Five Years Follow-up of Short Implants Placed in Atrophic Maxilla with Simultaneous Sinus Floor Transcrestal Elevation

Abstract

Objective: Many authors have tried to face the anatomical limitations resulting from maxillary bone atrophy. Up to five millimeters bone height, the lateral sinus floor elevation is the most commonly used and validated strategy to achieve the prosthetic rehabilitation. However, the disadvantages of this technique are its invasiveness and delayed rehabilitation. The aim of this paper was to assess 5 years clinical outcome of implants placed with a technique that allows the percrestal sinus floor elevation and the immediate implant placement. Materials and Methods: 30 transcrestal sinus floor elevations with immediate implant placement were performed in severely atrophic maxillae. Implant survival, marginal bone level variation, harvested bone height variation and periodontal indices were assessed. Results: After a five year follow up none of the thirty implants were lost. The mean value of vertical harvested bone loss was 5%. The mean crestal bone loss was -0.33 mm (Standard Deviation (SD) 0.11 mm). The mean value of periodontal indices was respectively: PD 1.22 mm (SD 0.72 mm), PI 17.47% (SD 15.01 mm), BOP 9.87% (SD 19.17 mm). Conclusion: The results obtained are comparable with success criteria in implant rehabilitation. The reported technique proved to be successful in the population observed, with minimal trauma and reduced invasiveness.

Introduction

The prosthetic rehabilitation in atrophic posterior maxilla is a current topic in dentistry. The biological and mechanical improvements of dental implants and reconstructive surgery have allowed surgeons to rehabilitate increasingly complex cases. Up to date, many techniques have been described in the literature to face the anatomical limitations and create the conditions for implants insertion (1). As shown by several studies, the sinus floor elevation has been demonstrated to be a predictable and well-documented strategy to overcome the maxillary atrophy (2). Nearly half of the studies present in the literature have been published in the last five years, thus showing the relevance and actuality of the current topic. Two techniques of sinus lift are largely used: the lateral sinus floor elevation (LSFE) and the osteotome sinus floor elevation (OSFE) (3, 4). The LSFE was reported firstly by Tatum in 1997 and modified over the years by various authors, using different materials, instruments or access designs (5-10). Despite its highly predictable and successful rate, the indications of this technique are its invasiveness and delayed rehabilitation. The aim of this paper was to assess the 5 years clinical outcome of implants placed with a technique that allows the percrestal sinus floor elevation and the immediate implant placement.

Uvod

Protetička rehabilitacija atrofične stražnje maksile je tema u dentalnoj medicini. Biološko i mehaničko poboljšanje dentalnih implantata i napredak rekonstruktivne kirurgije omogućili su kirurzima rehabilitaciju sve složenijih slučajeva. Do danas su u literaturi opisane mnoge tehnike za suočavanje s anatomskim ograničenjima i stvaranje uvjeta za ugradnju implantata (1). Uglavnom su se istaknuli autori nekoliko istraživanja, podizanje dna sinusa pokazalo je predvidljivom i dobro dokumentiranom strategijom za prevladavanje maksi-}

Author keywords: Crestal Window; Immediate Dental Sinus Floor Augmentation; Short Dental Implants; Sinus Lift.
of LSFE are limited to the severe cases of atrophy (<5 mm residual vertical bone) because of its invasiveness and risks of complications (11).

The OSFE, described by Summers in 1994, is able to create the condition to place standard-length screw-implants and regenerate bone at the same time without a second surgical stage (12, 13). The success rate of this technique is comparable to LSFE procedure but with a more conservative approach which is less burdened by complications (14).

However, the use of this technique is limited by the availability of at least 5 mm of residual bone height (RBH) to ensure the stabilization of standard-length screw-implants (15, 16).

On the contrary, when RBH is less than 5 mm the lateral approach is a suggested option, but according to Smiler DG et al. the delayed implant placement is recommended (17). Although new bone could be obtained with this technique, it is difficult to assess the position and the total amount of graft material needed for the future implant placement in the first surgical stage. Furthermore, a longer treatment time is required. However, Peleg et al. (2006) concluded that the bone graft in LSFE and simultaneous implant placement is predictable in case of 1-2 mm RBH, if “careful case planning and meticulous surgical techniques” are used (18).

In line with the abovementioned, and in order to reduce the treatment duration and the risks of complications, it could be auspicious to use the technique that simultaneously combines the safeness of crestal approach and the possibility of immediate positioning of implant even in case of RBH <5 mm.

Fugazzotto (1998) described a crestal window approach and bone graft in case of RBH ranging from 1 to 2 mm. However, the implants were still positioned in the second stage (19). The same author described a crestal sinus augmentation using a trephine bur to design the window. In this case, the minimal RBH had to be 4-5 mm for technical reasons (the use of trephine bur) and the implants were delayed as well (20).

A recent systematic review supports the use of short implants as alternative solution to bone augmentation procedures (21). The survival rate of a short implant placed in atrophic bone is comparable to the procedure that involved bone manipulation to place standard length implants (22).

A great majority of authors believe that a short implant is a fixture long 8 millimeters or less, whilst an implant with a length of < 6.5 mm has been considered an extra-short implant (23). The use of a short implant could limit the amount of bone graft, thus reducing the invasiveness of the technique.

Therefore the bone rebuilder should be functionalized and preserved by adequate bone stimulation according to the laws of Wolff and Frost (24, 25).

The aim of this study was to describe and evaluate a technique that allows a sinus lift via crestal window and immediate positioning of extra-short implant in case of RBH ranging from 1 to 3 mm.

Material and Methods

The study was conducted in accordance with the World Medical Association Declaration of Helsinki and approved by the Institutional Review Board (or Ethics Committee) of “Sa-

na teške slučajeve atrofije (rezidualna vertikalna kost < 5 mm) zbog invazivnosti i rizika od komplikacija (11).

OSFE, koji je opisao Summers 1994. godine, omogućuje stvaranje uvjeta za istodobnu ugradnju implantata standardne duljine i regeneraciju kosti bez druge kirurške faze (12, 13). Uspješnost te tehnike uspoređiva je s LSFE postupkom, ali s konzervativnijim pristupom koji je manje sklon komplikacijama (14).

No uporaba te tehnike ograničena je na najmanje 5 mm visine rezidualne kosti (RBH) kako bi se osigurala stabilizacija implantata standardne duljine (15, 16).

Suprotno tomu, kada je RBH kraći od 5 mm predloženo je lateralni pristup, ali prema Smileru i suradnicima, preporučuje se odgođena ugradnja implantata (17). Iako bi se tom tehnikom mogla dobiti nova kost, teško je procijeniti položaj i ukupnu količinu grafa potrebnog za buduću ugradnju implantata u prvoj kirurškoj fazi. Nadalje, potrebno je dulje liječenje. No Peleg i suradnici (2006.) zaključili su da je košti grafi u LSFE-u i simultano postavljanje implantata predvidljivo čak i u slučaju od 1 do 2 mm RBH-a, no potrebno je po-mno planiranje slučaja i precizna kirurška tehnika (18).

U skladu s gore spomenutim, i kako bi se skratilo liječenje i rizik od komplikacija, moglo bi biti povoljno primijeniti tehniku koja istodobno kombinira sigurnost krestalnog pristupa i mogućnost imedijatne ugradnje implantata čak i u slučaju RBH-a < 5 mm.

Fugazzotto (1998.) je opisao pristup kroz krestalni proraz i košti grafi u slučaju RBH-a u rasponu od 1 do 2 mm. No implantirati su se i dalje ugrađivati u drugoj fazi (19). Isti je autor opisao augmentaciju krestalnoga sinusa trepanacijskim svrdlom za oblikovanje prozora. U ovom slučaju je minimalni RBH morao biti od 4 do 5 mm iz tehničkih razloga (upotreba trepanacijskoga svrdla), a ugradnja implantata također je odgođena (20).

Autor nedavno objavljena sistematisiranoga preglednog rada ističe korist pri upotrebi kratkih implantata kao alternativnog rješenja u slučaju augmentacije kosti (21). Stoga preživljavaanja kratkih implantata postavljenih u atrofiranu kost uspoređiva je s postupkom koji je uključivao augmentaciju radi postavljanja implantata standardne duljine (22).

Velika većina autora vjeruje da je kratki implantatni vijak dužine 8 mm ili manje, a implantat dužine < 6,5 mm smatra se ekstra kratkim (23). Korištenje kratkog implantata moglo bi ograničiti količinu koštanoga grafa i tako smanjiti invazivnost tehnike.

Stoga bi se obnavljanje kosti moglo potaknuti i očuvati odgovarajućom stimulacijom prema zakonima Wolffa i Frost-a (24, 25).

Cilj ovog istraživanja bio je opisati i procijeniti tehniku koja omogućuje podizanje dna sinusa kroz krestalni proraz i imedijatnu ugradnju iznimno kratkog implantata u slučaju RBH-a u rasponu od 1 do 3 mm.

Materijali i metode

Istraživanje je provedeno u skladu s Deklaracijom Svjetoskoga liječničkog udruženja iz Helsinskija, a odobrio ga je Institucionalni etički odbor Sveučilišta Sapienza u Rimu
Patients with posterior maxillary atrophy (Class Ch Misch-Judy) (26), were the target population. Consecutive enrollment was used to select the patients between 2013 and 2014, and a total of 102 patients were enrolled for the first stage. Clinical visit and radiographic analysis (orthopantomography and intraoral periapical Rx) were prescribed. If vertical atrophies were considered eligible for the treatment, a Cone Beam CT scan was prescribed (27).

The inclusion criteria were: single or multiple posterior maxillary edentulism, stabilized post-extraction alveolus (at least 6 months after extraction) (28); space available for prosthetic rehabilitation; residual bone height from 1 to 3 mm; horizontal residual bone at least 5 mm (intra-cortical).

The exclusion criteria were: uncontrolled oral diseases, maxillary sinus disease, uncontrolled systemic diseases and ASA classes III, IV and V, chemo/radio tumor therapy, immunosuppressed and patients being treated with corticosteroid or bisphosphonates, smokers who smoked more than 10 cigarettes a day.

Before surgery, clinical examination was carried on evaluating soft tissues and the adjacent teeth condition.

Two different examiners measured the vertical and horizontal residual bone using Horos™ software (The Horos Project, 64-bit medical image viewer, GNU Lesser General Public Licence, version 3.0) for each Cone Beam CT scan. The calibration of measure was obtained using the CT software and CT scans were analyzed using the paraxial cross section at the center of the area selected for implant placement and mesial/distal of it. The three measures were used to achieve the mean residual bone height (mRBH). (Figure 1)

Surgical procedures

All patients received 2g Amoxicillin with Clavulanic Acid 1 hour before treatment and 1g capsule every 12 hours for 6 days after the surgery. The surgery was performed under local anesthesia. A mid-crestal incision was designed, and releasing was made only if strictly necessary. Using the calibrated bone chisel, a window was designed smaller than the chosen implant, horizontally. The window was mobilized starting from the corners using the concave calibrated hand-osteotome of the same diameter of the chisel used. When mobilized, the window was displaced apically towards the Schneider’s membrane up to 8 mm from the bone crest. If necessary, gentle dissection of membrane was carried on with the sinus floor surgical detangler. The allograft material, synthetic Beta-Tricalcium Phosphate (Synthograft™, Bicon Implants LLC, Boston MA, USA) was inserted into the sinus and gentle compacted using the calibrated osteotomes till reaching the expected vertical dimension. The filling was checked by a periapical Rx.

The implant used, a short titanium biphasic implant, conometric-connected (Bicon Implants LLC, Boston MA, USA) was joined to the “sinus-lift abutment” (SLA) (Bicon Implants LLC, Boston MA, USA). The SLA is a healing sub-(protokolarni kod 27/13.06.2013). Svi su sudionici dali informirani pristanak. Implantprotektišća terapija provedena je na Odjelu za oralnu kirurgiju Zavoda za oralne i maksilofacialne znanosti Sveučilišta Sapienza u Rimu.

Pacijenti s maksilarnom atrofijom u stražnjem segmentu (klasa Ch Misch-Judy) (26) bili su ciljana populacija. Uzastopni upis korišten je za odabir pacijenata između 2013. i 2014. godine, a ukupno su za prvu fazu upisana 102. Obavljeni su klinički pregled i radiološka analiza (ortopantomogram i intraoralni periapikalni RTG). Ako se vertikalna atrofija smatra prihvatljivom za liječenje, propisana je CT snimka (27).

Kriteriji za uključivanje bili su nedostatak jednoga ili više zuba u stražnjem dijelu maksile, stabilizirana postekstrakcijska alveola (naajmanje 6 mjeseci nakon vodenja) (28), raspoloživ prostor za protetičku rehabilitaciju, rezidualna visina kosti od 1 do 3 mm i horizontalna rezidualna kost najmanje 5 mm (intrakortikalna).

Kriteriji za isključivanje bili su nekontrolirane bolesti usne šupljine, bolest maksilarnoga sinus, nekontrolirane sistema bolesti i ASA klase III, IV i V, zatim kemo/radioterapija, imunosupresivi i bolesnici koji se liječe kortikosteroidima ili bisfosfonatima te pušači koji puše više od 10 cigareta na dan.

Prijе operacije obavljen je klinički pregled radi procjene mekih tkiva i stanja susjednih zuba.

Dva različita ispitivača izmjerila su vertikalnu i horizontalnu rezidualnu kost s pomoću softvera Horos™ (The Horos Project, 64-bit preglednik medicinskih slika, GNU Lesser General Public License, verzija 3.0) na svakom CBCT-u. Mjere su kalibrirane s pomoću CT softvera, a CT skenovi su analizirani u paraksijalnom presjeku središta područja odabrano za ugradnju implantata i mezijalno/distalno od njega.

Tre tri mjere korištene su za izračun srednje rezidualne visine kosti (mRBH) (slika 1.).

Kirurški postupak

Svi pacijenti primili su jedan sat prije zahvata 2 g amoxicilina s klavulanskom kiselinom, a po 1 g morali su uzimati svakih 12 sati šest dana poslije operacije. Operacija je obavljena u lokalnoj anesteziji. Učinjen je krestalni rez po sredini, a oslobađanje je provedeno samo ako je bilo potrebno. Kalibriranim dlijetom horizontalno je oblikovan prozor manji od odabranih implantata. Prozor je mobiliziran početniši od uloga konvornih kalibriranih ručnim osteotomom istog promjera korišteno dlijeto. Kada se prozor mobilizira, pomiče se apikalno prema Schneiderovej membrani do 8 mm od krestalnih kosti. Ako je potrebno obavljena se njezina disekcija membrane. Alogeni materijal, sintetički beta-trikalcijski fosfat (Synthograft™, Bicon Implants LLC, Boston MA, SAD), umetnut je u sinus i lagano zbijen kalibriranim osteotomom do postizanja očekivane vertikalne dimenzije. Punnje je provjereno periapikalnim RTG-om.

Upotrijebljeni implantat, kratki dvozubi titanijev implantat (Bicon Implants LLC, Boston MA, SAD), povezan je s nadogradnjom SLA (sinus-lift abutment) (Bicon Implants LLC, Boston MA, SAD). SLA je nadogradnja za cijeljenje veća od antrostomije koja spriječava pomicanje implantata u si-
merged abutment larger than the antrostomy that prevents the displacing of the implant into the sinus. The SLA-Implant complex was positioned in the site tapping the abutment on the crestal bone. Primary stability was thus obtained by the friction between SLA and antrostomy. In order to obtain a primary closure of the flap, the wound edges were everted and simple knots were made, (Figure 2).

Patients were instructed to take analgesic treatment (Paracetamol 1g) only if required. Oral and written postoperative instructions were given to all patients. It was recommended to avoid increasing the pressure between the mouth and nose. Oral hygiene was performed as normal, except for toothbrushing around the implants site for 7 days. Sutures were daily deterged at home with chlorhexidine 0,20% and removed 7-10 days after surgery.

Prosthetic rehabilitation

After 6 months the implant was uncovered, and the SLA was removed rotating the abutment with forceps. Subsequently, the healing abutment was transgingivally connected to the implant.

After two weeks an impression was made and the implant was restored with a prosthesis called Integrated Abutment Crown (IACTM). Restauracija je izrađena od Morseove konične naluka.

Prostetička rehabilitacija

Nakon šest mjeseci implantat je otvoren, a SLA uklonjen rotirajući nadogradnju pincetom. Nakon toga je nadogradnja za cijeljenje transgingivno povezana s implantatom.

Nakon dva tjedna uzet je otisak i implantat je protetički opskrbljen jednodijelnom krunicom s nadogradnjom (IACTM).
Ugradnja kratkih implantata u atrofičnu maksilu uz istodobno podizanje dna sinusa

Crown (IACTM). The restoration was made of the Morse taper abutment and a composite crown fused together, one piece, for direct application on the implant. The abutment was made of Titanium alloy (Ti V6 A14) and the resin material used for the crown was a highly filled polymeric resin composite (Shofu Inc. Kyoto Japan) (Figure 3). Intraoral x-ray was performed (Figure 4).

Follow ups

After prosthetic rehabilitation, follow-up visits were scheduled at 1, 6 and 12 months during the first year of function, and annually thereafter. At each recall, clinical and radiographical (periapical) examination was carried out to evaluate the following: implant survival; marginal bone level; periodontal indices. Evaluations made at one month of follow-up were considered the baseline values.

In the follow-up evaluations, only the patients, who in the period of one year and five years from the implant placement needed a 3-dimensional investigation for other reason not linked to this study, were considered. In line to this, only 26 out of 102 patients (30 implants) were considered for the follow-ups evaluations. CBCT scans were evaluated in order to assess the mean bone height after prosthetic restoration (mARBH), (Figure 5).

Implant survival was defined as being symptom free and stable without mobility or radiographic evidence of severe bone loss (more than 2 mm). No inflammation or infection should affect hard and soft tissues. Two different examiners analyzed the implants using a blind analysis technique, and by giving univocal (yes/not) responses.

Marginal Bone Lost (MBL) is defined as the maximum distance from the implant-abutment junction (IAJ) to the marginal bone. Digital periapical radiographs were taken at each follow up and images were analyzed using the software (Dentsply, Sirona). Calibration was achieved using the software tools and using the implant length as control. Mesial and distal values (expressed in millimeters) were recorded for each implant. A positive value was assigned if the bone was over the IAJ, while a negative value was assigned if bone was below IAJ. The zero score was given when bone level was at IAJ. Mean value of the two measurements was obtained for each implant. Two different examiners, who were independent of the surgeons, were enrolled to evaluate radiograms. The mean value of mesial and distal measurement was obtained.

The mean values of MBL at baseline (1 month) were compared with values at the last follow up (five years) obtaining the marginal bone level variation (MBLV).

At each follow-up visit, a clinical evaluation was carried out in order to record the pocket depth (PD), the O’Leary plaque index (PI), and bleeding on probing (BOP) around implants.

PD was measured with a CP12 probe on six sites: three vestibular (mesial, vestibular, and distal) and three lingual (mesial, lingual, distal). The values, expressed in millimeters, were used to achieve the mean PD value for each implant and finally for all the implants.

PI was measured on six sites (three vestibular and three lingual) around each implant. Data were collected for all implants.

Prečenje

Nakon protertičke rehabilitacije kontrolni pregledi bili su dogovoreni jedan, šest i dvanaest mjeseci tijekom prve godine, a nakon toga jedanput svake godine. Pri svakom posjetu obavljen je klinički i radiološki (periapikalni) pregled kako bi se procijenilo sljedeće: preživljanje implantata, razina marginalne kosti i parodontološki indeksi. Vrijednosti dobivene nakon jednog mjeseca smatrane su osnovnim vrijednostima.

U naknadnim evaluacijama razmatarani su samo pacijenti kojima je u razdoblju jedne i pet godina od postavljanja implantata bilo potrebno trodimenzionalno istraživanje iz drugih razloga koji nisu povezani s ovim istraživanjem. U skladu s tim, samo je 26 od 102 pacijenta (30 implantata) uključeno u naknadne procjene. CBCT snimke analizirane su da bi se procijenila srednja visina kosti nakon protertičke restauracije (mARBH) (slika 5.).

Preživljanje implantata definirano je kao stabilno stanje bez simptoma i bez pokretljivosti ili radioloških dokaza o ozbiljnom gubitku kosti (više od 2 mm). Upala ili infekcija ne bi smjele utjecati na tvrda i meka tkiva. Dvoje različitih ispitivača analiziralo je implantate tehnikom slijepe analize i dvajam jednoznačnih (da/ne) odgovora.

Gubitak marginalne kosti (MBL) definiran je kao maksimalna udaljenost od spoja implantata i implantatne nadogradnje (IAJ) do marginalne kosti. Digitalne periapikalne snimke snimljene su tijekom svakog praženja i analizirane s pomoću softvera (Dentsply, Sirona). Kalibracija je postignuta softverskim alatima i korištenjem dužine implantata kao kontrole. Mezijalne i distalne vrijednosti (izražene u milimetrima) zabilježene su za svaki implantat. Pozitivna vrijednost dodijeljena je ako je kost bila isnad IAJ-a, a negativna ako je bila ispod IAJ-a. Ocjena nula dana je kada je razina kosti bila na IAJ-u. Prosječna vrijednost dviju mjera dobivena je za svaki implantat. Dvoje različitih ispitivača, koji su bili neovisni o kirurgu, uključeni su u procjenu rendgenske snimke. Dobivena je srednja vrijednost mezijalne i distalne mjere.

Prosječne vrijednosti MBL-a na početku (1 mjesec) uspoređivane su s vrijednostima u posljednjem praženju (pet godina) te se tako dobila varijacija razine marginalne kosti (MBLV).

Pri svakom naknadnom posjetu učinjena je klinička procjena da bi se zabilježila dubina džepa (PD), indeks plaka prema O’Learyiju (PI) i kvarenje na sondiranje (BOP) oko implantata.

PD je izmjerjen sondom CP12 na šest mjesta – tri vestibularno (mezijalna, vestibularna i distalna) i tri lingualno (mezijalno, lingvalno, distalno). Vrijednosti izražene u milimetrima korištene su za izračun srednje vrijednosti PD-a za svaki implantat i na kraju za sve implantate.

PI je izmjerjen na šest mjesta (tri vestibularno i tri lingualno) oko svakog implantata. Podatci su prikupljeni za sve im-
plants and were expressed as percentage of plaque sites (% PI) (number of surfaces with plaque/total number of sites examined x100).

BOP was also measured on six sites (three vestibular and three lingual) around each implant and evaluated altogether. Data are expressed as percentage of bleeding sites (% BOP) (Number of bleeding sites/total number of sites examined x100).

Two different examiners, independent of the surgeons, were enrolled to value implants.

ARBH is defined as the distance from the crest to the top of grafted bone after the surgery. It is achieved in the same way as mARBH using the CT scan software tools. Calibration was achieved using the software tools and using the implant length as control. The mean value (mARBH) was obtained for each implant by three measurements, one at the implant center and two mesially and distally of 2 mm on paraxial sections. The value of mARBH measured at 1 year of follow-up was compared to data at 5 years follow-up. The difference between the two values was the objective of this study and it has been called mARBH variation (mARBHv).

Some adverse events were recorded.

Results

A total of 30 implants were inserted in 26 patients. The population sample included 20 female and 6 male subjects. The average age of participants was 50.5 years (min 35 years and max 65 years). The dental sites treated were: 10 second upper premolar; 15 first upper molar; 5 second upper molar; max 65 years). The dental sites treated were: 10 second upper premolar, 15 first upper molar, 5 second upper molar. Three implant measures were used (diameter X length in mm): 5x6 (13); 5x5 (7); 6x5 (7); 6x6 (3). The mean RBH of population was 2.13 mm with a minimum of 1.1 mm and a maximum value of 3 mm.

- Implant survival:
  All the implants survived until the last follow-up.

- Marginal bone level variation:
  The difference of the mean bone level measured at each implant at 1-month follow-up and the mean value at 60 months of follow up (five years) resulted on average -0.33 mm (Standard Deviation (SD) 0.11) in the population observed (minimum -0.12 and maximum -0.52).

- Mean Bone Height After Prosthetic Restoration (mARBHv):
  The mean value registered at 1 year was compared to the mean value registered at 60 months. The bone harvested resorption was on average -0.4 mm (DS 0.26) in the population observed, with a minimum loss of -0.06 mm and the maximum loss of -1.11 mm. The bone loss could be expressed as percentage, mean 5% of vertical harvested bone loss (max -11%; min -1%).

- Periodontal indices at the last follow up (5 years):
  The probing depth measured in the six sites for each implant was used to achieve the mean PD for the entire population. The mean value was 1.22 mm (DS 0.72) with values ranging from 0 and 3 mm.

plantate and were expressed as percentage of plaque sites (% PI) (number of surfaces with plaque/total number of sites examined x100).

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Rezultati

Dvadeset i šestero pacijenata dobilo je ukupno 30 implantata. Uzorak populacije obuhvaćao je 20 žena i 6 muškaraca. Prosječna dob sudionika bila je 50,5 godina (najmanje 35 godina i najviše 65 godina). Regije liječenja obuhvaćale su: 10 gornjih pretkutnjaka, 15 prvih gornjih kutnjaka, 5 drugih gornjih kutnjaka. Korištene su три dimenzije implantata (promjer x dužina u mm): 5 x 6 (13); 5 x 5 (7); 6 x 5 (7); 6 x 6 (3). Prosječni RBH populacije bio je 2,13 mm s minimalnom vrijednošću od 1,1 mm i maksimalnom vrijednošću od 3 mm.

- Preživljavanje implantata:
  svi implantati preživjeli su do posljednjeg praćenja.

- Varijacija razine marginalne kosti
  Razlika srednje razine kosti izmjerene na svakom implantatu tijekom jednomjesečeg praćenja i srednje vrijednosti nakon 60 mjeseci (pet godina) rezultirala je u prosjeku gubitkom od 0,33 mm [standardna devijacija (SD) 0,11] u pro-matranoj populaciji (minimalno -0,12, a maksimalno -0,52).

- Srednja visina kosti nakon protetičke opskrbe (mARBHv)
  Prosječna vrijednost zabilježena poslije jedne godine uspoređena je sa srednjom vrijednošću registriranom nakon 60 mjeseci. Resorpcija kosti iznosila je u prosjeku -0,4 mm (DS 0,26) u praćenoj populaciji, s minimalnim gubitkom od -0,06 mm i maksimalnim gubitkom od -1,11 mm. Gubitak kosti može se izraziti kao postotak, što znači 5% vertikalnoga gubitka kosti (maks. -11%; min. -1%).

- Parodontološki indeksi u posljednjem praćenju (5 godina)
  Dubina sondiranja izmjerena na šest mjesta za svaki implantat korištena je za izračun srednje vrijednosti PD-a za ci-
Plaque and bleeding were recorded among the implant group at the last follow up. Thirty-two sites were positive to plaque and eighteen sites were positive to bleeding among the 180 sites analyzed. The relative mean percentage of Plaque Index was 17.47% (DS 15.01), while the mean percentage of Bleeding on Probing was 9.87% (DS 19.17).

The principal data on the five years follow-up are listed in Table 1.

| Table 1 | Schematic representation of the principal final data with respective mean values and standard deviations (SD). |
|---------|------------------------------------------------------------------------------------------------------------------|
| Implant survival • Preživljavanje implantata | 100 % |
| Mean MBLv • Prosječni MBLv | -0.33 mm (SD 0.11) |
| Mean PD • Prosječni PD | 1.22 mm (SD 0.72) |
| Mean PI • Prosječni PI | 17.47 % (SD 15.01) |
| Mean BOP • Prosječni BOP | 9.87 % (SD 19.17) |
| Adverse events • Neželjeni događaji | 0 |
| ARBHv | -0.4 mm (SD 0.26) on average (5 %) |

Discussion

The maxillary atrophy is a challenge for prosthetic rehabilitation. Over the years, many techniques were recommended to gain the adequate bone volume to place dental implants (1). The sinus floor elevation is the most documented treatment option and various techniques have been described. Many authors have questioned the best approach for each condition (2). The vertical residual bone height has been considered the crucial parameter in choosing the best strategy. When the amount of residual bone is at least 5 mm vertically, the immediate implant positioning is allowed (11), while the lateral approach for sinus floor elevation and delayed implant positioning is suggested in case of 4mm or less of residual vertical bone (17).

The objective of this study was to evaluate the long-term performance of a sinus floor elevation technique that allows immediate implant positioning in case of residual bone height less than 3 mm.

The population observed showed a good maintenance of crestal bone after the prosthetic restoration (mean -0.33 mm of crestal loss after 5 years). The stability of crestal bone could be explained by the subcrestal placement of the conometric implant-abutment junction. The mechanical and biological seal joined to the epicrestal stimuli carried by the abutment could be considered the key factor. The good health condition is confirmed by good values of periodontal indices registered.

The findings of this paper could be considered satisfactory according to the results presented in the literature (29).

As previously reported, socio-economic status and patients’ compliance are crucial in order to achieve implant success (30). All patients in care at Oral Surgery Unit of the Department of Oral and Maxillofacial Sciences of “Sapienza” University of Rome have been regularly followed over the years. In our study, after 5 year of function, we noted a reduction of grafted bone of 5% (mean value) in the interval between one year and five year follow up. The value is conformable to the results published in the literature (29).
sidered acceptable according to the results present in the litera-
ture (29, 31).
In authors’ opinion, the substantial stability of graft-
ed bone volume depends not only on the osteoconductivity of
the bone allograft but also on the formation of haversian
bone following the functional stimulation carried out by the
implant design. As reported by histological studies, the pla-
teau macrodesign of those implants allows a direct bone for-
mation (32). The healing chamber is filled by the blood clot,
promoting the contact with fibrin and osteogenic cells, lead-
ting to bone formation (33).
Moreover, in reference to our case, Daher S. (2019) re-
ported a histological analysis of a human retrieved function-
ing implant which was placed using Beta-Tricalcium Phos-
phate (34). The specimen analyzed showed no discernable
differences between the original host bone and a new bone in
terms of lamellar and osteonic structure.
Eventually, the use of short implants could reduce the
time of rehabilitation, thus providing faster prosthesis even in
case of extreme atrophy, when compared to traditional bone
graft procedures.

Conclusions
This technique is considered safe for the patient and less
invasive if compared to LSFE. Incidents and compliances are
inevitable in every surgical procedure, even more in these ad-
vanced cases. The worst complication is a displacement of the
fixture into the sinus. Anyway, if the case is carefully selected
and the procedure carefully performed, the main complica-
tions are avoided.
Although more casuistry is needed, with its limitations,
this research validated the viability of the technique present-
ed.

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Institutional Review Board Statement
The study was conducted according to the guidelines of
the Declaration of Helsinki and approved by the Institutional
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Informed Consent Statement
Informed consent was obtained from all subjects involved
in the study.

Conflicts of Interest
The authors declare no conflict of interest.

Author’s Contributions: Conceptualization, A.C. and S.C.;
methodology, A.C.; software, A.P.; validation, L.T.; formal analysis, G.P.; in-
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Prema mišljenju autora, stabilnost volumena augmentira-
ne kosti ne ovisi samo o osteokonduktivnosti koštanoga alo-
grafta, nego i o formiranju kosti nakon funkcijalne stimula-
cije zbog dizajna implantata. Kao što su pokazale histološke
studije, makrodizajn tih implantata omogućuje izravno stva-
ranje kosti (32). Štajkina se puni krvnim ugroženom potiču-
ći kontakt s fibrinom i osteogenim stanicama, pa se počinje
stvarati kost (33).
Štovše, S. Daher (2019.) izvijestio je o histološkoj anal-
iziji ljudskoga funkcionalnog implantata koji je postavljen s
pomoću beta-trikalcijeva fosfa (34). Analizirani uzorak nije
pokazao uočljive razlike između izvorne kosti domaćina i no-
voformirane kosti kad je riječ o strukturi.
Na kraju, upotreba kratkih implantata mogla bi skratiti
rehabilitaciju i tako omogućiti brži protetički oskrbu, čak i
u slučaju ekstremne atrofije, u usporedbi s tradicionalnim po-
stupcima augmentacije kosti.

Zaključci
Ova se tehnika smatra sigurnom za pacijenta i manje in-
vazivnom u usporedbi s LSFE-om. Komplikacije su kratk
e izbježne tijekom kirurškog zahvata, čak i češće u ovim slo-
ženim slučajevima. Najgore što se može dogoditi jest pom-
canje implantata u sinus. U svakom slučaju, ako se pažljivo
odabere slučaj i jednako tako obavi postupak, izbjegavaju se
veće komplikacije.
Iako je potreban veći broj slučajeva, uzimaći u obzir
ograničenja, ovo je istraživanje potvrdilo održivost predstav-
ljene tehnike.

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A.C.; All authors have read and agreed to the published version of the
manuscript.
Sazetak

Svrsna rada: Mnogi su se autori pokusali suočiti s anatomskim ograničenjima koja nastaju zbog atrofije makijske kosti. Do visine kosti od pet milimetara lateralno podizanje dna sinusa najčešće je korištena i potvrđena strategija za protektivku rehabilitaciju. No nedostatci te tehničke su uvisinost i odgođena rehabilitacija. Prikaz se ovoga rada bio je procenti poteškoće i kličen ugrađenih implantata tehnikom koja omogućuje perkrestalno podizanje dna sinusa i imedijatnu ugradnju implanta.

Materijal i metode: Obavljeno je 30 transkrestalnih podizanja dna sinusa sa isprednjoj ugradnjom ugradnje implantat u vrlo atrofiranu maksilu. Procijenjena su preživljavanja implantata, varijacija razine marginalne kosti te varijacija visine kosti i parodontoloških indeksa. Rezultati: Nakon petogodišnjeg praćenja ni jedan od trideset implantata nije bio izgubljen. Srednja vrijednost vertikalnog gubitka kosti iznosila je 5%.

Zaključak: Dobiveni rezultati uspoređivu su s kriterijima uspješnosti u imantloškoj rehabilitaciji. Prikazana tehnika pokazala se u visinom u promatranoj populaciji, uz minimalne traume i smanjenu invazivnost.

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