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Short versus Standard Length Implants with Sinus Floor Elevation for the Atrophic Posterior Maxilla

Kratki implantati nasuprot implantatima standardne dužine uz podizanje dna sinusa u slučaju atrofične stražnje maksile

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Abstract

Objectives: the aim of this clinical study was to compare clinical and radiological outcomes of short dental implants inserted in pristine bone to standard length implants inserted in combination with sinus floor elevation. **Materials and methods**: For this clinical study, the clinical and radiological outcome of 126 short dental implants (84 patients), inserted in pristine bone were compared with 312 standard length implants (156 patients), placed in combination with maxillary sinus floor elevation procedures. **Results**: The short implant group (test group [TG]; mean follow-up (± standard deviation (SD) 56.6 ± 42.9 months) and the augmented group (control group [CG]; mean follow-up 41.6 ± 37.6 months) showed cumulative survival rates of 91.8% and 92.4%. Cumulative 5-year implant survival rates were 91.8% for the TG and 90.7% for the CG (p=0.421). Mean marginal bone loss was significantly higher in the CG than in the TG, with a mean MBL of 0.70 ± 0.72 mm in the TG and 0.96 ± 0.91 mm in the CG (p<0.001). A comparable and promising oral health-related quality of life (OHRQoL) was observed in the control and test groups. **Conclusions**: After over 3 years, short implants placed in the resorbed posterior maxilla obtained similar results to standard implants combined with maxillary sinus floor augmentation procedures.

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Introduction

Dental implant therapy has proved to be a predictable and viable option for the prosthetic rehabilitation of the edentulous jaw, even in medically compromised patients (1-5). Furthermore, the rehabilitation achieved by dental implants seems to contribute to an increased oral health-related quality of life (6). The edentulous atrophic maxilla is a challenge which clinicians have to cope with when planning implants. The loss of teeth in this region leads to adaptive changes and morphological remodeling of the bone tissue with reduction of the alveolar ridge in vertical and horizontal dimensions (7). In the resulting atrophic posterior maxilla, it is not always feasible to use standard length implants. Clinicians must decide which technique to use to compensate for the bone loss. One option often used is the application of maxillary sinus floor elevation (SFE) in combination with implants of conventional length. This method is still regarded as gold

Uvod

Terapija dentalnim implantatima pokazala se predvidljivom i održivom opcijom za protetičku rehabilitaciju bezube čeljusti, čak ako su pacijenti medicinski kompromitirani (1 – 5). Nadalje, čini se da rehabilitacija postignuta dentalnim implantatima pridonosi povećanju kvalitete života povezane s oralnim zdravljem (6). Bezuba atrofična maksila izazov je koji kliničari moraju riješiti pri planiranju implantoprotetičke terapije. Gubitak zuba u toj regiji rezultira adaptivnim promjenama i morfološki se remodelira koštano tkivo, uz smanjenje alveolarnoga grebena u vertikalnoj i horizontalnoj dimenziji (7). U atrofičnoj stražnjoj maksili nije uvijek moguće upotrijebiti implantate standardne dužine. Kliničari moraju odlučiti kojom će tehnikom nadoknaditi gubitak kosti. Jedna od mogućnosti koja se često primjenjuje jest podizanje dna maksilarnoga sinusa u kombinaciji s implantatima konvencionalne dužine. Ta se metoda još uvijek smatra zlatnim stan-

standard (8). Applying this technique, it is possible to achieve survival rates over 90% in long-term evaluations (7). However, regardless of the well documented long-term effectiveness of SFE, this invasive procedure involves several disadvantages such as increased cost and treatment duration, risk of infections, post-operative sinusitis, and limited amount of bone gain. Additionally, it is technically more complex and the outcome is dependent on the operator's skills (7). Considering these factors, the patient might refrain from undergoing the surgical procedure of SFE (9).

Another option to overcome the problem of bone deficiency is using implants with a shorter length alternatively in order to avoid bone-augmenting operations altogether. Choosing short implants and to resign from augmentative surgery, will reduce the treatment time, the cost and morbidity for the patient, which could lead to higher patient compliance and satisfaction (6, 9-18).

A reduced vertical dimension of short implants has direct consequences regarding the static properties. In most cases, the clinical crown-to-implant ratio (C/IR) is increased in short implants, compared to implants with standard length. This results from a reduced intraosseous length of short implants, and an increased length of the crown, which is necessary to compensate for the reduced height of the atrophic alveolar ridge. While some studies show that an increased C/IR has no significant influence on survival rates (19-21), there are other reports which have reached the opposite conclusion (22). Regardless of its static properties, an increased crown length often does not produce a desirable esthetic outcome (7).

Existing studies suggest comparable survival and success rates for short and long dental implants (13, 14, 23, 24). In addition, the implant length does not seem to influence levels of osteoimmunological and microbiological markers in peri-implant tissues and survival rates (25). The results of some study further imply that there is even a smaller marginal bone loss (MBL) around short implants compared to long implants (7). There are not many studies providing evidence of longer follow-up time and larger sample sizes for short implants compared to long implants with surgical augmentative procedures. Consequently, there is only a limited number of meta-analyses showing superior survival rates for either. The results of the current study are promising regarding survival rates of short implants. Finally, a universally used and formalized definition of short implants has not yet existed in the literature. The definition for short implants is still ambiguously used in published studies and varies between <=10.5 and <=6mm (10). However, implants with an intraosseous length of 8mm or less were classified as short implants at the first European Association for Osseointegration (EAO) consensus conference (26).

In conclusion, the aim of this clinical study was to investigate clinical and radiological outcomes of short dental implants inserted in pristine bone and to compare them to standard length implants inserted in combination with sinus floor elevation.

dardom (8). Njezinom se primjenom može postići stopa preživljenja viša od 90 % u dugoročnim analizama (7). No bez obzira na dobro dokumentiranu dugoročnu učinkovitost podizanja dna sinusa, taj invazivni postupak ima nekoliko nedostataka kao što su povećanje cijene i trajanja liječenja, rizik od infekcija, postoperativni sinusitis, ograničena količina dobivene kosti, tehnički složen postupak i činjenica da ishod ovisi o vještinama operatera (7). S obzirom na te čimbenike, pacijent bi mogao odbiti podvrgnuti se takvome kirurškom zahvatu (9).

Druga mogućnost prevladavanja problema nedostatka kosti jest alternativna upotreba kraćih implantata kako bi se potpuno izbjegla operacija u svrhu augmentacije kosti. Odabir kratkih implantata i izbjegavanje augmentativnoga kirurškoga zahvata skraćuje vrijeme liječenja, trošak i morbiditet kada je riječ o pacijentu, što bi moglo potaknuti bolju suradnju i veće zadovoljstvo pacijenta (6, 9 – 18).

Smanjena vertikalna dimenzija kratkih implantata izravno utječe na statička svojstva. U većini slučajeva kod kratkih implantata povećan je klinički omjer krune i implantata (C/IR) u usporedbi s implantatima standardne dužine. To je posljedica smanjene intrakoštane dužine kratkih implantata te povećane dužine krunice, što je potrebno da se nadoknadi smanjena visina atrofičnoga alveolarnoga grebena. Dok autori nekih istraživanja ističu da povećani C/IR ne utječe znatno na stope preživljenja (19 – 21), postoje i druga izvješća sa suprotnim zaključcima (22). Bez obzira na statička svojstva, povećanom dužinom krunice često se ne postiže željeni estetski rezultat (7).

Dosadašnja istraživanja upućuju na usporedive stope preživljenja i uspješnosti kratkih i dugih dentalnih implantata (13, 14, 23, 24). Uz to, čini se da dužina implantata ne utječe na razinu osteoimunoloških i mikrobioloških biljega u periimplantacijskim tkivima, a ni na stope preživljenja (25). Neki rezultati istraživanja impliciraju pak da postoji čak i manji marginalni gubitak kosti (MBL) oko kratkih implantata u usporedbi s dugima (7). Nema mnogo istraživanja s duljim praćenjem i većim uzorkom za kratke implantate u usporedbi s dugim implantatima s kirurškim augmentativnim zahvatima. Posljedično, postoji samo ograničeni broj metaanaliza koje pokazuju bolje stope preživljenja i za jedne i za druge. Kada je riječ o stopi preživljenja kratkih implantata, istaknimo da dosadašnji rezultati istraživanja obećavaju. U literaturi još uvijek ne postoji univerzalno korištena i formalizirana definicija kratkih implantata. Definicija kratkih implantata u objavljenim istraživanjima varira između < = 10,5 i < = 6 mm (10). No na 1. Konsenzusnoj konferenciji Europskoga udruženja za osteointegraciju (EAO) kao kratki implantati klasificirani su oni s intrakoštanom dužinom od 8 mm ili manje (26).

Zaključno, cilj ovoga kliničkoga istraživanja bio je usporediti kliničke i radiološke rezultate kratkih dentalnih implantata ugrađenih u intaktnu kost s implantatima standardne dužine ugrađenima u kombinaciji s podizanjem dna sinusa.

Materials and methods

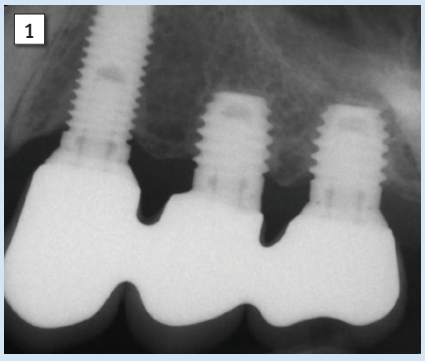
Study design

This retrospective study investigated clinical and radiological outcomes of 126 short dental implants (≤8 mm, 84 patients), inserted in pristine bone and 312 standard length implants (>8 mm, 156 patients), inserted in combination with maxillary sinus floor elevation (Figure 1 and Figure 2). The study was conducted in accordance with the Helsinki declaration and the protocol was approved by the Ethics Committee of Rhineland-Palatinate, Germany (Registration number: 2019-14414, Landesärztekammer Rheinland-Pfalz). Patients presenting themselves with an edentulous posterior maxilla and reduced residual vertical bone height received detailed information about both treatment concepts and the associated advantages and disadvantages of both treatments. After each patient had decided for one of the treatment options, the implants were placed by experienced surgeons in the Department of Oral and Maxillofacial Surgery of the University Medical Centre Mainz, Germany, between January 2003 and December 2018.

Materijal i metode

Studijski dizajn

U ovom retrospektivnom istraživanju uspoređivali su se klinički i radiološki rezultati 126 kratkih dentalnih implantata (≤ 8 mm, 84 pacijenta) ugrađenih u intaktnu kost s 312 implantata standardne dužine (> 8 mm, 156 pacijenata) ugrađenih u kombinaciji s podizanjem dna maksilarnoga sinusa (slike 1. i 2.). Istraživanje je provedeno u skladu s Helsinškom deklaracijom, a protokol je odobrio Etički odbor njemačke pokrajine Falačko Porajnje (Rhineland-Pfalz) (registracijski broj: 2019-14414, Landesärztekammer Rheinland-Pfalz). Pacijenti koji su imali bezubu stražnju maksilu i smanjenu preostalu vertikalnu visinu kosti dobili su detaljne informacije o oba koncepta liječenja te s time povezanim prednostima i nedostatcima. Nakon što se svaki od njih odlučio za jednu od mogućnosti liječenja, implantate su, između siječnja 2003. i prosinca 2018. godine, ugradili iskusni kirurzi na Odjelu za oralnu i maksilofacijalnu kirurgiju Sveučilišnoga medicinskoga centra u Mainzu.



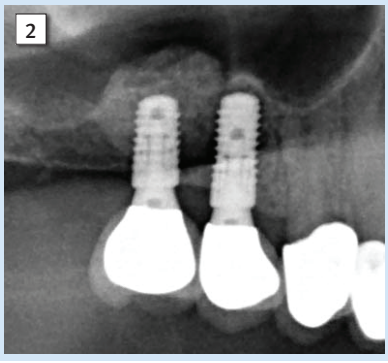


Figure 1 Radiological example of a short dental implant.
Slika 1. Radiološki primjer kratkoga dentalnog implantata
Figure 2 Radiological example of a long dental implant in combination with a sinus lift.
Slika 2. Radiološki primjer dugoga dentalnog implantata u kombinaciji s podizanjem dna sinusa

Inclusion criteria

Patients receiving short dental implants (<8 mm) which were inserted in pristine bone or standard-length implants (>8 mm) that were placed in combination with maxillary sinus floor elevation procedures; Implants were placed in posterior maxilla

Exclusion criteria

Patients with horizontal augmentation procedures; Patients with short dental implants and vertical augmentation procedures; Palatal implants; Observation period < 1 month

Surgical procedure and outcome measures

The implant surgery was performed in accordance with the protocol of the manufacturer. Cumulative survival rates were calculated in a retrospective approach. In patients available for a clinical follow-up examination, the following clinical parameters were evaluated: mobility of the implant, radiographic marginal bone loss, probing depth, suppuration and sensitivity, and tenderness or pain upon function were determined (27). Furthermore, the percussion test, the Approximal Plaque Index modified by Lange et al. (28), as well

Kriteriji za uključivanje

Pacijenti kojima su ugrađeni kratki dentalni implantati (< 8 mm) u intaktnu kost ili implantati standardne dužine (> 8 mm) u kombinaciji s postupcima podizanja dna maksilarnoga sinusa; implantati su postavljeni u stražnju maksilu.

Kriteriji za isključivanje

Pacijenti s postupcima horizontalne augmentacije; pacijenti s kratkim dentalnim implantatima i postupcima vertikalne augmentacije; palatalni implantati; razdoblje praćenja < 1 mjesec.

Kirurški postupci i mjerenje ishoda

Ugradnja implantata obavljena je u skladu s protokolom proizvođača. Kumulativne stope preživljenja izračunate su retrospektivnim pristupom. Pacijentima dostupnima za klinički kontrolni pregled ocjenjivani su sljedeći parametri: pokretljivost implantata, radiografski marginalni gubitak kosti, dubina sondiranja, gnojenje i osjetljivost te bol u funkciji (27). Uz to, evaluirani su nalazi perkusijskoga testa, indeksa aproksimalnoga plaka modificiranoga prema Langeu i suradnicima (28) te indeksi plaka i krvarenja sulkusa modificira-

as Plaque Index and Sulcus Bleeding Index both modified by Mombelli et al. (29) were evaluated. Prosthodontic appliance design and technical complications could not be evaluated, as prosthetic restorations were mostly provided *alio loco*. Radiological examination was conducted using orthopantomography at the time of examination. To determine the periimplant marginal bone loss, the follow-up and postoperative radiograph were compared, by analyzing the mesial and distal crestal bone levels adjacent to the implant as described before (9). To examine Oral health-related quality of life the OHIP-G14 was used (30, 31). Additionally, a questionnaire with the following questions was issued (score 1 to 5): 1) How satisfied are you with your implant? 2) How satisfied are you with the operation? 3) How satisfied are you with the prosthetic restoration? Higher scores implied a higher satisfaction and high oral health-related quality of life, while lower scores indicate dissatisfaction and low oral health-related quality of life.

Data analysis

This trial is a descriptive and exploratory study. The study was created without a primary hypothesis. All data analysis was carried out according to a pre-established analysis plan. Descriptive p-values of tests are reported and no adjustments were made to multiple testing. Cumulative survival rates were estimated using the Kaplan-Meier function. To evaluate the statistical significance of differences in implant survival between both treatment groups, a log-rank test was performed. A cox model was fitted for age and gender to consider confounding variables due to clustering of multiple implants per patient. The associated hazard ratio and 95% confidence intervals were reported. For comparisons with respect to radiographic marginal bone loss, clinical parameters and OHRQoL, we applied the Mann-Whitney U Test. Statistical analyses were performed at 0.05 level of significance. They were performed using SPSS Statistics 23 V5 R (IBM, USA).

Results

Implant Survival Rates

In the examined time period, 126 short dental implants were inserted in the pristine bone of 84 patients of the test group, whilst 312 standard length implants were placed in combination with maxillary sinus floor elevation procedures in another 156 patients in the control group. The test group consisted of 30 male and 54 female patients, whereas in the control group 64 patients were male and 92 patients were female. The mean age of the test group was 65 years, and 59.9 years in the control group. The length of implants in the test group ranged from 4.5 to 8.0 mm, whilst the implant length ranged from 8.5 mm to 14 mm in the control group. The diameter of implants in the test group ranged from 3.0 mm to 5.5 mm, whereas the control group included implant diameters ranging from 3.3 mm to 6.0 mm. Implants were splinted if two implants were inserted next to each other. In the control group, an external sinus floor elevation was performed on 199 implants; 69 implants received an internal sinus floor elevation, 26 implants received both an internal and an external sinus floor elevation and on 10 implants no bone augmentation was performed.

ni prema Mombelliju i suradnicima (29). Dizajn suprastrukture i tehničke komplikacije nisu se mogle procijeniti jer su se protetički radovi uglavnom izrađivali *alio loco*. Radiološki pregled učinjen je ortopantomogramom. Kako bi se odredio periimplantatni marginalni gubitak kosti, uspoređene su kontrolne i postoperativne rendgenske snimke te analizirane mezijalne i distalne razine krestalne kosti uz implantat, kako je već opisano (9). Za procjenu kvalitete života povezane s oralnim zdravljem korišten je upitnik OHIP-G 14 (30, 31). Pacijenti su dodatno ispunjavali upitnik sa sljedećim pitanjima (ocjene od 1 do 5):

1) Jeste li i koliko zadovoljni svojim implantatom?
2) Jeste li zadovoljni operacijom?
3) Jeste li i koliko zadovoljni protetičkim nadomjestkom?

Viši rezultati podrazumijevaju veće zadovoljstvo i visoku kvalitetu života povezanu s oralnim zdravljem, a niži upućuju na nezadovoljstvo i nisku kvalitetu života povezanu s oralnim zdravljem.

Analiza podataka

Ovo je istraživanje deskriptivno i eksplorativno. Nije postavljena primarna hipoteza. Sve analize podataka provedene su prema unaprijed utvrđenom planu analize. Prikazane su deskriptivne p-vrijednosti testova i nisu obavljene prilagodbe višestrukim testiranjima. Kumulativne stope preživljenja procijenjene su s pomoću Kaplan-Meierove funkcije. Kako bi se procijenila statistička značajnost razlika u preživljenju implantata između obiju liječenih skupina, proveden je log-rank test. Coxov model prilagođen je dobi i spolu kako bi se razmotrile varijable zbog grupiranja više implantata po pacijentu. Prikazani su povezani omjeri rizika i 95-postotni intervali pouzdanosti. Za usporedbu radiološkoga marginalnoga gubitka kosti, kliničkih parametara i OHRQoL-a, primijenjen je Mann-Whitneyjev U-test. Statistička analiza obavljena je na razini značajnosti 0,05. Analize su provedene u programu SPSS Statistics 23 V5 R (IBM, SAD).

Rezultati

Stope preživljenja implantata

U testnom razdoblju ugrađeno je 126 kratkih dentalnih implantata u intaktnu kost 84 pacijenta ispitne skupine, a 312 implantata standardne duljine ugrađeno je u kombinaciji sa zahvatima podizanja dna maksilarnoga sinusa kod još 156 pacijenata u kontrolnoj skupini. Testnu skupinu činilo je 30 pacijenata i 54 pacijentice, a u kontrolnoj skupini bila su 64 pacijenta i 92 pacijentice. Prosječna dob u testnoj skupini bila je 65 godina, a u kontrolnoj 59,9. Dužina implantata u testnoj skupini bila je od 4,5 do 8,0 mm, a u kontrolnoj se kretala od 8,5 do 14 mm. Promjer implantata u testnoj skupini bio je od 3,0 do 5,5 mm, a u kontrolnoj korišteni su promjeri implantata od 3,3 do 6,0 mm. Implantati su povezani ako su dva implantata ugrađena jedan do drugoga. U kontrolnoj skupini je na 199 implantata primijenjeno vanjsko podizanje dna sinusa, na 69 obavljeno je unutarnje podizanje dna sinusa, a na 26 i unutarnje i vanjsko podizanje, na 26 implantata provedeni su dodatni zahvati vertikalne augmentacije i na 10 nije bilo mogu-

ternal sinus floor elevation, on 26 implants additional vertical augmentation procedures were carried out and on 10 implants it was not possible to distinguish between internal and external sinus floor elevation retrospectively.

Mean follow-up (± SD) was 56.6 ± 42.9 months (ranging from 1 to 160 months) in the TG and 41.6 ± 37.6 months (ranging from 0 to 126 months) in the CG. During the follow-up period, 14 implants in ten patients were lost in the TG. The reasons for implant loss in the short implant group were: n= 4 implants with early implant failure due to lack of osseointegration; n = 2 implants due to a condition after radiotherapy; n = 3 implants due to overloading, n= 2 implants due to periimplantitis; n = 1 implant was lost in the course of extraction of an adjacent tooth; n = 4 implants with unknown reasons. In the CG, 29 implants in 18 patients were lost. The reasons for implant loss were: n = 24 implants were removed due to periimplantitis; n= 2 implants with early implant failure due to lack of osseointegration due to a lack of osseointegration; n = 3 implants with unknown reasons.

Cumulative 5- and 10-year implant survival rates for the TG were 91.8% and 82.5% respectively and 90.7% and 74.7% for the CG (p=0.421; Figure 3). The fitted Cox model (corrected for age and gender) favored the CG providing a hazard ratio (HR) of 1.116 (95%-confidence interval 0.550 to 2.265), however, the difference was not statistically significant (p=0.760; Figure 3).

Marginal bone loss

The marginal bone loss could be evaluated on the mesial and distal sides of 97 implants of the TG. There was no orthopantomogram available for 26 implants of the TG and another 3 implants of the TG were not assessable due to a poor quality of the orthopantomogram.

In the CG marginal bone loss could be assessed at the mesial sides of 222 implants and at the distal sides of 221 implants. There was no orthopantomogram available for 79 implants of the CG and, due to a poor quality of some orthopantomograms; another 11 implants of the CG were not assessable on the mesial side of the implant, whilst another 12 implants were not assessable on the distal side of the implant.

The mean time period between the initial, postoperative radiograph and that of the follow-up examination (±SD) was 42.1 ± 37.1 months in the TG (ranging from 1 to 139 months), whilst it was 32.9 ± 32.3 months in the CG (ranging from 1 to 121 months).

In this time period, the mean marginal bone loss (± SD) of the TG was 0.70 ± 0.72 mm, with an average of 0.75 ± 0.77 mm on the mesial side and 0.65 ± 0.67 mm on the distal side of the implant (figure 4). In the TG, the maximum marginal bone loss was 5.49 mm and the minimum was 0.00 mm. Compared with that, the mean marginal bone loss (± SD) of the CG was 0.96 ± 0.91 mm, with an average of 0.98 ± 0.86 mm on the mesial side and 0.94 ± 0.95 mm on the distal side of the implant. In the CG, the maximum marginal bone loss was 7.01 mm and the minimum was -0.16 mm. The intergroup difference showed statistical significance (p<0.001) indicating a significantly smaller average marginal bone loss in the TG (Figure 4).

će retrospektivno razlikovati unutarnje i vanjsko podizanje dna sinusa.

Srednja vrijednost praćenja (± SD) iznosila je 56,6 ± 42,9 mjeseci (u rasponu od 1 do 160 mjeseci) u TG-u i 41,6 ± 37,6 mjeseci (u rasponu od 0 do 126 mjeseci) u CG-u. Tijekom razdoblja praćenja u TG-u je 10 pacijenata izgubilo 14 implantata. Razlozi gubitka implantata u skupini s kratkim implantatima bili su: n = 4 implantata s ranim neuspjehom zbog nedostatka oseointegracije; n = 2 implantata zbog stanja nakon radioterapije; n = 3 implantata zbog preopterećenja, n = 2 implantata zbog periimplantitisa; n = 1 implantat izgubljen je tijekom vađenja susjednoga zuba; n = 4 implantata s nepoznatim razlozima. U CG-u je 18 pacijenata izgubilo 29 implantata. Razlozi su bili sljedeći: n = 24 implantata uklonjena su zbog periimplantitisa; n = 2 implantata s ranim neuspjehom zbog nedostatka oseointegracije; n = 3 implantata s nepoznatim razlozima.

Kumulativne petogodišnje i desetogodišnje stope preživljenja implantata za TG iznosile su 91,8 %, odnosno 82, 5% te 90,7 % i 74,7 % za CG (p = 0,421; slika 3.). Coxov model (korigiran za dob i spol) favorizirao je CG pružajući omjer rizika (HR) od 1,116 (95-postotni interval pouzdanosti od 0,550 do 2,265), no razlika nije bila statistički značajna (p = 0,760; slika 3.).

Marginalni gubitak kosti

Marginalni gubitak kosti mogao se procijeniti na mezijalnoj i distalnoj strani 97 implantata u TG skupini. U toj skupini nije bilo dostupnog ortopantomograma za 26 implantata, a još tri implantata u istoj skupini nije bilo moguće procijeniti zbog loše kvalitete ortopantomograma.

U CG skupni marginalni gubitak kosti mogao se procijeniti na mezijalnim stranama 222 implantata i na distalnim stranama 221 implantata. U toj skupini nije bilo dostupnoga ortopantomograma za 79 implantata, a zbog loše kvalitete nekih ortopantomograma njih još 11 nije bilo moguće procijeniti na mezijalnoj strani implantata, a još 12 nije bilo moguće procijeniti na distalnoj strani.

Prosječno razdoblje između inicijalne, postoperativne radiološke analize i kontrolnoga pregleda (±SD) bilo je 42,1 ± 37,1 mjeseci u TG skupini (u rasponu od 1 do 139 mjeseci), a u CG skupini 32,9 ± 32,3 mjeseca (u rasponu od 1 do 121 mjeseca).

U tom razdoblju je srednji marginalni gubitak kosti (± SD) u TG skupini bio 0,70 ± 0,72 mm, s prosjekom od 0,75 ± 0,77 mm na mezijalnoj strani i 0,65 ± 0,67 mm na distalnoj strani implantata (slika 4.). U TG skupini maksimalni marginalni gubitak kosti iznosio je 5,49 mm, a minimalni 0,00 mm. U usporedbi s tim, srednji marginalni gubitak kosti (± SD) u CG skupini bio je 0,96 ± 0,91 mm, s prosjekom od 0,98 ± 0,86 mm na mezijalnoj strani implantata i 0,94 ± 0,95 mm na distalnoj. U CG skupini maksimalni marginalni gubitak kosti bio je 7,01 mm, a minimalni -0,16 mm. Razlika među skupinama pokazala je statističku značajnost (p < 0,001) sa znatno manjim prosječnim marginalnim gubitkom kosti u TG skupini (slika 4.).

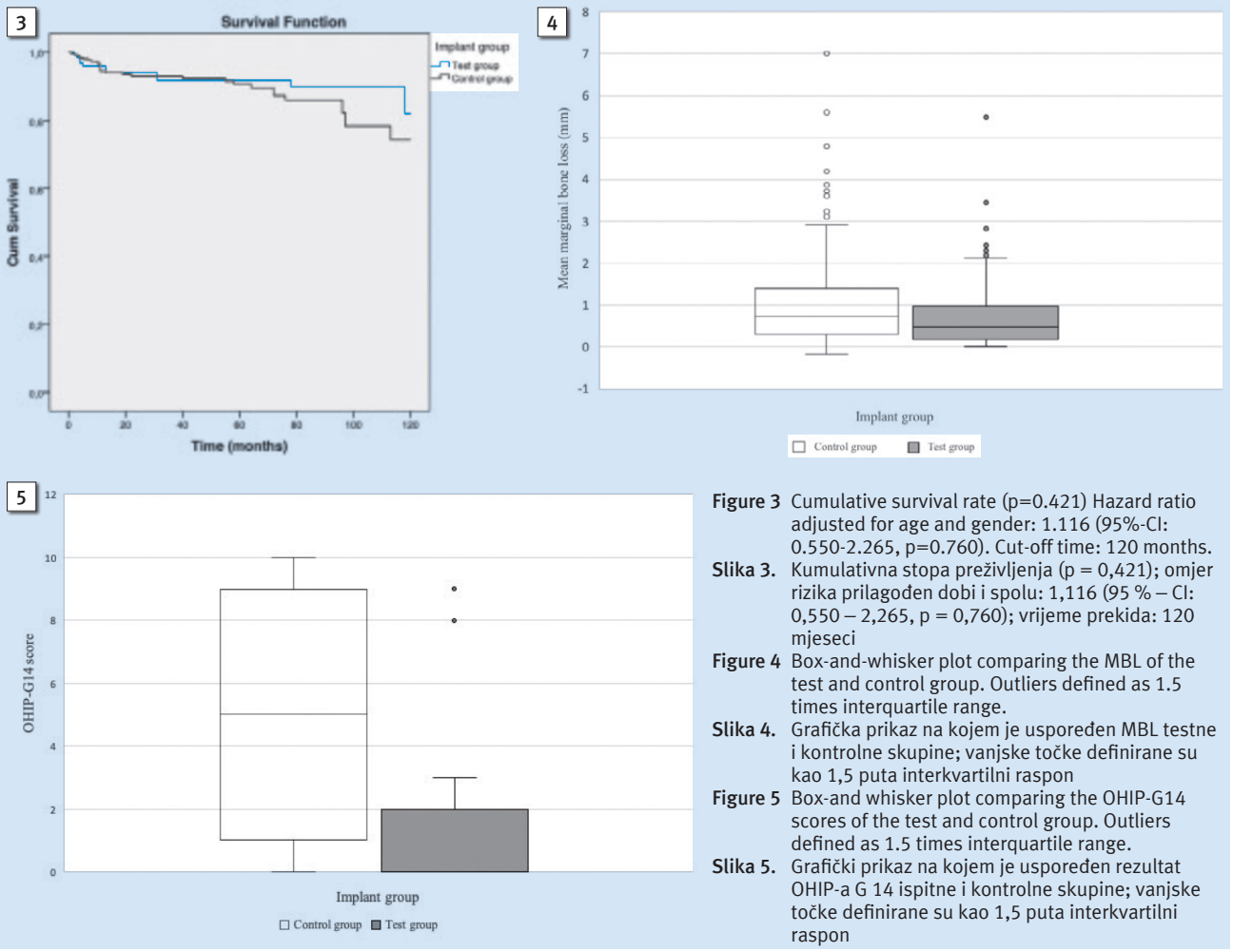


Figure 3 Cumulative survival rate (p=0.421) Hazard ratio adjusted for age and gender: 1.116 (95%-CI: 0.550-2.265, p=0.760). Cut-off time: 120 months.

Slika 3. Kumulativna stopa preživljenja (p = 0,421); omjer rizika prilagođen dobi i spolu: 1,116 (95 % – CI: 0,550 – 2,265, p = 0,760); vrijeme prekida: 120 mjeseci

Figure 4 Box-and-whisker plot comparing the MBL of the test and control group. Outliers defined as 1.5 times interquartile range.

Slika 4. Grafička prikaz na kojem je uspoređen MBL testne i kontrolne skupine; vanjske točke definirane su kao 1,5 puta interkvartilni raspon

Figure 5 Box-and whisker plot comparing the OHIP-G14 scores of the test and control group. Outliers defined as 1.5 times interquartile range.

Slika 5. Grafički prikaz na kojem je uspoređen rezultat OHIP-a G 14 ispitne i kontrolne skupine; vanjske točke definirane su kao 1,5 puta interkvartilni raspon

Clinical follow-up

14 patients (with 23 implants) of the TG and 5 patients (with 11 implants) of the CG attended the clinical follow-up examination. The average time between implant placement and clinical follow-up examination (± SD) was 6.5 ± 2.8 years in the TG and 8.1 ± 2.1 years in the CG. The mean overall clinical follow up was 7.01 ± 2.69 years.

None of the implants showed clinical mobility or sensitivity, tenderness or pain upon function. An evaluation of the Plaque Index modified by Mombelli et al. (29) showed no significant differences between the groups (p=0.123), with all implants of both groups reaching a satisfactory degree of oral hygiene (grade 0 and 1). Also the Approximal Plaque Index modified by Lange et al. (28), showed no statistically significant differences in the oral hygiene of both groups (p=0.214).

None of the implants of the TG showed bleeding on probing when applying the Sulcus Bleeding Index as modified by Mombelli et al. (29), thus having 100% of the TG implants reach a grade 0. Conversely, 3 implants (27.3%) of the CG, all in the same patient, showed isolated bleeding points (grade 1), whereas the remaining 8 implants (72.7%) of the CG did not show any bleeding on probing and were graded as grade 0. The intergroup differences regarding the Sulcus Bleeding Index did not reach statistical significance (p=0.214).

Kliničko praćenje

Kliničkom kontrolnom pregledu odazvalo se 14 pacijenata (s 23 implantata) u TG skupini i njih 5 (s 11 implantata) u CG skupini. Prosječno vrijeme između ugradnje implantata i kliničkoga kontrolnog pregleda (± SD) bilo je 6,5 ± 2,8 godina u TG skupini i 8,1 ± 2,1 godina u CG skupini. Prosječno ukupno razdoblje kliničkoga praćenja iznosilo je 7,01 ± 2,69 godina.

Ni jedan implantat nije bio pomičan ili osjetljiv, niti se pojavljivala bol u funkciji. Procjena indeksa plaka modificiranoga prema Mombelliju i suradnicima (29) nije pokazala značajne razlike između skupina (p = 0,123), pri čemu je na svim implantatima u objema skupinama postignut zadovoljavajući stupanj oralne higijene (stupanj 0 i 1). Ni aproksimalni indeks plaka modificiran prema Langeu i suradnicima (28) nije pokazao statistički značajne razlike u oralnoj higijeni u objema skupinama (p = 0,214).

Pri postavljanju implantata u TG skupini ni jedan nije krvario pri sondiranju prema indeksu krvarenja sulkusa modificiranome prema Mombelliju i suradnicima (29), tako da je 100 % implantata u toj skupini dobilo ocjenu 0. Suprotno tomu, kod 3 implantata (27,3 %) u CG skupini, svi kod istoga pacijenta, pojavila su se izolirana mjesta krvarenja (1. stupanj), a kod preostalih 8 (72,7 %) u toj skupini nije zabilježeno krvarenje pri sondiranju i ocijenjeni su ocjenom 0.

In the TG, the average probing depth was 2.0 ± 0.8 mm, whereas it was 2.7 ± 1.1 mm in the CG (p=0.000), indicating a statistically significant smaller probing depth in the TG.

Oral health-related quality of life

A total of 17 patients with 31 implants, of which 11 patients of the TG and further 6 patients of the CG, agreed to complete the questionnaires regarding the OHRQoL. Mean OHIP-G14 scores were 1.9 ± 3.4 (ranging from 0 to 9) in the TG and 5.0 ± 4.5 (ranging from 0 to 10) in the CG (p=0.180; Figure 5). On average (± SD), the patients of the TG rated their satisfaction with the implant 4.9 ± 0.3 out of a maximum of 5, whereas the mean (± SD) score in the CG was 3.8 ± 1.5 (p=0.033), indicating a significantly higher satisfaction in the group of short implants. Regarding the satisfaction with the operation (TG: 4.8 ± 0.4; CG: 4.7 ± 0.5; p=0.718) and the prosthetic restoration (TG: 4.6 ± 0.7; CG: 3.5 ± 1.5; p=0.091), comparable results were observed.

Discussion

The present clinical study aimed to evaluate clinical and radiographic outcomes of short dental implants in comparison to standard length implants placed in combination with SFE procedures for the rehabilitation of posterior atrophic arches. Our study revealed similar results regarding implant survival. Interesting observations were made in terms of MBL and patient satisfaction, in which short implants compared favorably with standard length implants with SFE. Respecting the retrospective character of this study, the results should be interpreted with caution and causal links should not be concluded based on these results. Nevertheless, the present results are in line with findings of several randomized controlled trials, thus suggesting that short implants obtain similar, if not better clinical results, when compared with implants in standard length placed in combination with SFE.

In a randomized controlled trial (RCT) with split-mouth design, Felice et al. compared short implants (5 mm) with longer implants (≥ 10 mm) in augmented bone placed in posterior atrophic edentulous jaws (32). After a 5-year follow-up period, Felice et al. found no statistically significant differences with regards to the implant failures (32). A randomized controlled study compared 6-mm-long implants inserted in pristine bone with 11-mm-long implants placed in combination with SFE over a 5-year follow-up period (33). In this study, no statistically significant differences were found with regards to implant survival (33). Although the mean marginal bone loss (± SD) was smaller in the 6-mm group (0.12 ± 0.36 mm) compared with the 11-mm group (0.14 ± 0.63 mm), the differences did not reach a statistical significance (33). The average patient satisfaction (± SD) was slightly higher in the short implant group (9.4 ± 0.8 out of a maximum score of 10) in comparison to the 11-mm group (9.2 ± 0.8), however, these intergroup differences were also not statistically significant (33). Furthermore, no statistically significant differences regarding the plaque accumulation

Međuskupne razlike, kada je riječ o indeksa krvarenja sulkusa, nisu postigle statističku značajnost (p = 0,214).

U TG skupini prosječna dubina sondiranja bila je 2,0 ± 0,8 mm, a u CG skupini iznosila je 2,7 ± 1,1 mm (p = 0,000), što upućuje na statistički značajno manju dubinu sondiranja u TG skupini.

Kvaliteta života povezana s oralnim zdravljem

Ukupno 17 pacijenata s 31 implantatom, od čega 11 iz TG skupine i 6 iz CG skupine, pristalo je ispuniti upitnike OHRQoL-a. Prosječni rezultati dobiveni za OHIP-G 14 bili su 1,9 ± 3,4 (u rasponu od 0 do 9) u TG skupini i 5,0 ± 4,5 (u rasponu od 0 do 10) u CG skupini (p = 0,180; slika 5). Prosječno (± SD) su pacijenti u TG skupini svoje zadovoljstvo implantatom ocijenili s 4,9 ± 0,3 od maksimalnih 5, a srednja (± SD) ocjena u CG skupini bila je 3,8 ± 1,5 (p = 0,033), što pokazuje znatno veće zadovoljstvo u skupini s kratkim implantatima. Kada je riječ o zadovoljstvu operacijom (TG: 4,8 ± 0,4; CG: 4,7 ± 0,5; p = 0,718) i protetičkim nadomjestkom (TG: 4,6 ± 0,7; CG: 3,5 ± 1,5; p = 0,091), uočeni su usporedivi rezultati.

Rasprava

Cilj ovoga kliničkog istraživanja bio je procijeniti kliničke i radiološke rezultate kratkih dentalnih implantata u usporedbi s implantatima standardne dužine postavljenima u kombinaciji s postupcima podizanja dna sinusa za rehabilitaciju atrofične stražnje maksile. U našem istraživanju dobiveni su slični rezultati u vezi s preživljenjem implantata. Zanimljiva su zapažanja o zadovoljstvu pacijenata – kratkim implantatima postignuti su povoljni rezultati u usporedbi s onima standardne dužine s podizanjem dna sinusa. Poštujući retrospektivni karakter ovog istraživanja, rezultate treba tumačiti s oprezom i na temelju njih ne treba zaključivati o uzročno-posljedičnim vezama. Ipak, u skladu su s nalazima nekoliko randomiziranih kontroliranih istraživanja, što sugerira da se kratkim implantatima postižu slični, ako ne i bolji klinički rezultati, u usporedbi s implantatima standardne dužine postavljenima u kombinaciji s podizanjem dna sinusa.

U randomiziranom kontroliranom istraživanju (RCT) s dizajnom podijeljenih usta, Felice i suradnici uspoređivali su kratke implantate (5 mm) s dužima (≥ 10 mm) u augmentiranoj kosti postavljenima u stražnje atrofične bezube čeljusti (32). Nakon petogodišnjega praćenja autor i njegovi suradnici nisu utvrdili statistički značajne razlike kada je riječ o neuspjehu implantata (32). Autori randomiziranoga kontroliranog istraživanja uspoređivali su tijekom pet godina implantate od 6 mm ugrađene u intaktnu kost s onima od 11 mm postavljenima u kombinaciji s podizanjem dna sinusa (33). U ovom istraživanju nisu pronađene statistički značajne razlike u preživljenju implantata (33). Iako je srednji marginalni gubitak kosti (± SD) bio manji u skupini od 6 mm (0,12 ± 0,36 mm) u usporedbi sa skupinom od 11 mm (0,14 ± 0,63 mm), razlike nisu dosegnule statističku značajnost (33). Prosječno zadovoljstvo pacijenata (± SD) bilo je nešto veće u skupini s kratkim implantatima (9,4 ± 0,8 od 10, što je maksimalni rezultat) u usporedbi sa skupinom od 11 mm (9,2 ± 0,8), ali te međuskupne razlike također nisu bile statistički značajne

and bleeding tendency were found (33). In a RCT over 3 years, Bechara et al. compared short implants (6 mm) in 33 patients with standard length-implants (≥ 10 mm) placed in combination with external SFE in 20 patients (9). Survival rates on implant-level were 100% in the short implant group and 95.6% in the augmented group (9). As in our study, the radiological results revealed a significantly smaller mean marginal bone loss in the short implant group (9). Regarding patient satisfaction, no statistically significant differences could be found concerning function, esthetics, cleanability and the overall satisfaction (9). However, patient satisfaction was significantly higher in the short implant group regarding the treatment costs (9). Interesting observations regarding the quality of life in both implant groups were also made in a RCT by Taschieri et al., who compared short dental implants (6,5 to 8,5 mm) with longer ones (10 mm or longer) placed with external SFE (34). Over a follow-up period of 3 years, the authors found an implant survival of 100% in both groups and no statistically significant differences in implant failure and mean marginal bone loss (34). The clinical parameters regarding plaque accumulation, bleeding on probing and implant mobility were similar in both groups (34). However, in the first 6 days after surgery, patients with short dental implants had significantly lower pain levels, with a reduced intake of analgesics, as well as less swelling, hematoma and impairment of daily activities such as sleeping, chewing and speaking (34). Nevertheless, patient satisfaction was similar after 1 year, with no significant differences in all aspects, besides the easiness of oral hygiene maintenance, which was considered significantly better by patients of the short implant group (34). When comparing 5- to 6-mm-long implants with ≥ 10 mm-long-implants placed in combination with an internal SFE over 3 years, a study by Gastaldi et al. also found out that all patients were fully or partially satisfied with the function and esthetics, with a slightly higher patient satisfaction in the short implant group. (35). Generally, both short implants in native bone and those in standard length placed in combination with SFE appeared to reach high levels of patient satisfaction (9, 34, 35). However, considering the minimal invasiveness, the associated morbidity and treatment costs, patients seem to prefer short implants (9, 34, 35).

A randomized controlled study by Thoma et al. compared 6-mm-long implants with 11-mm-long implants placed in combination with lateral SFE (36). Over a 5-year follow-up period, Thoma et al. did not find statistically significant intergroup differences with regards to implant survival, marginal bone loss and oral health impact profile (OHIP-49) (36). Survival rates on implant level were 98.5% in the short implant group versus 100% in the augmented group (36). On implant level, mean marginal bone loss was 0.45 ± 0.79 mm in the short implant group and 0.45 mm ± 0.91 mm in the augmented group (36). No statically significant differences were found regarding probing depth, bleeding on probing and plaque accumulation (36). Furthermore, the crown-to-implant ratio did not seem to have a statistically significant effect (36). After 5 years, median overall OHIP-49 scores were 3.0 in the short implant group and 5.0 in the augmented group, showing significantly improved scores from base-

(33). Nisu pronađene ni statistički značajne razlike u nakupljanju plaka i sklonosti krvarenju (33). U randomiziranom kontroliranom istraživanju tijekom tri godine, Bechara i suradnici usporedili su kratke implantate (6 mm) kod 33 pacijenta s implantatima standardne dužine (≥ 10 mm) postavljenima u kombinaciji s vanjskim podizanjem dna sinusa kod 20 pacijenata (9). Stope preživljenja na razini implantata bile su 100 % u skupini s kratkim implantatima i 95,6 % u skupini s augmentacijom (9). Kao i u našem istraživanju, radiološki nalazi pokazali su znatno manji srednji marginalni gubitak kosti u skupini s kratkim implantatima (9). Kada je riječ o zadovoljstvu pacijenata, nisu zabilježene statistički značajne razlike u vezi s funkcijom, estetikom, čistoćom i ukupnim zadovoljstvom (9). Međutim, zadovoljstvo pacijenata bilo je znatno veće u skupini s kratkim implantatima s obzirom na troškove liječenja (9). Zanimljiva zapažanja o kvaliteti života u objema skupinama pokazalo je i randomizirano kontrolirano istraživanje Taschierija i suradnika. Oni su uspoređivali kratke dentalne implantate (6,5 do 8,5 mm) s dužima (10 mm ili duže) postavljenima s vanjskim podizanjem dna sinusa (34). Tijekom trogodišnjega praćenja autori su ustanovili 100-postotno preživljenje implantata u objema skupinama i bez statistički značajnih razlika u neuspjehu implantata i srednjem marginalnom gubitku kosti (34). Klinički parametri o nakupljanju plaka, krvarenju pri sondiranju i pokretljivosti implantata, bili su slični u objema skupinama (34). No prvih šest dana poslije operacije pacijenti s kratkim dentalnim implantatima imali su značajno nižu razinu boli te zato i manji unos analgetika, te manje otekline, hematome i tegobe pri svakodnevnim aktivnostima poput spavanja, žvakanja i govora (34). Ipak, zadovoljstvo pacijenata bilo je slično nakon jedne godine, bez značajnih razlika u svim aspektima, osim u lakoći pri održavanju oralne higijene koju su pacijenti iz skupine s kratkim implantatima ocijenili znatno boljom (34). Kada se tijekom tri godine uspoređuju implantati dužine od 5 do 6 mm s onima dužine ≥ 10 mm postavljenim u kombinaciji s unutarnjim podizanjem dna sinusa, Gastaldi i suradnici u svojem su istraživanju također istaknuli da su svi pacijenti potpuno ili djelomično zadovoljni funkcijom i estetikom, uz nešto veće zadovoljstvo onih u skupini s kratkim implantatima (35). Općenito, čini se da se i kratkim implantatima u nativnoj kosti i implantatima standardne dužine postavljenim u kombinaciji s podizanjem dna sinusa, postiže visoka razina zadovoljstva pacijenata (9, 34, 35). No s obzirom na minimalnu invazivnost, pridruženi morbiditet i troškove liječenja, čini se da pacijenti preferiraju kratke implantate (9, 34, 35).

U randomiriranom kontroliranom istraživanju Thoma i suradnici uspoređivali su implantate dužine 6 mm s onima od 11 mm postavljenim u kombinaciji s lateralnim podizanjem dna sinusa (36). Tijekom petogodišnjega praćenja, autori nisu pronašli statistički značajne razlike među skupinama u preživljenju implantata, marginalnom gubitku kosti i utjecaju na oralno zdravlje (OHIP-49) (36). Stope preživljenja na razini implantata bile su 98,5 % u skupini s kratkim implantatima prema 100 % u skupini s augmentacijom (36). Na razini implantata, prosječni marginalni gubitak kosti bio je 0,45 ± 0,79 mm u skupini s kratkim implantatima i 0,45 mm ± 0,91 mm u skupini s augmentacijom (36). Nisu pronađene statistički

line in both groups (36). The OHIP-survey was designed by Slade and Spencer to assess the impact of oral health on the subjective well-being (37, 38). Amongst other fields, it has become well established in the rating of different treatment options in implant therapy (39-45). The shortened version, the OHIP-14, explains 94% of the variance of the OHIP-49 and therefore is a reliable and efficient tool in the assessment of the oral health impact under clinical conditions (37, 46). In our study, the German shortened version of the OHIP-survey (OHIP-G14) was applied and yielded very similar values to those in the study by Thoma et al.. In the test group, average overall scores were 1.9 ± 3.4 (ranging from 0 to 9), whilst the control group had a mean overall score of 5.0 ± 4.5 (ranging from 0 to 10) (p=0.180).

Our study is similar to a retrospective cohort study by Pieri et al., in which short implants (6 to 8 mm) were compared to standard length implants (≥ 11 mm) placed in combination with a lateral sinus elevation procedure (47). The mean observation period was 47.03 ± 7.46 months for the control group and 44.18 ± 6.42 months for the test group (47). After a follow-up of at least 3 years, implant survival was 90.6% in the augmented group and 95.8% in short implant group, with differences in proportion not being statistically significant (47). These results are similar to the 3-year Kaplan-Meier-estimator of our study, estimating a cumulative survival of 93.1% for the control group and 91.8% for the test group.

Conclusion

In conclusion, the results of this study are in general agreement with those found in the literature, providing promising clinical data for short dental implants in the edentulous atrophic maxilla. However, larger trials carried out over a long-term follow-up period are needed to evaluate whether short- and medium-term clinical advantages of short implants can be maintained in the long-term. This study was carried out under real clinical conditions with only very few exclusion criteria, which should allow experienced operators to treat patients with similar characteristics in other medical centers to obtain similar results. Within the limitations due to the retrospective nature of the study and due to a high number of drop-outs, short implants showed similar clinical and radiological results to implants in standard length in combination with sinus floor elevation procedures. When considering the associated patient morbidity, cost and treatment duration, short implants are a promising treatment option.

Conflict of Interest

Dr. Schiegnitz reports Grants and Personal fees from Dentsply, personal fees from Geistlich, personal fees from Sanofi-Aventis, personal fees from Septodont, grants and per-

značajne razlike u dubini sondiranja, krvarenju pri sondiranju i nakupljanju plaka (36). Nadalje, čini se da omjer krunice i implantata nije imao statistički značajan učinak (36). Nakon 5 godina medijan ukupnih rezultata OHIP-a 49 bio je 3,0 u skupini s kratkim implantatima i 5,0 u skupini s augmentacijom, što pokazuje znatno poboljšane rezultate u usporedbi s početnom vrijednosti u objema skupinama (36). OHIP-ovu anketu osmislili su Slade i Spencer kako bi procijenili utjecaj oralnoga zdravlja na subjektivnu dobrobit (37, 38). Osim u ostalim područjima, dobro se ustalila i u ocjenjivanju različitih mogućnosti liječenja u implantoprotetici (39 – 45). Skraćena verzija OHIP-a 14, objašnjava 94 % varijance OHIP-a 49 i zato je pouzdan i učinkovit alat u procjeni utjecaja na oralno zdravlje u kliničkim uvjetima (37, 46). U našem istraživanju primijenjena je skraćena njemačka verzija OHIP-ove ankete (OHIP-G 14) i dobivene su vrlo slične vrijednosti onima u istraživanju Thomea i suradnika. U testnoj skupini prosječni ukupni rezultati bili su 1,9 ± 3,4 (u rasponu od 0 do 9), a kontrolna skupina postigla je prosječni ukupni rezultat od 5,0 ± 4,5 (u rasponu od 0 do 10) (p = 0,180).

Naše istraživanje slično je retrospektivnom kohortnom istraživanju Pierija i suradnika u kojemu su kratki implantati (6 do 8 mm) uspoređeni s implantatima standardne dužine (≥ 11 mm) postavljenim u kombinaciji s postupkom lateralnoga podizanja dna sinusa (47). Prosječno razdoblje promatranja bilo je 47,03 ± 7,46 mjeseci za kontrolnu skupinu i 44,18 ± 6,42 mjeseca za testnu skupinu (47). Nakon praćenja od najmanje tri godine, preživljenje implantata bilo je 90,6 % u skupini s dugim implantatima i 95,8 % u skupini s kratkima, pri čemu razlike u omjeru nisu statistički značajne (47). Ti su rezultati slični trogodišnjem Kaplan-Meierovom procjenom, uz kumulativno preživljenje od 93,1 % za kontrolnu skupinu i 91,8 % za testnu.

Zaključak

Zaključno, rezultati ovog istraživanja općenito se slažu s rezultatima u literaturi te daju vrijedne kliničke podatke za kratke dentalne implantate u bezuboj atrofičnoj maksili. No potrebna su veća istraživanja i dulje razdoblje praćenja da bi se procijenilo mogu li se dugoročno održati kratkoročne i srednjoročne kliničke prednosti kratkih implantata. Ovo istraživanje provedeno je u stvarnim kliničkim uvjetima uz vrlo malo kriterija za isključivanje, što bi trebalo omogućiti iskusnim operaterima, koji liječe pacijente sa sličnim karakteristikama u drugim medicinskim centrima, da postignu slične rezultate. U okviru ograničenja, zbog retrospektivne prirode istraživanja i velikoga broja odustajanja, kratki implantati pokazali su slične kliničke i radiološke rezultate kao i oni standardne dužine u kombinaciji s postupcima podizanja dna sinusa. Kada se uzme u obzir morbiditet, trošak i trajanje liječenja, kratki implantati obećavajuća su opcija liječenja.

Sukob interesa

Dr. Schiegnitz prijavio je projekte i osobne naknade od Dentsplyja, te osobne naknade od Geistlicha, Sanofi-Aventisa te Septodonta, potpore i osobne naknade od Straumanna

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Ethical approval

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i zaklade ITI, osobne naknade od Mectrona i Osteološke zaklade, izvan pristigloga rada. Nina Hill nije prijavila ništa. Dr. Keyvan Sagheb prijavio je osobne honorare od Denstplyja i Geistlicha te projekte i osobni honorar od Straumanna, izvan poslanoga rada. Dr. König nije ništa prijavio. Dr. Kawe Sagheb nije ništa prijavio. Dr. Al-Nawas prijavio je projekte i osobne naknade od Dentsplyja, Geistlicha, Sanofi-Aventisa i Septodonta, potpore i osobne naknade od Straumanna, potporu od zaklade ITI, osobne naknade od Mectrona, potpore i osobne naknade te honorare od Camloga, honorare od Medartisa, Zimmera i zaklade Osteology, izvan prijavljenoga rada.

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Sažetak

Svrha rada: Uspoređivali su **se** klinički i radiološki rezultati kratkih dentalnih implantata ugrađenih u intaktnu kost s implantatima standardne dužine ugrađenima u kombinaciji s podizanjem dna sinusa. **Materijal i metode:** Za ovo kliničko istraživanje su klinički i radiološki ishodi 126 kratkih dentalnih implantata (84 pacijenta) ugrađenih u intaktnu kost uspoređeni s 312 implantata standardne dužine (156 pacijenata) usađenih u kombinaciji s postupcima podizanja dna maksilarnoga sinusa. **Rezultati:** Skupina s kratkim implantatima [testna skupina (TG); srednja vrijednost praćenja (± standardna devijacija (SD) 56,6 ± 42,9 mjeseci] i augmentirana skupina [kontrolna skupina (CG); srednja vrijednost praćenja 41,6 ± 37,6 mjeseci] pokazale su kumulativne stope preživljenja od 91,8 i 92,4 %. Kumulativne petogodišnje stope preživljenje implantata bile su 91,8 % za TG i 90,7 % za CG (p = 0,421). Prosječni marginalni gubitak kosti bio je značajno veći u CG-u nego u TG-u, uz srednji MBL od 0,70 ± 0,72 mm u TG-u i 0,96 ± 0,91 mm u CG-u (p < 0,001). I u kontrolnoj i u testnoj skupini uočena je usporediva i obećavajuća kvaliteta života povezana s oralnim zdravljem (OHRQoL). **Zaključci:** Nakon više od tri godine s kratkim implantatima ugrađenima u resorbiranu stražnju maksilu postignuti su slični rezultati kao i pri uporabi standardnih implantata u kombinaciji s postupcima podizanja dna maksilarnoga sinusa.

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