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Overdentures on Implants Placed in Bone Augmented with Fresh Frozen Bone

Leone Rigo[1], Alessandro Viscioni[1], Maurizio Franco[1], Riccardo Guidi[2], Laura Strohmenger[2], Giorgio Brunelli[3], Francesco Carinci[3]

[1]Department of Maxillofacial Surgery, Civil Hospital, Castelfranco Veneto, Italy;
[2]Dental School, University of Milan, Milan, Italy;
[3]Department of Maxillofacial Surgery, University of Ferrara, Ferrara, Italy

SUMMARY

Introduction In the last decade several studies have been performed to evaluate the clinical outcome of one or two stage loaded implants supporting overdentures.

Aim Since fresh frozen bone (FFB) has an ever-increasing number of clinical applications and few reports are available on implants inserted into FFB, we performed a retrospective study on fixtures inserted in FFB and bearing overdentures.

Methods In the period between December 2003 and December 2006, 17 patients (14 females and 3 males with a median age of about 56 years) were grafted and 60 implants inserted thereafter. A total of 17 overdentures were delivered: 8 in the mandible and 9 in the maxilla. Multiple implant systems were used: 22 Double etched, 7 SLA, 9 Anodic oxidized, and 22 $CaPo_4$ ceramic-blasted. Implant diameter ranged from 3.25 to 4.3 mm and length from 11.5 to 16.0 mm. Implants were inserted to replace 23 incisors, 9 cuspids, 20 premolars and 8 molars.

Results No implants were lost (i.e. survival rate = 100%) and no differences were detected among the studied variables. Kaplan Meier algorithm and Cox regression did not reveal any statistical differences among the studied variables also as regards the success rate.

Conclusion Implants inserted FFB and bearing overdentures have a high survival rate and success rates, which are comparable to those of implants inserted in non-grafted bone. FFB bone is a reliable material for alveolar ridge augmentation. No difference was detected among removable prostheses supported by 2 or more implants.

Keywords: iliac crest; allograft; homograft; overdenture; ridge augmentation

INTRODUCTION

Overdentures (ODs) are reliable, non-invasive, low cost devices for replacing missing teeth. Implants can retain ODs in both jaws and they greatly improve the retention and stability of dentures [1, 2]. In the mandible OD design is based on two to four implants placed in the interforaminal region, possibly connected together with a bar [3]. In the maxilla, it is usually recommended that a minimum of four implants joined together with two lateral bars are provided due to the poorer bone quality of the upper jaw [4].

Clinical trials on implant-retaining ODs report a cumulative survival rate (SVR i.e. total implants still in place at the end of the follow-up) of about 90% at 5 years and a success rate (SCR i.e. good clinical, radiological and aesthetic outcome) of more then 85% [1-4]. Immediate loading (i.e. placing the final or provisional prosthetic restoration immediately after the surgical procedure) of four implants retaining mandibular Ods [5] is a predictable procedure, which permits successful dental rehabilitation with a shortening of treatment times. Even in a totally edentulous maxilla immediate loading of ODs is a successful procedure [6].

In recent years, several reports have become available on atrophied edentulous jaws grafted with autologous bone to restore alveolar ridge volume prior to implant insertion [7-10]. Although autografts are the standard procedure for bone grafting, it is sometimes not possible to collect an adequate amount of bone from other donor sites in the same patient [11]. Moreover, autologous bone grafts have the drawback of requiring secondary surgery for autograft retrieval, with increased operation time, and donor site morbidity. On the other hand, biomaterials are good but expensive, and may extrude at a later date. So, the use of homografts provides a reasonable alternative to meet the need for graft material [11].

A homograft (or allograft) is a transplant in which transplanted cells, tissues or organs are sourced from a genetically non-identical member of the same species. Bone allograft transplantation has been performed in humans for more than one hundred years and is being used in increasing numbers by orthopedic surgeons [12].

Many forms of banked bone allograft are available: among them are fresh frozen bone (FFB), freeze dried bone (FDB), and demineralized fresh dried bone (DFDB). Each one of these grafts carries risks and has unique limitations and handling properties. In order to use these materials appropriately, the surgeon must be familiar with the properties of each of them and must feel confident that the bone bank providing the graft is supplying a safe and sterile graft [13].

Since FFB has an ever-increasing number of clinical applications and no report is available on implants inserted into FFB and bearing ODs we therefore decided to perform a retrospective study.

METHODS

Patients

In the period between December 2003 and December 2006, 81 patients (52 females and 29 males) with a median age of 52 years were operated on at the Civil Hospital, Castelfranco Veneto, Italy. Among them, 17 patients (14 females and 3 males) with a median age of 56 years were grafted with FFB and then implants were inserted. A total of 17 ODs were delivered: 8 in the mandible and 9 in the maxilla. Informed written consent approved by the local Ethics Committee was obtained from patients to use their data for research purpose. The mean implant follow-up was 26 months.

Homologue FFBs were inserted in patients' jaws under general anesthesia. All patients have atrophic jaws due to lost teeth. Usually the mean post-grafting period was 6 months before implant surgery and the final prosthetic restoration was delivered after an additional 6 months.

Subjects were screened according to the following inclusion criteria for implant placement: controlled oral hygiene, the absence of any lesions in the oral cavity, sufficient residual bone volume (i.e. autologous plus FFB graft) to receive implants of 3.25 mm in diameter and 11.5 mm in length; in addition, the patients had to agree to participate in a post-operative check-up program.

Exclusion criteria were as follows: a high degree of bruxism, smoking more than 20 cigarettes/day and excessive consumption of alcohol, localized radiation therapy of the oral cavity, antitumor chemotherapy, liver, blood and kidney diseases, immunosupressed patients, patients taking corticosteroids, pregnant women, inflammatory and autoimmune diseases of the oral cavity, poor oral hygiene.

Graft material

The FFB - obtained from the Veneto Tissue Bank in Treviso (Italy) - is a mineralized, non-irradiated, only disinfected and frozen homologous bone (Regione Veneto, Law n. 3948, 15 December 2000). The bone harvesting is obtained from the anterior and posterior iliac crest, in the first 12 hours after donor death. The bone is then disinfected, for at least 72 hours at -4°C, in a polychemotherapeutic solution of vancomycine, polymyxine, glazidine and lincomycine, following that the sample is irrigated with a sterile saline solution. The sample is then subdivided into cortico-medullary blocks, packed in double sterile casing and frozen at -80°C.

The requirements for homologous bone donors are more stringent with respect to those of organ donors. The presence of risk factors such as contagious disease, neoplasm, rheumatical and/or degenerative disease and sepsis necessarily disqualifies the donor. In order to detect infectious agents, the following tests are performed on donor blood samples taken within 8 hours of death: anti-HIV-I/II Ab, anti-HCV Ab, HbsAg, anti-HBc Ab, anti-HBs Ab, anti-HTLV-I/II Ab, anti-Ag Treponemal Ab, anti-CMV IgG Ab, anti-CMV IgM Ab, anti-Toxoplasma IgG Ab, anti-Toxoplasma IgM Ab. A culture is also performed to detect aerobic and anaerobic bacteria, mycobacteria and mycotical agents. As a further safety method, a serological follow-up is conducted using Polymerase Chain Reaction techniques to detect any viral RNA or DNA of HIV, HCV and HBV. This method reduces the "diagnostic window period" to 7 days for HIV, HCV and HBV.

Grafting procedure and outcome

Data regarding grafting procedure and FFB outcome were recently published [14].

Data collection

Before surgery, radiographic examinations were done with the use of orthopantomograph and CT scans.

In each patient, peri-implant crestal bone levels were evaluated by the calibrated examination of ortopantomograph x-rays (Ortoralix SD, Gendex, Milano, Italia). Measurements were recorded before surgery, after surgery and at the end of the follow-up period. The measurements were carried out mesially and distally to each implant, calculating the distance between the implant abutment junction and the bone crestal level. The bone level recorded just after the surgical insertion of the implant was the reference point for the following measurements. The measurement was rounded off to the nearest 0.1 mm. A Peak scale loupe (The GWJ Company, Hacienda Heights, CA, USA) with a magnifying factor of seven times and a scale graduated in 0.1 mm was used.

Peri-implant probing was not performed since controversy still exists regarding the correlation between probing depth and implant success rates [15, 16].

The implant success rate (SCR) was evaluated according to the following criteria: absence of persisting pain or dysesthesia; absence of peri-implant infection with suppuration; absence of mobility; and absence of persisting peri-implant bone resorption greater than 1,5 mm during the first year of loading and 0,2 mm/years during the following years [17].

Implants

A total of 60 implants were inserted in 17 patients: 9 (15.0%) and 51 (85.0%) in partially and totally edentulous patients, respectively. Twenty (33.3%) were placed as four implants connected with two bars (FICWTB) in the maxilla to support prosthetic restorations and 40 (66.7%) in the remaining ODs which were retained by 2 implants (n=3 prostheses, all in the mandible), 3 fixtures (n=6 prostheses, 5 in the mandible and one in the maxilla), 5

implants (n=2 prostheses, all in maxilla) and 6 implants (n=1 prosthetic restoration in maxilla). There were 22 Double etched (3i implants, Osseotite, Biomet Inc., US), 7 SLA (Astra implants, Astratech Inc., US), 9 Anodic oxidized, and 22 $CaPo_4$ Ceramic-blasted (RBM implants, Lifecore Biomedical Inc., US).

Implant diameter and length ranged from 3.25 to 4.3 mm and from 11.5 to 16.0 mm, respectively. Implants were inserted to replace 23 incisors, 9 cuspids, 20 premolars and 8 molars.

Implantological and prosthetic technique

All patients underwent the same surgical protocol. An antimicrobial prophylaxis was administered with 500 mg Amoxycillin twice daily for 5 days starting 1 hour before surgery. Local anesthesia was induced by infiltration with articaine/epinephrine and post-surgical analgesic treatment was performed with 100 mg Nimesulid twice daily for 3 days. Oral hygiene instructions were provided.

After making a crestal incision a mucoperiosteal flap was elevated. Implants were inserted according to the procedures recommended. The implant platform was positioned at the alveolar crest level. Sutures were removed 14 days after surgery. After 24 weeks from implant insertion, the provisional prosthesis was provided and the final restoration was usually delivered within an additional 4 weeks. The number of prosthetic units (i.e. NPU, implant/crown ratio) was about 0.3. All patients were included in a strict hygiene recall.

A total of 17 ODs were delivered: 8 in the mandible and 9 in the maxilla. In the maxilla there were 5 FICWTB; all the remaining ODs were supported by 2 implants (n=3 prostheses) or 3 implants (n=6 prostheses) or 5 implants (n=2 prostheses) or 6 implants (n=1 prosthetic restoration). Thirty-nine implants were inserted in the maxilla and 21 in the mandible. The antagonist was a complete prosthesis in 12 cases, a mix of natural teeth and prosthesis in 4 cases and natural teeth only in one case. All the antagonists of the mandible were complete prostheses; among the antagonists of the maxilla, 4 were complete prostheses, 3 partial prostheses and 1 was made of natural teeth. Fifteen patients had bimaxillary total edentulism, whereas two were partially edentulous in the antagonist jaw.

Statistical analysis

Since no implants were lost (i.e. SVR = 100%), no or reduced crestal bone resorption was considered an indicator of SCR to evaluate the effect of several host-, implant-, and occlusion-related factors.

The difference between the implant abutment junction and the bone crestal level was defined as the Implant Abutment Junction (IAJ) and calculated at the time of operation and during follow-up. The delta IAJ is the difference between the IAJ at the last check-up and the IAJ recorded just after the operation. Delta IAJ medians were stratified according to the variables of interest.

Disease-specific survival curves were calculated according to the product-limit method (Kaplan-Meier algorithm) [18]. Cox regression analysis was then applied to determine the single contribution of covariates on survival rate [19]. Stepwise Cox analysis allowed us to detect the variables most associated with implant' survival and/or success.

RESULTS

Tables 1 to 6 report the median delta IAJ according to the studied variables. No implants were lost in the post-operative period (i.e. SVR=100%).

As regards SCR, the Kaplan Meier algorithm demonstrates that no variables are associated with statistically significant differences in the delta IAJ (also comparing ODs vs. FICWTB, Log rank test 1.54; df=1; p=0.2). Cox regression gave the same result (Table 7).

Table 1. Distribution of implant sites and ΔIAJ
Tabela 1. Raspodela lokalizacije implantata i ΔIAJ

Implant site Lokalizacija implantata	Number Broj	Mean Srednja vrednost
Incisors Sekutići	23	1.9±0.9
Cuspids Očnjaci	9	1.6±0.5
Premolars Premolari	20	1.7±0.5
Molars Molari	8	2.2±1.2

Table 2. Distribution of implant length and ΔIAJ
Tabela 2. Raspodela dužine implantata i ΔIAJ

Implant length Dužina implantata	Number Broj	Mean Srednja vrednost
<13 mm	3	1.5±0.5
13 mm	29	2.0±1.0
>13 mm	28	1.7±0.6

Table 3. Distribution of implant diameter and ΔIAJ
Tabela 3. Raspodela prečnika implantata i ΔIAJ

Implant diameter Prečnik implantata	Number Broj	Mean Srednja vrednost
<3.75 mm	7	1.7±1.3
3.75 mm	32	1.8±0.5
>3.75 mm	21	2.0±1.0

Table 4. Distribution of implant types and ΔIAJ
Tabela 4. Raspodela vrste implantata i ΔIAJ

Implant type Vrsta implantata	Number Broj	Mean Srednja vrednost
Double etched Dvostruko nagrizani	22	2.0±1.1
SLA1	7	1.3±0.4
Anodic oxidized Anodom oksidisani	9	1.4±0.4
CaPo4 ceramic-blasted Keramički	22	2.0±0.3

Table 5. Distribution of overdentures and ΔIAJ
Tabela 5. Raspodela supradentalnih proteza i ΔIAJ

Prosthetic type Vrsta proteze	Number Broj	Mean Srednja vrednost
FICWTB	20	2.0±0.6
Other overdentures Ostale supradentalne proteze	40	1.7±0.8

Table 6. Distribution of edentulism and ΔIAJ
Tabela 6. Raspodela bezubosti i ΔIAJ

Edentulism type Vrsta bezubosti	Number Broj	Mean Srednja vrednost
Partial Parcijalna	9	2.1±1.2
Total Totalna	51	1.8±0.7

Table 7. Output of the Cox regression reporting the variables associated statistically with ΔIAJ
Tabela 7. Rezultati Koksove regresije sa varijablama značajno povezanim sa ΔIAJ

Variable Varijabla	B	S.E.	Significance Značajnost (p<0.05)	95% CI	
				Lower Donji	Upper Gornji
Age Starost	0.1855	0.0556	0.0008	1.0796	1.3425
Gender Pol	1.3114	1.3856	0.3439	0.2455	56.0996
Graft site Lokalizacija grafta	-1.8390	2.0399	0.3673	0.0029	8.6632
Implant site Lokalizacija implantata	-0.9766	0.6366	0.1250	0.1081	1.3114
Implant length Dužina implantata	1.4352	1.0040	0.1528	0.5871	30.0545
Implant diameter Prečnik implantata	1.4501	0.8995	0.1069	0.7314	24.8567
Implant type Vrsta implantata	-0.1976	0.3543	0.5770	0.4098	1.6435
Type of overdenture Vrsta supradentalne proteze	1.0353	1.3845	0.4546	0.1867	42.4753
Type of edentulism Vrsta bezubosti	-0.1764	1.5657	0.9103	0.0390	18.0342

DISCUSSION

The identification of guidelines for the long term SVR (i.e. total implants still in place at the end of the follow-up) and SCR (i.e. good clinical, radiological and aesthetic outcome) are the main goals of the recent literature. Several variables can influence the final result, but in general they can be grouped as surgery-, host-, implant-, and occlusion-related factors [20]. The surgery-related factors comprise several variables such as an excess of surgical trauma for instance, thermal injury [21], bone preparation, drill sharpness and design [22]. Bone quality and quantity are the most important host-related factors [22, 23], while length [24] and design [25], surface coating [26], and diameter [27, 28] are the strongest implant-related factors. Finally, quality and quantity of force [29] and prosthetic design [30] are the variables of interest among the occlusion-related factors. All these variables are a matter of scientific investigation since they may affect the clinical outcome.

In general, length (Table 2), diameter (Table 3) and type (Table 4) are considered to be relevant fixture-related factors. In the present study none has had a statistically significant impact on the clinical outcome. Previous reports on implants inserted into autologous iliac crest bone graft and supporting fixed restoration have comparable results [7-10].

Bone quality, a host-related factor, is believed to be one of the most important predictors of outcome. It is generally accepted that the mandible (especially the interforaminal region) has a better bone quality than the maxilla, and this fact is probably the reason why several reports are available regarding critical occlusal procedure (i.e. immediate loading) of implants inserted into the mandible with a high SVR [5]. Our data has shown that FFB is an effective material for restoring alveolar ridge volume as no implants were lost nor was alveolar bone greatly resorbed.

In a recent report Sjöström et al. [9] performed a longitudinal follow-up study of implant stability in grafted maxillae. A total of 192 implants were placed with a survival rate of 90% at the 3-year follow up. Twelve of the 20 failed implants were lost before loading (early failures), whereas the change in the marginal bone level was 0.3±0.3 mm between baseline (bridge delivery) and the 3-year follow up. This datum indicates a better SCR for implant inserted in autografts compared to those inserted in FFB.

Among the occlusal-related factors, FICWTB were analyzed separately from other types of ODs (i.e. supported by 2, 3, 5 or 6 implants) but no statistically differences were detected. This is in agreement with other reports where different numbers of implants were successfully used to bear ODs [1-6].

CONCLUSION

FFB is a reliable grafting material for the insertion of implants retaining ODs. Fixtures inserted in FFB had a high survival and success rate similar to those reported in previous studies on non-grafted jaws. Implants inserted in FFB are successful devices for oral rehabilitation.

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Address for correspondence
Prof. Francesco Carinci, M.D.
Chair of Maxillofacial Surgery
Arcispedale S. Anna
Corso Giovecca 203
44100 Ferrara
Italy
Email: crc@unife.it
Web: www.carinci.org
Phone/Fax: +39.0532.455582

Supradentalne proteze na implantatima u alografu sveže zamrznute kosti

Leone Rigo[1], Alessandro Viscioni[1], Maurizio Franco[1], Riccardo Guidi[2], Laura Strohmenger[2], Giorgio Brunelli[3], Francesco Carinci[3]

[1]Odeljenje maksilofacijalne hirurgije, Civilna bolnica, Kastelfranko Veneto, Italija;
[2]Stomatološki fakultet, Univerzitet u Milanu, Milano, Italija;
[3]Odsek maksilofacijalne hirurgije, Univerzitet u Ferari, Ferara, Italija

KRATAK SADRŽAJ

Uvod U poslednjoj deceniji nekoliko studija je ispitivalo klinički uspeh jednostepeno ili dvostepeno opterećenih implantata supradentalnim protezama.

Cilj rada Kako sveža zamrznuta kost (SZK) ima sve veći potencijal u kliničkoj primeni, a tek nekoliko studija je urađeno na implantatima ugrađenim u SZK, uradili smo ovu retrospektivnu studiju na implantatima ugrađenim u SZK i opterećenim supradentalnim protezama.

Metode rada Od decembra 2003. do decembra 2006. godine kod 17 pacijenata (14 žena) prosečne starosti od 56 godina ugrađeni su graftovi i 60 implantata nakon toga. Ukupno je ugrađeno 17 supradentalnih proteza: osam u mandibuli i devet u maksili. Ugrađena su 22 implantata sa dvostrukim nagrizanjem, sedam SLA, devet anodnooksidisanih i 22 $CaPO_4$ keramička. Prečnik implantata je bio 3,25-4,3 mm, dok je dužina bila 11,5-16,0 mm. Implantati su zamenili 23 sekutića, devet očnjaka, 20 premolara i osam molara.

Rezultati Nijedan implantat nije bio neuspešan i nije zabeležena statistički značajna razlika između posmatranih parametara. Kaplan-Majerov (*Kaplan-Meier*) algoritam i Koksova (*Cox*) regresija nisu pokazali značajne razlike između posmatranih parametara u pogledu stope uspešnosti.

Zaključak Implantati ugrađeni u SZK i opterećeni supradentalnim protezama imaju visoke stope uspešnosti i preživljavanja, slične implantatima u kosti bez grafta. SZK je pouzdan materijal za augmentaciju alveolarnog grebena. Nije utvrđena razlika između parcijalnih proteza na dva implantata ili više njih.

Ključne reči: ilijačna kost; alograft; homograft; supradentalne proteze; augmentacija grebena

UVOD

Supradentalne proteze (SP) su pouzdane, neinvazivne i jeftine nadoknade kojima se zamenjuju zubi koji nedostaju. Mogu biti poduprte implantatima u obe vilice, a značajno povećavaju retenciju i stabilnost proteza [1, 2]. U mandibuli je dizajn SP zasnovan na dva do četiri implantata u interforaminalnoj regiji, koji mogu biti povezani spojnicom [3]. U maksili se obično preporučuje spajanje najmanje četiri implantata sa dve lateralne spojnice zbog slabijeg kvaliteta kosti u gornjoj vilici [4].

Kliničke studije na SP nošenim implantatima prikazuju kumulativnu stopu preživljavanja (SVR, tj. ukupan broj implantata *in situ* na kraju perioda praćenja) od oko 90% posle pet godina i stopu uspešnosti (SCR, tj. dobar klinički, radiološki i estetski ishod) od preko 85% [1-4]. Imedijatno opterećenje (postavljanje konačne ili privremene protetičke nadoknade neposredno nakon hirurške procedure) četiri implantata koja nose mandibularnu SP je predvidljiv postupak koji omogućava uspešnu rehabilitaciju sa skraćivanjem kliničkog radnog vremena [5]. Čak i kod pacijenata koji u gornjoj vilici nemaju zuba ovo opterećenje SP se smatra uspešnom procedurom [6].

Poslednjih godina izvedeno je nekoliko studija na atrofiranim bezubim vilicama s autolognim koštanim graftovima kojima je nadoknađen volumen alveolarnog grebena pre ugradnje implantata [7-10]. Iako su autografovi standardan postupak za koštanu augmentaciju, ponekad nije moguće uzeti dovoljnu količinu kosti sa drugih donorskih mesta kod jednog istog pacijenta [11]. Osim toga, autologni koštani graft ima manu jer zahteva sekundarnu hiruršku intervenciju na donorskom mestu, što produžava radno vreme i morbiditet donorskog mesta. S druge strane, biomaterijali su dobri, ali skupi, te mogu biti odbačeni u kasnijoj fazi. Zato upotreba homografova predstavlja dobru alternativu, kojom se zadovoljavaju zahtevi materijala za graftove [11].

Homograft (ili alograft) je transplantat u kojem presađene ćelije, presađena tkiva i organi potiču od genetski različitih članova iste vrste. Transplantacija koštanog alografta se obavlja na ljudima već više od stotinu godina, najčešće prilikom ortopedskih intervencija [12]. Dostupni su različiti oblici koštanih alografova: sveža zamrznuta kost (SZK), zamrznuta suva kost (ZSK) i demineralizovana sveža suva kost (DSSK). Svaki od njih nosi određene rizike i ima jedinstvene mane i osobine rukovanja. Da bi se ovi materijali pravilno upotrebili, hirurg mora poznavati osobine svakoga od njih i biti siguran da banka graftova obezbeđuje bezbedne i sterilne graftove [13].

Budući da SZK ima sve više kliničkih primena, a nema dostupnih studija koje su opisale implantate ugrađene u SZK i opterećene SP, odlučili smo da uradimo retrospektivu studiju upravo o tome.

METODE RADA

Pacijenti

Od decembra 2003. do decembra 2006. godine ukupno 81 pacijent (52 ženskog i 29 muškog pola) prosečne starosti od 52 godine operisan je u Civilnoj bolnici u Kastelfranku Venetu, u Italiji. Kod 17 ovih pacijenata (14 žena) prosečne starosti od 56 godina ugrađeni su graftovi SZK i implantati. Ukupno 17 SP je ugrađeno posle toga: osam u donjoj i devet u gornjoj vilici. Od svakog pacijenta je dobijen potpisani pristanak na intervenciju,

a studiju je odobrio Etički komitet ustanove. Prosečno vreme praćenja implantata bilo je 26 meseci.

Homologni SZK graftovi su ugrađeni u opštoj anesteziji. Svi pacijenti su imali atrofične vilice zbog nedostatka zuba. Obično je prosečan tzv. postgrafting period trajao šest meseci pre implantne hirurgije i dodatnih šest meseci pre konačne protetičke rekonstrukcije.

Ispitanici su odabrani prema sledećim kriterijumima: kontrolisana oralna higijena, odsustvo lezija u usnoj duplji, dovoljan volumen kosti (autologni plus SZK graft) – za implantate 3,25 mm u prečniku i 11,5 mm dužine, i pristanak pacijenta da učestvuje u programu nadgledanja posle operacije. Kriterijumi za isključivanje iz studije bili su: izražen bruksizam, pušenje više od 20 cigareta dnevno, neumereno konzumiranje alkohola, lokalizovana radioterapija usne duplje, hemioterapija kod tumora, oboljenja jetre, krvi i bubrega, imunosupresija, kortikosteroidna terapija, trudnoća, zapaljenjske i autoimune bolesti usne duplje i loša oralna higijena.

Materijal za graft

SZK iz tkivne banke „Veneto" u Trevizu (Italija) je mineralizovani, nezračeni, dezinfikovani, smrznuti preparat homologne kosti. Kost je dobijena iz prednje i zadnje ilijačne kosti tokom prvih 12 sati od smrti davaoca. Kost je zatim dezinfikovana najmanje 72 sata na temperaturi od -4°C u polihemoterapijskom rastvoru vankomicina, polimiksina, glazidina i linkomicina, posle čega je ispirana sterilnim fiziološkim rastvorom. Uzorak kosti je zatim podeljen na kortikomedularne blokove, pakovane u dvostruko sterilisanim pakovanjima, koji su smrznuti na -80°C.

Zahtevi za davaoce homologne kosti su oštriji nego za davaoce organa. Faktori rizika za infektivno oboljenje, neoplazmu, reumatoidno, odnosno degenerativno oboljenje i sepsu automatski diskvalifikuju davaoca. Da bi se otkrili infektivni agensi, izvedeni su sledeći testovi na tkivima davaoca u roku od osam sati od trenutka smrti: anti-HIV-I/II Ab, anti-HCV Ab, anti-Hbs Ag, anti-HBc Ab, anti-HBs Ab, anti-HTLV-I/II Ab, anti-Ag Treponema Ab, anti-CMV IgG Ab, anti-CMV IgM Ab, anti-Toxoplasma IgG Ab, anti-Toxoplasma IgM Ab. Zasejavanje je takođe urađeno, kako bi se otkrile aerobne i anaerobne bakterije, mikobakterije i mikotični agensi. Kao još jedna mera prevencije, serološko ispitivanje je obavljeno primenom PCR tehnike, da bi se otkrili RNK i DNK HIV, HCV i HBV virusi. Ovaj metod smanjuje tzv. period dijagnostičkog prozora na sedam dana za HIV, HCV i HBV.

Grafting procedura i ishod

Podaci o ovoj proceduri i ishodu su nedavno objavljeni [14].

Prikupljanje podataka

Pre hirurške intervencije urađeni su OPT i CT. Kod svakog pacijenta nivo periimplantne kosti je procenjen na osnovu kalibrisanih OPT snimaka (Ortoralix SD, Gendex, Milan, Italy). Merenja su urađena pre i posle operacije i na kraju perioda praćenja. Merenja su rađena mezijalno i distalno od svakog implantata, pri čemu je izračunata udaljenost između implantata i nivoa koštanog grebena. Nivo kosti neposredno nakon hirurške ugradnje implantata je služio kao referentna vrednost za kasnija merenja. Merenje je zaokruživano na najbliži 0,1 mm. Korišćena je uveličavajuća lupa (The GWJ Company, Hacienda Heights, CA, USA) sa uveličanjem od sedam puta i graduisanom skalom od 0,1 mm. Periimplantno sondiranje nije rađeno zbog kontroverznih stavova o eventualnoj korelaciji između dubine sondiranja i stope uspešnosti implantata [15, 16].

Stopa uspešnosti implantata (SCR) je procenjena na osnovu sledećih kriterijuma: izostanak bola ili parestezije, periimplantitisa sa supuracijom, mobilnosti, perzistentne resorpcije kosti oko implantata koja je veća od 1,5 mm tokom prve godine posle opterećenja, odnosno 0,2 mm godišnje tokom narednih godina [17].

Implantati

Ukupno 60 implantata je ugrađeno kod 17 pacijenata: devet (15,0%) kod krezubih i 51 (85,0%) kod bezubih pacijenata. Dvadeset (33,3%) je urađeno kao sistem od četiri implantata povezana sa dve spojnice (FICWTB) u gornjoj vilici i 40 (66,7%) kao sistem od dva implantata (tri proteze u donjoj vilici), tri fiksna sistema (pet proteza u donjoj i jedna u gornjoj vilici), pet implantata (dve proteze u gornjoj vilici) i šest implantata (jedna proteza u gornjoj vilici). Ugrađena su ukupno 22 implantata sa dvostrukim nagrizanjem (3i implantati, Osseotite, Biomet Inc., USA), sedam SLA (Astra implants, Astratech Inc., USA), devet anodnooksidisanih i 22 $CaPO_4$ keramička (RBM implants, Lifecore Biomedical Inc., USA).

Prečnik implantata je bio 3,25-4,3 mm, dok je dužina bila 11,5-16,0 mm. Implantati su zamenili 23 sekutića, devet očnjaka, 20 premolara i osam molara.

Implantološka i protetična tehnika

Kod svih pacijenata je primenjen istovetan hirurški protokol. Antibiotska profilaksa je podrazumevala 500 mg amoksicilina dva puta dnevno tokom pet dana, počev od prvog sata pre operacije. Lokalna anestezija je postignuta infiltracijom artikaina i epinefrina, a analgetički tretman posle operacije je podrazumevao primenu 100 mg nimesulida dva puta dnevno tokom tri dana. Pacijent je posavetovan o tome kako da održava oralnu higijenu.

Posle incizije u predelu grebena, odignut je mukoperiostalni režanj. Implantati su ugrađeni u skladu s preporučenom procedurom za svaki tip. Platforma implantata je pozicionirana u nivou alveolarnog grebena. Suture su uklonjene 14 dana posle hirurške intervencije. Posle 24 nedelje od ugradnje implantata, privremene protetičke nadoknade su urađene, a konačne odložene za dodatne četiri nedelje. Broj protetičkih jedinica (NPU, odnos implantata i krune) je bio oko 0,3. Svi pacijenti su uključeni u program nadgledanja posle operacije.

Ukupno je ugrađeno 17 SP: osam u donjoj i devet u gornjoj vilici. U gornjoj vilici je bilo pet FICWTB; preostale SP su bile poduprte sa dva implantata (tri proteze), tri implantata (šest proteza), pet implantata (dve proteze) ili šest implantata (jedna proteza). U gornju vilicu ugrađeno je 39 implantata, a u donju

21. U antagonističkoj vilici je bila totalna proteza kod 12 pacijenata, kombinacija zuba i proteze kod četiri, a samo prirodni zubi kod jednog pacijenta. Kao antagonisti u donjoj vilici, kod svih pacijenata su bile totalne proteze, kao antagonisti u gornjoj vilici su bile četiri totalne i tri parcijalne proteze, a kod jednog pacijenta prirodni zubi. Bimaksilarna bezubost je ustanovljena kod 15 pacijenata, dok su dva pacijenta bila krezuba u antagonističkoj vilici.

Statistička analiza

Pošto nijedan implantat nije izgubljen (SVR 100%), resorpcija kosti alveolarnog grebena je uzeta kao indikator SCR u proceni efekta različitih faktora povezanih sa domaćinom, implantatom i okluzijom. Razlika između spoja implantat–suprastruktura i nivoa kosti grebena je definisana kao implantno-suprastrukturni spoj (IAJ) i izračunat u vreme operacije i tokom perioda nadgledanja pacijenata. ΔIAJ je razlika u IAJ između poslednje kontrole i referentne IAJ neposredno nakon operacije. Medijane ΔIAJ su stratifikovane prema posmatranim varijablama.

Krive preživljavanja su izračunate prema Kaplan-Majerovom (*Kaplan-Meier*) algoritmu proizvoda i limita [18]. Koksova (*Cox*) regresiona analiza je zatim primenjena da bi se odredio pojedinačni doprinos kovarijansi na stopu preživljavanja [19]. Ova analiza je omogućila otkrivanje varijabli koje su bile od najvećeg uticaja na preživljavanje, odnosno uspeh implantacije.

REZULTATI

Tabele 1-6 prikazuju medijane ΔIAJ za različite varijable. Nijedan implantat nije izgubljen posle operacije (SVR 100%). U pogledu SCR, Kaplan-Majerov algoritam je pokazao da nijedna varijabla nije bila statistički značajno povezana sa ΔIAJ (takođe, poređenje SP i FICWTB; log rank test 1,54; df=1; p=0,2). Koksova regresiona analiza je dala isti rezultat (Tabela 7).

DISKUSIJA

Utvrđivanje smernica za dugoročnu SVR (tj. ukupan broj implantata *in situ* posle perioda praćenja) i SCR (tj. dobar klinički, radiološki i estetski ishod) je glavni cilj u savremenoj literaturi. Nekoliko varijabli može uticati na finalni rezultat, a one se uopšteno mogu grupisati u faktore povezane s hirurškom procedurom, domaćinom, implantatom i okluzijom [20]. Faktori povezani s hirurškom procedurom obuhvataju varijable kao što su ekstenzivna trauma, termička trauma [21], preparacija kosti, oštrina i dizajn svrdla [22]. Kvalitet i kvantitet kosti su najvažniji faktori domaćina [22, 23], dok su dužina [24] i dizajn [25], kvalitet površine [26] i prečnik [27, 28] najvažniji faktori implantata. Na kraju, kvalitet i kvantitet sile [29] i protetički dizajn [30] su bitni faktori povezani s okluzijom. Svi ovi faktori su predmet naučnih istraživanja jer mogu uticati na klinički ishod.

Uopšteno govoreći, dužina (Tabela 2), prečnik (Tabela 3) i tip (Tabela 4) se smatraju relevantnim faktorima implantata. U ovoj studiji nijedan od njih nije imao bitan uticaj na klinički ishod. Prethodne studije na implantatima ugrađenim u autologne ilijačne koštane graftove i opterećene fiksnim nadoknadama dale su slične rezultate [7-10].

Kvalitet kosti, faktor domaćina, smatra se jednim od najvažnijih indikatora ishoda. Generalno se smatra da mandibula (naročito u interforaminalnoj regiji) ima bolji kvalitet kosti nego maksila, pa je ova činjenica verovatno razlog visokog SVR u nekoliko studija na imedijatno opterećenim implantatima u mandibuli. Naši podaci pokazuju da SZK može biti efikasan materijal za restauraciju volumena alveolarnog grebena, jer nijedan implantat nije izgubljen, niti je alveolarna kost značajnije resorbovana.

U nedavnoj studiji Sjerstroma (*Sjöström*) i saradnika [9] prikazana je longitudinalna analiza stabilnosti implantata u graftovanoj maksili. Ukupno 192 implantata su ugrađena, a stopa njihovog preživljavanja posle tri godine bila je 90%. Dvanaest od 20 neuspešnih implantata je izgubljeno pre faze opterećenja (rani neuspeh), dok je promena nivoa marginalne kosti posle tri godine bila 0,3±0,3 mm između bazne linije i nivoa. Ovaj podatak ukazuje na bolji SCR za implantate ugrađene u autologne graftove u poređenju sa SZK.

Od okluzivnih faktora, FICWTB su analizirani nezavisno od drugih tipova SP (tj. da li su poduprti sa dva, tri, pet ili šest implantata), ali nisu uočene statistički značajne razlike. Ovaj rezultat je u skladu s nalazima drugih studija, gde je različit broj implantata mogao uspešno da nosi SP [1-6].

ZAKLJUČAK

SZK je pouzdan materijal za graf za ugradnju implantata nosača SP. Sistemi ugrađeni u SZK imaju visoke stope preživljavanja i uspeha, slične prethodno pokazanim rezultatima na vilicama bez graftova. Implantati ugrađeni u SZK su uspešna sredstva za oralnu rehabilitaciju.

ZAHVALNICA

Ovu studiju je podržao FAR s Univerziteta u Ferari, u Italiji.