statistical analysis

Statistical analyses were performed using SPSS software, p values < 0.05 were considered statistically significant.

Results

During a clinical examination, no serious biological or prosthetic complications have been reported. The esthetic result evaluated from patients was excellent.

The mean value RFA recordings of 312 implants were 65,2 ISQ (Implant Stability Quotient) at implant placement respectively 75,6 ISQ after 2 months.

After 6 months mean MBL short implants 0.87mm, after 1 year 1.13 mm, after 5 year was 1.48 mm. After 6 months mean MBL standard implants 0.84 mm, after 1 year 1.24 mm, after 5 year was 1.58 mm. After 5 years of observation, the average PPD was 2.42 ± 0.47 mm, the average BOP was 1.32 ± 0.85.

The CT examination showed the presence of dense bone around and above the implants. At 5 years follow up, steady levels of bone around the implants and healthy peri-implant tissues were reported. Implants were demonstrated to integrate normally; postoperative occlusal function and esthetics have been favorable. Of the 312 implants, 3 failed to osseointegrate (3 standard implants), 5 implants failed after 5 years (1 short implants, 4 standard implants). After 5 years of follow-up, stable levels of bone tissue around the implants and healthy tissues around the implants were recorded, postoperative occlusal function was favorable, the effectiveness of implants was 97.4%. The results of the study showed that treatment with implants using surgical guides improved the masticatory efficiency of the patient's acceptable quality of life, they were satisfied with the functional and aesthetic results of the treatment.

Discussion

Resorption of the alveolar bone of the mandible can complicate the treatment plan with dental implants due to the risk of damage to the anatomical structures. In such clinical cases, for predictable and effective implantation, correct diagnosis and accurate implantation planning are key factors.[21,22] In orthopedic rehabilitation of edentulous patients with the use of dental implants, the most important points are the optimization of treatment, minimal risk of complications and patient comfort.

In recent years, a protocol with immediate functional loading has been widely used in clinical practice for the rehabilitation of edentulous patients. This protocol has demonstrated the effectiveness of the treatment, giving patients the opportunity to receive a prosthesis.

According to these concepts, minimally invasive computer-assisted implant treatment protocols have the potential to revolutionize the practice of dental

implantology. The use of surgical templates can significantly reduce the time of implant placement with minimal risk of complications in the surgical stage.[23,24]

Computer-aided design and manufacturing (CAD/CAM) CBCT provides virtual surgical planning in a 3D environment, giving the practitioner a realistic view of the patient's bone anatomy, thereby allowing future surgery to be performed perfectly with precise implant placement with minimal soft tissue trauma.

The surgical template minimizes implant positioning errors, allows the prefabricated temporary prosthesis to be fixed at the planned implant position, thereby increasing patient satisfaction, including comfort, functionality and aesthetics.[25,26]

Deviation of the implant placement plan by several degrees can interfere with perfect prosthetics, the use of computer surgery is the best way to avoid these problems.[27,28]

UV photo functionalization can optimize osseointegration even with shorter implant length in bone tissue compared to non-photo functionalized implants.31 Upon photo functionalization, the titanium implant surface becomes superhydrophilic and the electrical status of the implant surface becomes positively charged.[29,30]

This prospective case series evaluated the results of a 5-year follow-up of implant placement in the mandible using a flapless technique with templates and immediate loading supporting orthopedic rehabilitation and was planned to evaluate implant survival. The study included patients with insufficient bone volume without teeth and a sufficient amount of keratinized tissue around the planned implant position.

In edentulous segments of insufficient bone volume, 64 UV functionalized short (≤6 mm) implants were placed, and in segments of sufficient alveolar bone height, 248 standard implants were placed.

Patients were subjected to clinical examination and collected anamnesis. Informed consent was obtained. A thorough clinical examination of patients was carried out to assess the size and ratio of the jaws, bone volume and occlusal connections. Initially, the protocol was planned virtually using computer planning software and guidelines were created. Study shows that computer guided surgery and the immediate loading of implants inserted into the lower jaw appear to be a viable option.

If there is a sufficient amount of keratinized gingiva in the implantation zone, the use of a flapless implant installation technique is minimized postoperative swelling, pain and discomfort, the soft tissue architecture and periosteum integrity are preserved, which contributes to better blood circulation, which will reduce bone resorption.

The use of ultraviolet functionalized (UV) short implants in the atrophied mandible and immediate loading on implants reduces the operating time and costs, making the procedure more accessible to patients. Patients were satisfied with the minimally invasive method of treatment.

A computer-controlled implant operation ensures accurate positioning of the implant with safety and has the advantage of reducing the time of surgery and optimizing the existing bone.

Conclusion

Computer guided implant surgery and immediate loading on implants represent a viable option for the immediate rehabilitations of completely edentulous lower jaws. The method significantly shortening the rehabilitation period of patients with insufficient bone tissue in the lower jaw.

Abbreviations

CT: computed tomography
CBCT: cone beam computed tomography
3D: Three-dimensional
CAD: Computer Aided Design
RFA: resonance frequency analysis
ISQ: implant stability quotient
MBL: marginal bone loss
UV: ultraviolet functionalized

Disclosure

Conflict of interest

No conflict of interest.

Consent Statement

Written informed consent was obtained from the patient for publication of this case report and accompanying images.

Ethical approval

The study was approved by the University ethics committee and was conducted in accordance with the Declaration of the World Medical Association. Informed consent Patients were informed verbally and in writing about the study and gave written informed consent.

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ՍՏՈՐԻՆ ԾՆՈՏԻ ԱՏՐՈՖԻԱՅՈՎ ԼՐԻՎ ԱՆԱՏԱՄՈՒԹՅԱՄԲ ՀԻՎԱՆԴՆԵՐԻ ՄՈՏ ՈՒՂՂՈՐԴՎԱԾ ԻՄՊԼԱՆՏԱՅԻԱՅԻ ԿԼԻՆԻԿԱԿԱՆ ԱՐԴՅՈՒՆԱՎԵՏՈՒԹՅՈՒՆԸ

Նաիրա Ղամբարյան[1]

[1] Երևանի Մ. Հերացու անվան պետական բժշկական համալսարանի բերանի խոռոչի և դիմածնոտային վիրաբուժության ամբիոնի դասախոս, Երևան, Հայաստան

Ամփոփում

Նպատակներ. Այս հետազոտության նպատակն էր գնահատել ստորին ծնոտի պրոթեզավորման արդյունքները՝ հիմնված 6 իմպլանտների վրա, որոնք տեղադրված են ուղղորդված վիրահատությամբ և անմիջական բեռնվածությամբ ամբողջովին անատամ ծնոտով հիվանդների մոտ:

Նյութեր և մեթոդներ. Ստորին ծնոտի ատրոֆիայով լրիվ անատամությամբ հիվանդների 52 հիվանդեր մասնակցել են այս հետազոտությանը, ովքեր ունեին իմպլանտի վրա հիմնված ամբողջական վերականգնման կարիք:

Հիվանդների ծնոտոսկորները գնահատվել են ըստ համակարգչային տոմոգրաֆիայի (CT) արդյունքների: Համակարգչային 3Diagnostys ծրագրաշարն օգտագործվել է իմպլանտների բուժման վիրտուալ վիրաբուժական ուղեցույցներ ստեղծելու համար: Պատրաստվել են օստեէկտոմիայի և իմպլանտացիայի վիրաբուժական ուղեցույցներ օգտագործելով 3D տպիչ (Stratasys): Իմպլանտները տեղադրվել են վիրաբուժական ուղեցույցների միջոցով՝ 35–45 Նամ ձգման մոմենտով: Տեղադրվել են 312 իմպլանտ՝ 64 կարճ (≤ 6 մմ) ուլտրամանուշակագույն ֆունկցիոնալացված իմպլանտներ, 248 ստանդարտ իմպլանտներ, 52 պրոթեզ: Գնահատվել են հետևյալ պարամետրերը՝ իմպլանտացիայի հաջողությունը, պրոթեզի գոյատևումը

և մարգինալ ոսկորի (MBL) փոփոխությունները, պերիիմպլանտային լնդի խորությունը (PPD) և և արյունահոսությունը (BOP):

Արդյունքներ. 3 ամիս դիտարկումից հետո մարգինալ ոսկորի կորուստը 0,7 ± 0,35 մմ (MBL), 12 ամիս դիտարկումից հետո մարգինալ ոսկորի կորուսըտը 1,2 ± 0,38 մմ (MBL), 5 տարվա դիտարկումից հետո 1,47±0,42մմ (MBL), 5 տարվա դիտարկումից հետո միջին PPD-ն եղել է 2,42 ± 0,47 մմ, միջին BOP-ը՝ 1,32±0,85: 312 իմպլանտներից 3-ը չհաջողվեց օսսեոինտեգրվել, 5 իմպլանտը ձախողվեց (պերիիմպլանտիտ) 5 տարի անց: Պրոթեզավորման լուրջ բարդություններ չեն գրանցվել: 5 տարի անց իմպլանտների արդյունավետությունը կազմել է 97,4%:

Եզրակացություն. Համակարգչային ուղղորդված իմպլանտացիան և իմպլանտների անհապաղ բեռնումը ծնոտի ատրոֆիայով լրիվ անատամությամբ հիվանդների մոտ կանխատեսելի և արդյունավետ մեթոդ է՝ նվազագույն վերականգնողական շրջանով:

КЛИНИЧЕСКАЯ ЭФФЕКТИВНОСТЬ УПРАВЛЯЕМОЙ ИМПЛАНТАЦИИ У ПАЦИЕНТОВ С ПОЛНОЙ АДЕНТИЕЙ И АТРОФИЕЙ НИЖНЕЙ ЧЕЛЮСТИ

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Абстракт

Цели: Целью данного исследования была оценка результатов протезирования нижней челюсти на основе 6 имплантатов, установленных с помощью хирургии по шаблонам и немедленной нагрузкой у пациентов с полной адентией нижней челюсти.

Материалы и методы: В этом исследовании приняли участие 52 пациента, нуждающихся в полной реконструкции нижней челюсти с опорой на имплантаты. Пациенты с костной тканью челюсти диагностировались с помощью конусно-лучевой компьютерной томографии. Больных оценивали по результатам компьютерной томографии (КТ). Компьютерное программное обеспечение использовалось для создания виртуальных шаблонов для 3Diagnosys, лечения имплантатов. Хирургические шаблоны для остеоэктомии и имплантации были изготовлены с использованием 3D-принтера (Stratasys). Имплантаты устанавливали методом безлоскутной имплантации через гильзы хирургического шаблона с моментом затяжки 35-45 Нсм. Пациентам было установлено 312 имплантатов (64 коротких (≤6 мм) имплантата, функционализированных УФ-излучением, 248 стандартных имплантатов), 52 протеза с опорой на имплантаты. Оценивались следующие параметры: успешность имплантации, приживаемость протезов и изменения уровня маргинальной кости вокруг имплантата (MBL), глубины зонда (PPD) и кровотечения зонда (BOP).

Полученные результаты: Через 3 мес потеря маргинальной кости 0,7±0,35 мм (МКК), через 12 мес наблюдения отмечена незначительная потеря маргинальной кости с течением времени 1,2±0,38 мм (МКЛ), 1,47±0,42. мм (MBL), через 5 лет наблюдения. Через 5 лет наблюдения средний ППД составил 2,42 ± 0,47 мм, средний BOP — 1,32 ± 0,85. Из 312 имплантатов 3 не смогли остеоинтегрироваться, 5 имплантатов вышли из строя (периимплантит) через 5 лет. О серьезных протезных осложнениях не сообщалось. Через 5 лет эффективность имплантатов составила 97,4%.

Заключение: Компьютерная управляемая имплантация и немедленная нагрузка имплантатов у пациентов с полной адентией и атрофией нижней челюсти является предсказуемым и эффективным методом с минимальным реабилитационным периодом.