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CASE REPORT

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Imedijatno opterećenje kratkih implantata u stražnjem dijelu gornje čeljusti: prikazi slučajeva

Immediate Loading of Short Implants in Posterior Maxillae: Case Series

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Sažetak
Sve je više znanstvenih dokaza koji podupiru kliničku uporabu kratkih dentalnih implantata. No u malo se studija procjenjivao dugoročni uspjeh imedijatnog opterećenja tih usadaka. Ovo istraživanje usmjereno je na procjenu imedijatnog opterećenja kratkih implantata u stražnjim područjima maksile. **Materijali i metode:** Odabrani su pacijenti s kratkim implantatima u stražnjem području maksile postavljenima prije prosinca 2010. O njima su prikupljeni sljedeći podatci: dob, spol, dimenzije implantata, anatomska lokacija i protetička terapija. Izlazne varijable bile su remodeliranje kosti oko implantata te trajnost kratkih implantata i protetičkih radova. **Rezultati:** Osam pacijenata dobilo je deset kratkih implantata. Srednja vrijednost vremena praćenja bila je 4,6 ± 1,21 godina nakon opterećenja, a pritom je jedan implantat izgubljen. Dogodila se i jedna protetička komplikacija. Ni jedna proteza nije rezultirala neuspjehom te je zabilježeno 100-postotno zadovoljstvo. **Zaključci:** Imedijatno opterećenje kratkih implantata u maksili moglo bi uštedjeti vrijeme i troškove te bi se moglo smatrati uspješnom terapijom.

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Ključne riječi
rano umetanje zubnog usatka; zubne proteze podržane usatkom; preoblikovanje kosti; oseointegracija; gornja čeljust

Uvod

Nakon prvoga objavljenog članka o imedijatnom opterećenju zubnih implantata, tiskan je znatan broj sustavnih preglednih radova i obavljeno mnogo istraživanja. U preglednom članku o mogućnostima kliničkih i eksperimentalnih istraživanja prihvaćena je 2000. godine ideja o imedijatnom opterećenju implantata i preporučena vrsta fiksacije koja minimizira njegove mikropokrete (1). Skupni podatci za imedijatno opterećenje pokazali su slično preživljavanje implantata kao i u slučaju odgođenog opterećenja (1 – 5). Jedan od najutjecajnijih parametara za terapijski uspjeh jest kontrola torka uvrtanja (1 – 5). Pri korištenju implantata standardne duljine, znanstveni dokazi upućivali su na odsutnost značajnih razlika među protokolima funkcionalizacije u smislu preživljavanja implantata i remodeliranja okolne kosti (5). Anatomska lokacija implantata mogući je čimbenik koji bi mogao utjecati na preživljavanje dentalnih implantata i protetičkih nadomjestaka. Implantati s imedijatnim opterećenjem imaju u različitim objavljenim istraživanjima veću stopu neuspjeha u stražnjim (0,54 %) negoli u prednjim (0,45 %) područjima kada se procjenjuju zajedno (6). S implantatima u maksili bilo je više neuspjeha negoli s onima u mandibuli (6).

Introduction

Since the first publication on immediate loading of dental implants, an increasing number of research and systematic reviews have been published. In 2000, a review of the available clinical and experimental studies have accepted the idea of immediate implant loading and have recommended the type of fixation that minimizes the implant micro movements (1). The data compiled for the immediate loading have shown a similar implant survival as delayed loading (1-5). The insertion torque is one of the most influential parameters in the treatment success (1-5). When standard-length implants are used, the scientific evidence indicated the absence of significant differences between functionalization protocols in terms of implant survival and peri-implant bone remodelling (5). However, the anatomical location of the implant is a factor that could affect the survival of dental implants and prostheses. Immediate implants with immediate loading have a higher failure rate in posterior areas than in the anterior areas when estimated together in different published studies (0.54% - 0.45% respectively), (6). The implants in the maxilla have more failures than in the mandible (6).

The use of short dental implants may limit the needs for bone augmentation. The predictability of short implants has

Korištenje kratkih dentalnih implantata može smanjiti potrebu za augmentacijom kosti. Njihova predvidivost procijenjena je u nedavnom istraživanju o praćenju randomiziranih kliničkih postupaka postavljanja implantata u podignuto dno maksilarnog sinusa (7). Kratki implantati (duljina ≤ 8 mm) pokazali su predvidivu stopu preživljavanja i rezultirali su tri puta nižom stopom intraoperativnih komplikacija negoli dugi (6). Kratki implantati postavljeni u stražnjim dijelovima bezubih grebena pokazali su visoku inicijalnu stopu preživljavanja sličnu dugim implantatima (8). Iz svega navedenoga slijedi da kratki dentalni implantati mogu biti terapija izbora u liječenju atrofične alveolarne kosti jer su povezani s manje bioloških komplikacija, smanjenim odbacivanjem i kirurškim vremenom te pristupačnijom cijenom (8). Predvidivost imedijatno opterećenijih kratkih dentalnih implantata potaknula je pitanje i o predvidivosti protetičkih nadomjestaka na kratkim dentalnim implantatima. Da bi se odgovorilo na to pitanje, kratki implantati(≤ 8,5 mm) postavljeni su i imedijatno opterećeni te periodično procjenjivani. Nulta hipoteza glasila je da imedijatno opterećenje ne utječe na stopu njihovu preživljavanja i stabilnost marginalne kosti oko kratkih implantata postavljenih u stražnje područje maksile. Procjenjivani su stopa preživljavanja implantata i periimplantološko remodeliranje kosti, zatim komplikacije te preživljavanje protetičkih nadomjestaka.

Materijali i metode

Pri izradi članka poštovane su preporuke STROBE-a (9). Istraživanje je provedeno u Dentalnom centru u Victoriji u Španjolskoj. Kriteriji za uključivanje bili su sljedeći:

- dob iznad 18 godina
- postavljanje kratkih BTI implantata (duljine 7,5 – 8,5 mm) prije prosinca 2010.
- implantat postavljen u stražnje područje maksile
- imedijatno opterećenje.

Implantati su praćeni klinički i panoramskim radiogramima sa svrhom uočavanja mogućih neuspjeha. Neuspjehom se smatralo ako tijekom procjene u ustima pacijenta nije bilo implantata. Remodeliranje kosti oko implantata procjenjivalo se računanjem smještaja marginalne kosti (u odnosu na platformu implantata) na posljednjim radiogramima u odnosu na njezin smještaj tijekom postavljanja i imedijatnog opterećenja implantata. Za kalibriranje linearnih mjera korištene su duljine implantata (Sidexis, Sirona, SAD). Za ispitivanje normalne raspodjele podataka korišten je Shapiro-Wilksov test, a za učinak antagonista na tip stabilnosti marginalne kosti upotrijebljena je jednosmjerna ANOVA analiza.

Plan terapije određen je na temelju kliničkog pregleda i proučavanja dijagnostičkog navoštavanja te nakon analize snimaka kompjutorizirane tomografije koničnim zrakama (CBCT). Kirurg je pripremio mjesto za implantat niskoturažnom bušilicom (125 okretaja u minuti) bez irigacije, a promjer posljednjeg svrdla za kost određivao se ovisno o gustoći kosti (određena prema CBCT-u), (10, 11). Za poboljšanje osteointegracije dentalnih implantata korištena je plazma bogata čimbenicima rasta (PRGF-Endoret®, Biotechnology Institute BTI, Vitoria, Španjolska). Tijekom postavljanja im-

been assessed in a recent survey of randomized clinical trials of implants placed in augmented sinus (7). Short (length ≤ 8 mm) implants have presented a predictable survival rates and have resulted in three times lower intraoperative complications compared to long implants (6). Short implants placed in a posterior partial edentulous region have presented a high initial survival rate, which is similar to long implants (8). As mentioned above, shorter dental implants may represent the preferred treatment alternative in atrophic alveolar bone since they have been associated with lower biological complications, decreased morbidity, costs and surgical time (8).

Many clinical questions were raised regarding the predictability of immediate implant loading and short implants. For example, the logical question was whether the immediate loading of short implants is predictable as well. In order to answer the question, short (≤8.5 mm) implants have been immediately loaded and periodically assessed. The null hypothesis was that immediate loading has no effect on the survival rate and marginal bone stability around short implants inserted in maxillary posterior areas. The implant survival rate and peri-implant osseous remodeling, complications and survival of the prosthesis were assessed.

Materials and methods

STROBE guidelines were followed for the preparation of the manuscript[9] . The study was performed in a dental center in Vitoria, Spain. The inclusion criteria in this retrospective study were:

- Age higher than 18 years.
- Placement of short BTI implants (length 7,5 - 8,5 mm) before December, 2010.
- Implant inserted in maxillae posterior areas.
- Immediate implant loading.

To assess the principal outcome, implants were followed clinically and radiographically with panoramic radiographs to identify any implant failure. A failure event was defined as the absence of the dental implant in the patient mouth at the time of evaluation. Peri-implant bone remodeling was measured by assessing the difference in the position of the marginal bone (in relation to implant platform) in the most recent radiograph and its position at the time of implant loading. The implant length was used to calibrate the linear measurements (Sidexis, Sirona, USA). The Shapiro-Wilk test was selected for testing the normality of data. The one-way ANOVA analysis was used to indicate the effect of the antagonist type on the marginal bone stability.

Surgery

The plan of treatment was set after clinical examination and the study of the diagnostic wax-up and cone-beam computerized tomography (CBCT) scans. A surgeon prepared the implant site using a low-speed drilling procedure (125 rpm) without irrigation and the diameter of the last bone drill was determined according to the bone density (obtained from a CBCT scan), (10, 11). Plasma rich in growth fac-

plantata kirurški motor postavljen je na 25 N/cm^2, a završno zatezanje implantata obavljeno je ručno kalibriranim torkključem. Transepitelni abutmenti (Multi-Im, BTI Biotechnology Institute, Vitoria, Španjolska) postavljeni su imedijatno. Protetičar je obavio rehabilitaciju pacijenata – postavio je žlice za otiske i uzeo ih polimernim materijalom (Impregum Penta; 3M ESPE) tehnikom otvorene žlice.

Postavljeni su privremeni protetički radovi retinirani vijcima i držani 48 sati nakon usađivanja implantata. Konačni fiksni protetički radovi postavljeni su tek kada su se oko implantata oblikovala mekana tkiva. Kontrolni pregledi bili su jedan tjedan nakon zahvata, zatim nakon mjesec dana, tri mjeseca i šest mjeseci te poslije jedanput na godinu.

Kontrole i procjena uspjeha

Uspješnost implantata definirana je prema kriterijima koje su predložili Buser i suradnici (12), a prilagodili Albrektsson i njegovi kolege (13). Preživljavanje implantata definirano je njihovom prisutnošću u ustima na kraju kontrolnog razdoblja.

Protetički radovi na implantatima pregledavani su zbog pojave tehničkih komplikacija. Praćeni su i procjenjivani prema kriterijima Langa i suradnika (6).

Statistička analiza

Dva neovisna doktora dentalne medicine skupljala su i analizirala podatke. Za kvalitativne varijable izračunate su apsolutne i relativne frekvencije raspodjele, a za kvantitativne srednje vrijednosti i standardne devijacije.

Za provjeru normalne raspodjele podataka korišten je Shapiro-Wilksov test. Za procjenu preživljavanja protetičkih radova i implantata korištena je Kaplan-Mierova metoda.

Rezultati

U ovom radu sudjelovalo je osam pacijenata s deset kratkih implantata u stražnjem maksilarnom području. Sve je postavio isti kirurg i odmah su opterećeni privremenim protetičkim radom s mostom na vijke nošeni multiabutmentima. Raspon godina u vrijeme operacije pacijenata bio je 65 ± 5,9 godina (raspon: 55 do 74 godine) i 70 posto bile su žene. Jedan pacijent bio je umjereni pušač.

Kratki implantati bili su dugi 7,5 mm (3 implantata) i 8,5 mm (7 implantata) (tablica 1.). Insercijski tork bio je u svim

tors was used to enhance the osseointegration of dental implants (PRGF-Endoret®, Biotechnology Institute BTI, Vitoria, Spain). For placing the dental implant, the surgical motor was set at 25 N/cm^2 and the implants were finally seated manually by a calibrated torque wrench. Transepithelial abutments (Multi-Im, BTI Biotechnology Institute, Vitoria, Spain) were subsequently immediately placed. A prosthodontist performed the prosthetic rehabilitation of the patients. Impression copings were placed and an impression was made with polyether impression material (Impregum Penta; 3M ESPE) and the open-tray technique. A screw-retained temporary fixed prosthesis was then placed during the first 48 hours after implant placement. The definitive fixed prosthesis was delivered once the stable peri-implant soft tissue was achieved. The follow-up check-ups were at 1 week after intervention, at 1 month, at 3 months, at 6 months, and from that moment ahead, once a year.

Follow-up and evaluation of success

Implant success was defined according to the criteria suggested by Buser et al (12) and modified by Albrektsson et al. (13). Survival of the implants was defined by the presence of the implant in the mouth at the end of the follow-up period.

The implant-supported prostheses were screened for the occurrence of technical complications. The criteria proposed by Lang et al (6) were followed to assess the prosthesis.

Statistical analysis

The data were collected and analyzed by two independent dentists. Absolute and relative frequency distributions were calculated for qualitative variables and mean values and standard deviations for quantitative variables. The Shapiro-Wilk test was selected for testing the normality of data distribution.

Kaplan-Mier method was used to assess the survival of the prosthesis and the implant.

Results

Eight patients with 10 short implants in maxillae posterior areas participated in this study. All implants were inserted by the same surgeon. Subsequently, they were immediately loaded by provisional prostheses with screw prostheses and multi-im abutments. The patients' mean age was 65 ±5,9 years (range: 55 to 74 years) at the time of surgery and 70% of patients were females. One patient was a moderate smoker.

The short implants had a length of 7.5 mm (3 implants) and 8.5 mm (7 implants) (Table 1). The insertion torques

Tablica 1. Duljine i promjeri implantata
Table 1 Lengths and diameters of implants

Diameter (mm)	Lenght (mm)		Total
	7,50	8,50	
3.75	0	2	2
4.00	1	2	3
5.00	3	0	3
5.50	1	1	2
Total	5	5	10

slučajevima ≥ 30 Ncm. Implantati su praćeni 55,5 ± 14 mjeseci (raspon: 18 do 69 mjeseci). Implantati su devetorici sudionika praćeni ≥ 4,5 godina (90 %).

Jedan implantat, nakon petogodišnjeg opterećenja, nije uspio. Zamijenjen je zubom # 45.

Kumulativna stopa preživljavanja imedijatno opterećenoga kratkog implantata bila je 90 posto (slika 1.). Nije bilo neuspjeha u postavljanju protetičkoga rada.

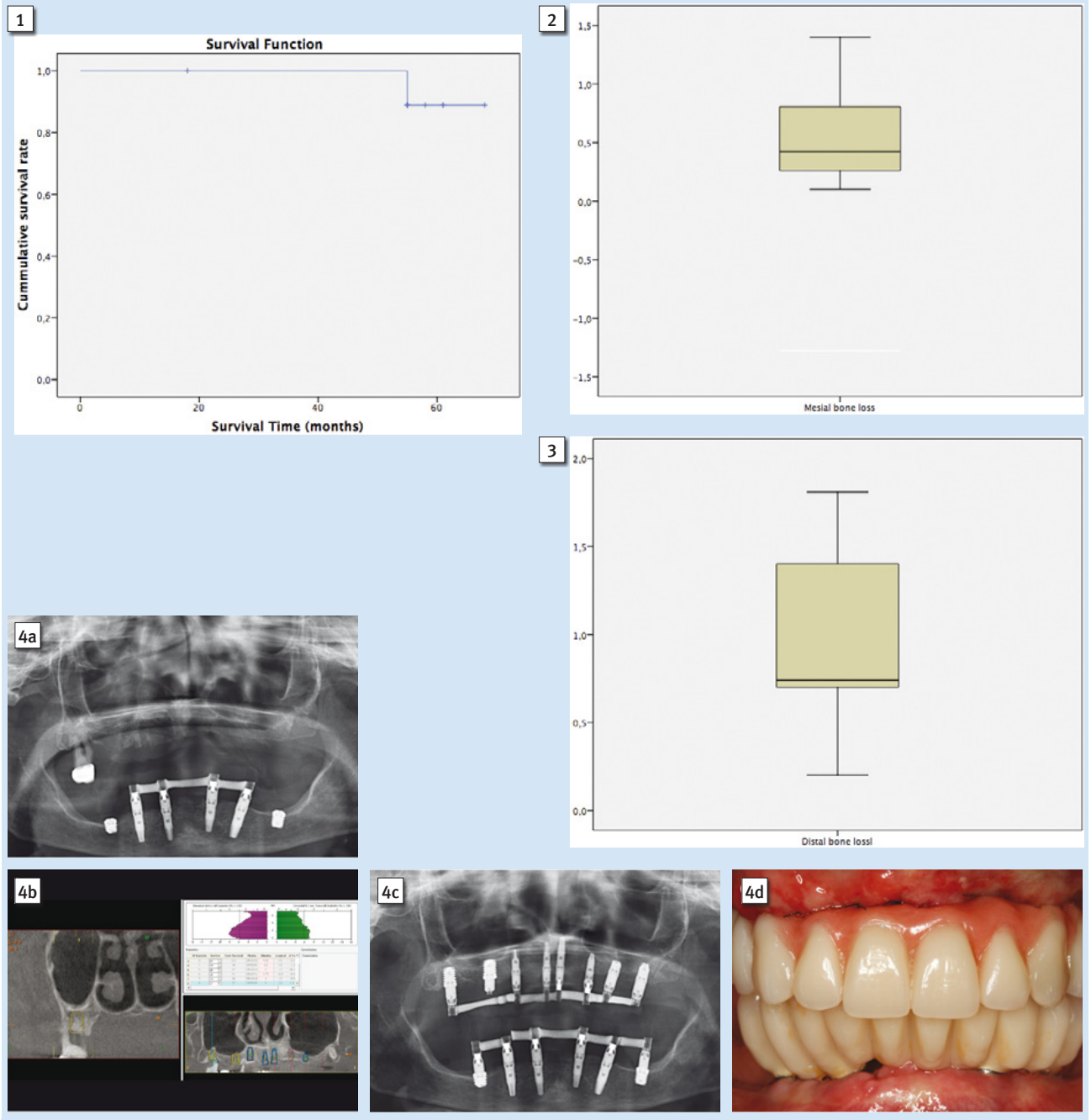
Nakon 54 ± 16 mjeseci poslije opterećivanja procijenjena je koštana stabilnost periimplantata. Glavni gubitak mezijal-

were ≥ 30 Ncm in all cases. The implants were followed for 55,5 ± 14 months (range: 18 to 69 months). The implants were followed for ≥ 4.5 years for 9 (90%).

One implant failed after 5 years of loading. This implant was replacing the tooth #45.

The cumulative survival rate of immediately loaded short implants was 90% (Figure 1). There was no failure at the prosthesis level.

The periimplant bone stability was assessed after 54 ± 16 months of loading. The mean of mesial bone loss was 0,35



Slika 1. Kumulativna stopa preživljavanja implantata
Figure 1 Cumulative survival rate of implants
Slika 2. Mezijalni gubitak kosti
Figure 2 Mesial bone loss
Slika 3. Distalni gubitak kosti
Figure 3 Distal bone loss

Slika 4a-d. Konačni protetski nadomjestak
Figure 4a-d Final prosthetic apliances

ne marginalne kosti bio je 0,35 mm (+/-0,73; raspon 0,41-1,40) (slika 2.), a glavni gubitak distalne marginalne kosti iznosio je 0,93 mm (+/- 0,54; raspon 0,23 – 1,81) (slika 3.).

Protetički radovi bili su izrađeni od metal-smole za devet kratkih implantata i od smole za jedan. Privremeni protetički rad zamijenjen je stalnim nakon 12 ± 3 mjeseci (raspon: 4 do 20 mjeseci) od opterećenja. Konačni protetički radovi bili su svim pacijentima spiralno učvršćeni i svi implantati bili su pričvršćeni za druge implantate (jedan ili više), slika 4a-d.

Za njih tri nasuprotna denticija bili su prirodni zubi (obnovljeni i neobnovljeni), a za njih sedam protetički radovi retinirani implantatima. ANOVA analiza upućivala je na odsutnost utjecaja antagonističkog tipa na stabilnost bočne marginalne kosti.

Rasprava

Imedijatno opterećenje kratkim implantatima u stražnjem maksilarnom području ne utječe negativno na implantoprotetičke radove. Cannizzaro i suradnici izvijestili su o rezultatu koji su postigli u kontroliranom nasumičnom kliničkom ispitivanju koji su nakon četverogodišnjeg imedijatnog opterećenja nasuprot ranomu, a riječ je bila o 6,5 mm dugim pojedinačnim implantatima (14). Inzercijski tork bio je > 40 Ncm u obje grupe, a stopa uspješnosti implantata iznosila je 96,7 posto. U drugom kontroliranom nasumičnom kliničkom ispitivanju, jednogodišnji rezultat imedijatnog opterećenja 5,5 mm dugim implantatom s pomoću fiksnog križno-polukružnog protetičkog rada, uspoređen je s 11,5 mm dugim implantatima (15) gdje je inzercijski tork kod najvećeg broja implantata bio > 50 Ncm. Dogodio se samo jedan neuspjeh. Razlike nisu pokazale statističku značajnost. U nedavnim studijama o rehabilitaciji bezube maksile stopa preživljavanja imedijatnog opterećenja kratkog implantata (duljine između 7,0 i 8,5 mm) bila je 95,7 posto (21). Većina implantata (68 od 74) stavljena je na mjesto latelarnog sjekutića (16). U našem istraživanju implantati su postavljeni u područje stražnje maksile, na najlošije mjesto, ali je preživljavanje bilo stopostotno (17).

Pretjerana trauma i termička ozljeda tijekom pripreme ležišta za implantat smatraju se kritičnima za uspješnost postupka (17, 18). Ležište implantata pripremljeno je niskoturažnom bušilicom za kost bez irigacije. Ovaj protokol odabran je zato što se tijekom njegove primjene kost ne pregrijava ako je dužina zijela manja od 8mm, implantai 9-13mm su srednje dugački, a implanti dužgrijava (10, 11). Dobra kvaliteta koštanih strugotina nakon niskoturažnog bušenja ležišta potvrdila je da nema koštanih ozljeda (11, 19).

Glavni gubitak perimplantatske marginalne kosti oko imedijatno opterećenih kratkih implantata bio je u ovom istraživanju manji od jednog milimetra. Imedijatno opterećeni kratki implantati izgubili su 0,4/0,5 mm manje marginalne kosti negoli dugi (nakon jednogodišnje kontrole) (15). U jednom drugom istraživanju istaknuto je da je nakon tri godine oko kratkih implantata nastalo 1,25 ± 0,99 mm remodelirane marginalne kosti (16). Ovo istraživanje važan je prikaz podataka za retrospektivnu analizu i nedostatak nasumičnosti ili slijepog pokusa.

mm (+/-0,73; range 0,41-1,40) (Figure 2) and the mean of distal bone loss was 0,93 mm (+/- 0,54; range 0,23-1,81) (Figure 3).

The prostheses were of metal-resin for 9 short implants and of resin for one implant. The provisional prosthesis was replaced by a definitive one after 12 ± 3 months (range: 4 to 20 months) of loading. The definitive prostheses were all screw-retained in all patients and all of the implants were splinted to other implants (one or more), Figure 4a-d.

The opposing dentition were natural teeth (restored and unrestored) for 3 and implant-supported prostheses for 7. The one-way ANOVA analysis showed the absence of an effect of the antagonist type on the marginal bone stability.

Discussion

The immediate loading of short implants in the maxillary posterior areas has no negative effects on implant-supported prostheses.

Cannizzaro et al have reported the 4-year outcomes of immediate Vs early loading of 6.5 mm long single implants in a controlled randomized split-mouth clinical trial (14). The insertion torque was > 40 Ncm in both groups. The implant success rate was 96.7% for both groups. In another randomized controlled clinical trial, the 1-year outcome of immediate loading of 5 mm long implants by a fixed cross-arch prostheses have been compared to those of 11.5 mm-long implants (15). The insertion torque of most of the implants has been > 50 Ncm. Only one failure has occurred. The differences have not reached the statistical significance. In a recent study about the rehabilitation of edentulous maxilla, the survival rate of an immediately-loaded short implants (length between 7.0 and 8.5 mm) has been 95.7%.[21] However, most of the implants (68 of 74 implants) have been placed at the position of the lateral incisor (16). In our study, the implants have been placed in posterior maxillae areas, that is a worse localization, and the survival rate of implants was 100%% (17).

Excessive trauma and thermal injury during implant socket preparation have been considered to be critical for implant success (17,18). Implant site has been prepared by low-speed bone drilling without irrigation. This drilling protocol has not caused overheating of bone (10,11). The good quality of bone particles resulted from the drilling at low speed, thus confirming the absence of bone damage (11, 19).

In this study, the mean periimplant marginal bone loss around the immediately loaded short implants was less than 1 mm. Immediately-loaded short implants have lost 0.4/0.5 mm less marginal bone than the long implants (up to 1 year follow-up), (15) In another study, the 3-year marginal bone remodeling for short implants was 1.25 ± 0.99 mm (16).

The present study has some limitations regarding data, and the absence of randomization or blinding.

Zaključak

Imedijatno opterećenje kratkih implantata postavljenih u područje stražnje maksile kao potporanj višejediničnim protetičkim radovima nije ugrozilo ni implantat ni marginalnu kost. Mjerenja povećanja primarne stabilnosti implantata i minimiziranje njegovih mikropokreta pridonijeli su uočenim ishodima.

Zahvala

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Conclusions

The immediate loading of short implants inserted in posterior maxillae areas, supporting a multi-unit prosthesis, has not jeopardized either the implant success or the marginal bone loss. Taking the measurements which would increase the implant primary stability and minimize implants micromotions could contribute to the observed outcomes.

Acknowledgments

I am a scientific director of BTI Biotechnology Institute in Vitoria, Spain and the president of Eduardo Anitua Foundation.

Abstract

There is an increasing number of scientific evidence supporting the clinical use of short dental implants. However, few studies have evaluated the long-term outcomes of immediate loading protocols in short implants. This study aims to evaluate immediate loading of short dental implants in the posterior regions of the maxillae. **Materials and methods:** Patients having short implants in maxillae posterior areas inserted before December, 2010 and immediately loaded were selected. The following data were gathered regarding patients' age and gender, implant dimensions, anatomical location, and prosthodontic treatment. The outcome variables were peri-implant bone remodeling and the survival rates of the short implants and the prosthesis. .**Results:** A 10 short implants were placed in 8 patients. The mean follow-up time was 4.6 ± 1.21 years after loading and 1 implant failed. One prosthetic complication occurred. No prostheses failed resulting in a survival rate of 100%. **Conclusions:** The immediate loading of short implants in maxillae posterior areas could save time, cost and could be regarded as a successful treatment.

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Key words
Immediate Dental Implant Loading; Dental Prosthesis, Implant-Supported; Bone Remodeling; Osseointegration; Maxilla

References

1. Szmukler-Moncler S, Piattelli A, Favero GA, Dubruille JH. Considerations preliminary to the application of early and immediate loading protocols in dental implantology. Clin Oral Implants Res. 2000 Feb;11(1):12-25.
2. Benic GI, Mir-Mari J, Hammerle CH. Loading protocols for single-implant crowns: a systematic review and meta-analysis. Int J Oral Maxillofac Implants. 2014;29 Suppl:222-38. doi: 10.11607/jomi.2014suppl.g4.1.
3. Esposito M, Grusovin MG, Maghaireh H, Worthington HV. Interventions for replacing missing teeth: different times for loading dental implants. Cochrane Database Syst Rev. 2013;3:CD003878.
4. Norton MR. The influence of insertion torque on the survival of immediately placed and restored single-tooth implants. Int J Oral Maxillofac Implants. 2011 Nov-Dec;26(6):1333-43.
5. Su M, Shi B, Zhu Y, Guo Y, Zhang Y, Xia H, et al. Comparison of implant success rates with different loading protocols: a meta-analysis. Int J Oral Maxillofac Implants. 2014 Mar-Apr;29(2):344-52.
6. Lang NP, Pun L, Lau KY, Li KY, Wong MC. A systematic review on survival and success rates of implants placed immediately into fresh extraction sockets after at least 1 year. Clin Oral Implants Res. 2012 Feb;23 Suppl 5:39-66.
7. Thoma DS, Zeltner M, Husler J, Hammerle CH, Jung RE. EAO Supplement Working Group 4 - EAO CC 2015 Short implants versus sinus lifting with longer implants to restore the posterior maxilla: a systematic review. Clin Oral Implants Res. 2015 Sep;26 Suppl 11:154-69.
8. Atieh MA, Zadeh H, Stanford CM, Cooper LF. Survival of short dental implants for treatment of posterior partial edentulism: a systematic review. Int J Oral Maxillofac Implants. 2012 Nov-Dec;27(6):1323-31.
9. Von Elm E, Altman DG, Egger M, Pocock SJ, Gotzsche PC, Vandenbroucke JP, et al. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. Lancet. 2007;370:1453-1457.
10. Anitua E, Alkhraisat MH, Pinas L, Orive G. Efficacy of biologically guided implant site preparation to obtain adequate primary implant stability. Ann Anat. 2015 May;199:9-15.
11. Anitua E, Carda C, Andia I. A novel drilling procedure and subsequent bone autograft preparation: a technical note. Int J Oral Maxillofac Implants. 2007 Jan-Feb;22(1):138-45.
12. Buser D, Weber HP, Bragger U, Balsiger C. Tissue integration of one-stage implants: three-year results of a prospective longitudinal study with hollow cylinder and hollow screw implants. Quintessence Int. 1994 Oct;25(10):679-86.
13. Albrektsson T, Zarb GA. Determinants of correct clinical reporting. Int J Prosthodont. 1998 Sep-Oct;11(5):517-21.
14. Cannizzaro G, Felice P, Leone M, Ferri V, Viola P, Esposito M. Immediate versus early loading of 6.5 mm-long flapless-placed single implants: a 4-year after loading report of a split-mouth randomised controlled trial. Eur J Oral Implantol. 2012 Summer;5(2):111-21.
15. Cannizzaro G, Felice P, Buti J, Leone M, Ferri V, Esposito M. Immediate loading of fixed cross-arch prostheses supported by flapless-placed supershort or long implants: 1-year results from a randomised controlled trial. Eur J Oral Implantol. 2015 Spring;8(1):27-36.
16. Malo P, de Araujo Nobre MA, Lopes AV, Rodrigues R. Immediate loading short implants inserted on low bone quantity for the rehabilitation of the edentulous maxilla using an All-on-4 design. J Oral Rehabil. 2015 Aug;42(8):615-23.
17. Gapski R, Wang HL, Mascarenhas P, Lang NP. Critical review of immediate implant loading. Clin Oral Implants Res. 2003 Oct;14(5):515-27.
18. Satomi K, Akagawa Y, Nikai H, Tsuru H. Bone-implant interface structures after nontapping and tapping insertion of screw-type titanium alloy endosseous implants. J Prosthet Dent. 1988 Mar;59(3):339-42.
19. Park JC, Kim JC, Kim YT, Choi SH, Cho KS, Im GI, et al. Acquisition of human alveolar bone-derived stromal cells using minimally irrigated implant osteotomy: in vitro and in vivo evaluations. J Clin Periodontol. 2012 May;39(5):495-505.