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Analysis of Implant Survival Placed in Resorbed Alveolar Ridges Regenerated with Iliac Crest Autogenous Grafts: A 15-Year Follow-Up

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Abstract

Background: Over the years, techniques have been developed that allow bone to be placed where it is deficient, in order to regenerate the area of interest, and one of these involves the insertion of a graft. The iliac crest is one of the most frequently used donor sites in the context of extra-oral autologous blood harvesting, as it allows for the harvesting of a large quantity of both cortical and corticomedullary bone as well as spongiosa alone.

Methods: The retrospective study aims to evaluate the implant survival 15 years after a definitive prosthetic rehabilitation on implants, inserted as a result of an autologous bone graft taken from the iliac crest. The 72 implants examined were positioned in two surgical stages in the two upper and lower maxillary arches, some with the classic implant surgical technique and others with a guided implant surgical technique. Controls were performed with radiological examination, in particular orthopantomography, and clinical evaluation.

Result: Of the 72 implants placed, none showed implant failure 1 year after placement. At 5 years the success rate is 98.6%, at 10 years it is 94.4% and at 15 years it is 86.1%. The results show a total of 10 implants were lost: 1 at 5 years, 3 at 10 years and 6 at 15 years.

Conclusion: Despite the difficulties related to post-operative morbidity and the need for a second operation, the iliac crest graft allows the rehabilitation of large edentulous areas, with a reduced percentage of resorption and ensures faster neoangiogenesis with faster engraftment.

Keywords: Oral surgery; Autologous bone; Bone graft; Implantology; Iliac crest

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Introduction

Background

About 50 years ago the first osseointegrated implants were introduced, used to replace missing dental elements due to various reasons: from their loss due to trauma, carious lesions or periodontal disease to agenesis. We have witnessed a continuous evolution of implantology, with the advent of increasingly efficient, precise and less invasive techniques and technologies. Since then, implant-prosthetic rehabilitation has been an increasingly reliable and used method, with a survival percentage of the implants which, according to the literature, is around 95% after 5 years and exceeds 89% after 10 years.

Despite this, it is not always possible to resort to it due to the lack of sufficient bone tissue to achieve osseointegration. For this reason, techniques have been developed that make it possible to place bone (or replacement materials for it) where it is deficient, in order to regenerate the area of interest, and one of these methods involves inserting a graft, which consists of an intra-or extra-oral bone harvest. The iliac crest is one of the most frequently used donor sites in the context of extra-oral autologous blood donations. This anatomical site allows a large quantity of both cortical and corticomedullary bone as well as spongiosa to be harvested. With easy surgical access, it makes available a quantity of bone sufficient to reconstruct severe jaw atrophies in three dimensions [1].

For over twenty years, autologous bone, bone substitutes and biomaterials have been used to reconstruct defects and atrophies of the jaws for pre- and peri-implant purposes [2,3]. Although the use of these replacement materials and regenerative techniques has reached a high level of scientific

Table 1: Contraindications.

Absolute contraindications	Relative contraindications
Uncontrolled cardiovascular disease (recent MI, unstable angina, severe heart failure, severe valvular disease) Immune deficiencies (AIDS, organ transplant, chemotherapy) Serious coagulation disorders Severe liver disease Kidney failure Current neoplasms Osteomalacia, osteogenesis imperfecta, Paget's disease Neurological diseases (Parkinson's disease, Alzheimer's disease, stroke, mental handicap, Down syndrome) Serious psychological or mental disorders (which prevent collaboration in treatment and do not guarantee sufficient maintenance over time) Alcohol/drug abuse History of osteoradionecrosis of the jaws following radiotherapy	Controlled cardiovascular disease History of endocarditis or valvular disease (antibiotic prophylaxis is essential) Chronic respiratory failure Liver disease under control Kidney disease under control Uncontrolled diabetes mellitus (treatment possible only if diabetes is controlled) Osteoporosis Coagulation disorders: patients on anticoagulant therapy (heparin and vitamin K antagonists) and antiplatelet agents (acetylsalicylic acid) Hypertension Previous cervical-facial radiotherapy Anxiety and stress Strong smoking Periodontal disease (possible treatment only if after therapy the disease is controlled) Acute or chronic inflammatory pathologies affecting the residual teeth Oral mucous pathologies (lichen planus, pemphigus, erythema multiforme, herpetic stomatitis)

and clinical application, their predictability, in large reconstructions, is still lower than the use of autologous bone and, moreover, it requires longer waiting times [4]. This can be traced back to the consideration that, to date, autologous bone is the only one to have real osteo-inductive and osteo-conductive capacities [5,6].

For small reconstructions, minimally invasive intra-oral bone harvesting is performed on an outpatient basis, with a minor biological impact and under local anesthesia, which allow obtaining a sufficient quantity of bone tissue to be used, even mixed with heterologous substitutes.

On the contrary, for large reconstructions it is necessary to resort to extra-oral sampling from the iliac crest, from the skull or from the tibia, under analgo-sedation or general anesthesia; these operations can only be performed in the operating room and are burdened by greater morbidity.

Although the biomaterials and bone substitutes currently available to the clinician can be used successfully in many clinical conditions, reducing the need to resort to a second surgical site, the results obtained are not predictable enough to definitively replace autologous grafting techniques. They are in fact techniques which, despite solving the problem of invasiveness, still have long healing times and are currently unpredictable. Perhaps, in the near future, the use of growth factors could overcome these limitations.

In terms of the biology of bone atrophy, there are marked differences between the mandible and the maxilla with regard to the speed and direction of alveolar bone resorption [7]. In the upper jaw there is a narrowing of the dental arch especially in the premolar, canine and incisive area; otherwise, at the mandibular level, there is an enlargement of the molar area. More in-depth analyzes have been performed by many authors: among them Cawood and Howell, who have differentiated bone resorption according to the anatomical site. According to their conclusions, the resorption is almost entirely buccal and horizontal in the mandible, in the intra-foraminal area, while distally it is mostly vertical [8,9]. Other classifications have been proposed over the years, in an attempt to facilitate the comparison between the various cases and to associate a suitable therapeutic treatment to the different anatomical situations. The most important are those of Lekholm and Zarb [10], Misch and von-Arx.

Aim

The study aims to evaluate the implant survival 15 years after a definitive prosthetic rehabilitation on implants, inserted as a result of an autologous bone graft taken from the iliac crest. Therefore, the controls were performed with radiological examination, in particular orthopantomography, and clinical evaluation.

The absences of any postoperative complication, the effective increase of the alveolar crest and the successful implant osseointegration, as well as its survival are therefore taken into consideration.

Materials and Methods

In this study, a total of 72 implants were subjected to a 15-year evaluation, positioned in two surgical stages in the two upper and lower maxillary arches, some with classic implant surgical technique and others with a guided implant surgical technique.

The autologous graft harvesting operations from the iliac crest were performed at IRCCS San Gerardo deiTintori Foundation in Monza (MB).

The study was conducted retrospectively, subjecting patients to radiographic controls and physical examination 15 years after surgery. For the radiographic evaluation, four orthopantomography were taken into consideration:

- Radiographic control immediately following the iliac crest graft surgery;
- Radiographic control one year after the definitive prosthetic rehabilitation on the implants;
- Radiographic control 10 years after the definitive prosthetic rehabilitation on the implants;
- Radiographic control 15 years after the definitive prosthetic rehabilitation on the implants.

Evaluation parameters

Various evaluation parameters were taken into consideration through the radiographic examinations:

- Considering physiological a peri-implant bone reduction of less than 1 mm to 1.5 mm in the first year of implant insertion and less than 0.2 mm in the following years, the peri-implant bone height was evaluated, including not only the alveolar bone proper but also the inserted autologous graft. A possible bone loss was then evaluated mesial and distal to the implant surface.

- The effective height of the implants inserted was taken as a reference, to make the quantification of the lost bone more likely since the orthopantomography could have presented distortions. Each implant is individually evaluated for bone loss, so as to have a more precise assessment of implant success or failure [11];

- The peri-implant radiolucency, which is an indication, in case of peri-implantitis, of an inflammatory process that affects tissues around the implant and causes a variable amount of bone loss [12];

- The quantification of newly formed bone following the insertion of autologous bone graft. The measurement is carried out taking as reference the coronally implant-abutment junction and the most apical bone-implant contact. Absence of bone gain indicates treatment failure and can often occur following extensive autograft resorption;

- In mandibular arch, the approach of the inferior alveolar nerve canal to the alveolar crest is also taken into consideration, marked in important resorption.

Various aspects are considered in the objective evaluation of the immediate post-operative period and during subsequent follow-up:

- Absence of spontaneous pain symptoms or induced by the application of horizontal and vertical forces: it is one of the first parameters considered to exclude a possible peri-implant infectious complication or an incorrect distribution of prosthetic loads. In fact, persistent pain can occur in conjunction with the increase in implant mobility, even before there is detectable radiographic evidence. This symptom is understood as an indication of implant failure. Clinically, the presence of pain is detected by percussion of the implant;

- Absence of implant mobility, objectively verified by exerting horizontal and vertical forces on the implant. If the implant is mobile at the end of the months necessary for osseointegration, it can be assumed that there is no new bone formation around it, as well as the presence of connective tissue between the implant and the bone, a predictive index of implant failure. An implant movement of less than 75 μm is considered physiological [13];

- The signs that indicate an inflammatory process affecting the soft tissues around the implant: Redness, swelling, bleeding on probing or spontaneous, pain on probing. These are clinical manifestations that lead to the diagnosis of mucositis, whereas the detection of peri-implantitis presupposes the involvement of hard peri-implant tissues in the inflammatory process, with consequent loss of bone support. This parameter is confirmed by the radiological investigation, in order to be radiologically visible, it must exceed 2 mm, and is indicative of implant failure.

- As a diagnostic aid for the detection of peri-implant inflammation, a periodontal probe is used, passed circumferentially around the implant. Thus, bleeding on probing is recorded, normally absent in the case of peri-implant health, depth on probing, pathological if greater than 5 mm, and the presence of suppuration around the implant [14].

Patient selection

The selection of the patients allows excluding from the study all those patients who present pathological conditions or who take drugs such that a possible compromise of the result is probable.

Following a careful anamnesis, we proceed with a clinical and radiographic evaluation to evaluate the bone and oral cavity situation (Table 1).

Inclusion criteria

- Edentulousness of the anterior and/or posterior sectors of the upper and/or lower jaws;

- Reduced residual bone height (3-5 mm);

- Absence of systemic pathologies and pharmacological therapies, as well as bad habits capable of slowing down healing and predisposing to the onset of infections.

Exclusion criteria

- Patients with serious systemic pathologies that interfere with surgery or implant rehabilitation;

- Pregnant women;

- Presence of periapical lesions, presence of mucositis or implants in peri-implantitis, presence of periodontal disease or other anomalies affecting dental elements contiguous to the surgery area or benign or malignant lesions.

Study design

A total of 12 patients were selected, ranging in age from 45 to 70 years, with a desire to receive implant-prosthetic rehabilitation of the two arches but with initial anatomical conditions not favorable for implant insertion, as there was a marked bone deficit.

A total of 72 implants were inserted, of which 33 are to support screw-retained prostheses and 39 to support cemented prostheses.

Surgical procedures

The operation is performed in two moments, first by the orthopedist and then by the dentist, separately so as not to have contamination of the operating fields. The patient is in the supine position and is subjected to general anesthesia and nasotracheal intubation, so as to have free access to the oropharynx. After having disinfected the skin with povidone iodine, the operating field is delimited with sterile adhesive TNT drapes.

This is followed by local injection of anesthetic to aid hemostasis and reduce postoperative pain. To this end, bupivacaine 0.5% with vasoconstrictor 1:200,000 is used. Finally, an adhesive sterigrap is placed to complete the field.

An incision is made parallel to the iliac prominence and placed about 1/1.5 cm inferior, so as to avoid injury to the lateral femoral cutaneous nerve and the insertion of the sartorius muscle.

Remaining on a supra-periosteal plane, the iliac muscle is traction medially and the gluteal muscle on the external table, then four osteotomies are performed (with straight osteotomies one proceeds beyond the cortex to dissect the medulla and with appropriate movements the sample is detached) and the bone plug is taken, included between the anterior superior iliac spine and the iliac tubercle, which has a size of about 5 cm to 8 cm [15]. An accurate periosteal detachment of the crest is followed where necessary by that of the iliac muscle on the medial wall and its fascia is suitably protected with special retractors (Obwegeser) [16].

The bone block is then parceled up and temporarily stored in a liquid composed of sterile physiological solution and the patient's blood, taken at the same time as the surgery (there are cells inside the plasma and blood which keep the sample vital). It is important to remove the connective tissue residues in order to make the engraftment

optimal. If necessary, it is possible to proceed with the collection of spongy bone from the walls exposed by the sampling carried out with a spoon. With scrapers, the dual purpose of smoothing the bone edges and collecting additional cortical autologous bone chips is achieved. The sample taken is modeled on a sterile surface before insertion.

The control of the homeostasis of the intraosseous vessels which may present a variable degree of bleeding is obtained with suitably shaped and compressed collagen or fibrin sponges and, where necessary, with bone wax. It is very important to carry out an accurate bleeding control before suturing, in order to reduce possible complications. A drain is placed and removed over the next 24 h to 48 h.

Subsequently we proceed to the suture for anatomical planes: First the periosteum and fascia lata in separated stitches with a slow reabsorption synthetic thread, followed by the subcutaneous layer with a fast resorbable and finally the skin, managed both with slow reabsorption stitches to be removed and with a non-absorbable thread. To speed up it is also possible to use an automatic stapler. This is followed by the placement of a compression dressing to be removed on the first day and the placement of ice. The suture will be removed on the 7^{th} to 14^{th} day.

One to two days after the operation, depending on the blood flow in the drainage, the patient is discharged, antibiotic therapy is prescribed (amoxicillin + clavulanic acid 1 g tablet, 1 × 2 × 7) to be taken orally starting from the day before the operation and anti-inflammatory drugs after surgery and rinses with 0.2% chlorhexidine digluconate for 10 days.

The suture was removed one week after surgery. After the operation, the patient is motivated to mobilize the limb with the help of a support in the immediate postoperative period, even if difficulties in walking have often been highlighted for 7 to 10 days and therefore the use of a cane has been recommended in that period. Furthermore, rest for two weeks and abstention from sport for six weeks was suggested. Minor complications of iliac crest harvesting include postoperative donor site infections, gait disturbances, and seromas. Among the major complications there are instead nerve lesions, bone fractures, vascular damage and herniations [17] (Figures 1-10).

Results

Of the 72 implants placed, none showed implant failure 1 year after placement. All the implants inserted therefore achieved osseointegration in the absence of postoperative complications such as wound dehiscence, acute infection, nor of late complications such as failure to integrate the graft, peri-implantitis, and chronic infection. The bone graft procedure with iliac crest harvesting has therefore allowed surgical and prosthetic success in patients with insufficient bone volume in whom, otherwise, it would have been impossible to perform an implant-prosthetic rehabilitation.

The retrospective study carried out has in fact demonstrated that at 5 years the success achieved is 98.6%, at 10 years it is 94.4% and at 15 years it is 86.1% (Table 2).

The results obtained therefore show that a total of 10 implants were lost, of which 1 at 5 years, 3 at 10 years (of which 2 for the same patient presumably due to causes that were not analyzed in the study) and 6 at 15 years (all in the same patient due to incorrect oral maintenance at home and negligence towards periodic professional calls).

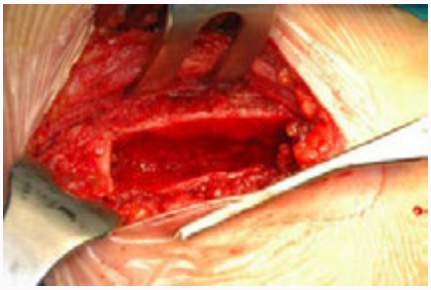

Figure 1: Autologous bone harvesting from the iliac crest: donor site.

Figure 2: Piece of bone taken to be grafted.

Figure 3: Maxillary sinus lift: boney trapdoor.

Figure 4: On lay graft with fixation screws.

The following table shows the data for each individual case: Age of the patient, number of implants inserted for each one, type of prosthesis and number of implants lost 5, 10 and 15 years after insertion.

Survival is therefore greater for implants restored with a cemented solution rather than with a screwed one.

Discussion

An implant-prosthetic rehabilitation in patients with jaw atrophies therefore requires even greater attention from the clinician, since often the vertical dimension of the bone is not such as to even guarantee the insertion of a short implant.

Figure 5: Insertion of 2 implants in the first quadrant.

Figure 6: Insertion of 3 implants in the second quadrant.

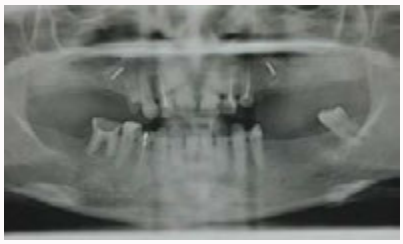

Figure 7: OPT performed immediately after the iliac crest graft in the upper jaw, in fact we can observe the presence of the fixing screws of the graft itself.

Figure 8: OPT performed 6 months after the graft, at which time 2 implants were placed in the first quadrant and 3 implants in the second quadrant.

One possibility is the reconstruction through bone grafting techniques, in particular, where the bone deficit is important, one of the best methods is the grafting after sampling from the iliac crest. Radiological and clinical criteria are therefore taken into considerations which allow the success or failure of implant therapy to be established as clearly as possible.

On the occasion of "The International Congress of Oral Implantologists (ICOI) Pisa Consensus Conference" (2008), implant success was evaluated, defining it as the optimal condition for the permanence of the implant in the oral cavity, survival, i.e., the permanence and functionality of the implant but not in ideal conditions, and failure, i.e., the loss of the implant or the need to remove it.

Figure 9: OPT performed at follow-up at 10 years, after checking the patient annually. The implants are still perfectly osseointegrated and loaded.

Figure 10: OPT performed at follow-up at 15 years. As at 10 years, the implants are still perfectly osseointegrated and loaded.

The conditions for delineating the condition of the implant are accompanied by some factors such as pain on palpation, percussion or function, mobility and radiographically visible bone loss around the implant (>2 mm). However, these are not decisive criteria, but must be associated with the possible presence of exudate and prosthetic overloads. These data therefore allow us to establish an evaluation scale of implant health [18,19].

The necessary condition for implant-prosthetic rehabilitation to have a good chance of success is the presence of a sufficient amount of bone to guarantee the primary and secondary stability of the implant. The use of regenerative techniques in the field of odontostomatological surgery has ensured the rehabilitation of edentulous areas otherwise impossible to rehabilitate with fixed solutions (Table 3).

In a study conducted by de Souza et al., 7 to 9-year follow-up was performed on 10 patients with atrophic maxillae reconstructed with iliac crest graft and rehabilitated with implant placement (between 2008 and 2011). The implants used were all 3.75 mm × 10 mm on average.

A total of 76 implants were inserted and of these only one failed, thus leading to a 98.6% success rate [20].

In another study conducted by Maiorana et al., the 26-year survival of 140 implants inserted in 21 patients (females) previously rehabilitated with an iliac crest graft was evaluated. This resulted in survival of 128 and failure of 12 of these, with a survival rate of 91.1% [21].

A third study examined is that of Sethi et al. where 173 patients with atrophy treated with iliac crest graft and implant insertion after 3 months are analyzed. Eight hundred sixty-nine implants were inserted in 190 grafts (of which 167 in the upper jaw, 23 in the lower jaw). The follow-up of these patients ranges from 3 months to 23 years after the operation and the survival index calculated according to the Kaplan-Meier analysis is 95% ± 2.7% [22].

The fourth study taken into consideration is that of Malò et al. in which a 1-year and 5-year follow-up was performed and the survival

Table 2: Results.

Case	Age	Number of implants inserted	Type of prosthesis	Implants lost 5 years after insertion	Implants lost 10 years after insertion	Implants lost 15 years after insertion
1	59	6	Screwed	0	0	6
2	50	6	Screwed	0	1	0
3	49	6	Screwed	0	0	0
4	68	9	Cemented	0	0	0
5	47	5	Cemented	0	1	0
6	50	7	Screwed	0	0	0
7	51	4	Screwed	1	1	0
8	4	4	Screwed	0	0	0
9	42	5	Cemented	0	0	0
10	46	5	Cemented	0	0	0
11	60	9	Cemented	0	0	0
12	55	6	Cemented	0	0	0

Table 3: Scientific examination of implant success.

Study	Type of study	No of patients	No of implants	Follow-up (in years)	% of implant success
De Souza et al. (2019)	Retrospective	10	76	7-9	98.6% (75 di 76)
Maiorana et al. (2019)	Retrospective	21	140	26	91.1% (128 di 140)
Sethi et al. (2020)	Retrospective	173	869	1-23	95 ± 2.7%
Malò et al. (2009)	Perspective	35	219	1 e 5	97.3% (1 year) 96.7% (5 years)
Clayman (2006)	Perspective	8	41	7-13	83% (34 di 41)

of implants inserted 6 months after an iliac crest graft was evaluated in 35 patients with atrophic jaws. As a result, of a total of 219 implants inserted, survival corresponds to 97.3% at 1 year and 96.7% after 5 years, also calculating those two patients left the study after 2 and 4 months without still having implants and one patient after 13 months with 4 implants inserted [23].

Clayman's prospective study considered 8 patients in whom 41 total implants 3.75 mm in diameter and 7 mm to 15 mm in length were placed. One patient was withdrawn from the study at 24 months and one at 75 months. The follow-up was performed from a minimum of 90 months to a maximum of 154 months, with a total survival of 34 out of 41 implants, or about 83%; 4 implants out of 6 lost were 7 mm long, only the other 2 reached 10 mm, while the last one lost was a 10 mm implant but had been placed in an area with low bone density [24].

Lastly, a case report is cited at the Department of Prosthodontics, School of Dentistry and Dental Research Institute, Seoul National University, Seoul, South Korea', where an iliac crest graft was performed on a 68-year-old patient then monitored after 11 years, confirming the goodness of the results [25].

Conclusion

An implant-prosthetic rehabilitation in presence of atrophic jaws turns out to be a complicated situation to manage and resolve. In the present study an iliac crest harvesting and grafting of the same around bone deficit was used, resulting in a safe, predictable result with a high success rate.

The 15-year survival of implants inserted 6 months after grafting appears to be in line with the other studies examined and with the literature reviews having a follow-up comparable to that taken into consideration in our analysis. Despite difficulties related to postoperative morbidity and the need for a second operation, iliac crest graft allows the rehabilitation of large edentulous areas, with a reduced percentage of resorption and ensures faster neoangiogenesis and therefore faster engraftment.

Other harvesting techniques or autologous bone substitutes used may present little or no postoperative morbidity and rapid engraftment; however, they only allow the rehabilitation of areas of reduced size. According to the literature, iliac crest sampling is therefore a reliable and widely used method, guaranteeing maintenance of the inserted implants which remain functional and prosthesis even after many years [26].

The future will probably reserve changes in the methodologies and techniques used; more and more synthetic materials and bone substitutes will be used which, however, do not currently represent an established and safe method. Instead, the use of autologous bone remains the current gold standard, with a large literature in this regard, an affirmed success of the intervention and little possibility of resorption of the graft.

References

1. Taylor GI. Reconstruction of the mandible with free composite iliac bone grafts. Ann Plast Surg. 1982;9(5):361-76.
2. Di Stefano D, Cazzaniga A. Prelievi Ossei nelle Ricostruzioni Pre e Perimplantari. Elsevier. 2011.
3. Williamson RA. Rehabilitation of the resorbed maxilla and mandible using autogenous bone grafts and osseointegrated implants. Int J Oral Maxillofac Implants. 1996;11(4):476-88.
4. Sartori S, Silvestri M, Forni F, Icaro Cornaglia A, Tesei P, Cattaneo V. Ten-year follow-up in a maxillary sinus augmentation using an organic bovine bone (Bio-Oss). A case report with histomorphometric evaluation. Clin Oral Implants Res. 2003;14(3):369-72.

5. Albrektsson T, Johansson C. Osteoinduction, osteoconduction and osseointegration. Eur Spine J. 2001;10(Suppl 2):S96-101.
6. Kalfas IH. Principles of bone healing. Neurosurg Focus. 2001;10(4):E1.
7. Bergman B, Carlsson GE. Clinical long-term study of complete denture wearers. J Prosthet Dent. 1985;53(1):56-61.
8. Cawood JL, Howell RA. A classification of the edentulous jaws. Int J Oral Maxillofac Surg. 1988:17(4):232-6.
9. Sicher H, DuBrul EL. Oral AnatomyEdi-Ermes. 1988.
10. Lekholm U, Zarb GA. Patient selection and preparation. In: Brånemark PI, Zarb GA, Albrektsson T, editors. Tissue-integrated prostheses: Osseointegration in clinical dentistry. Quintessence, Chicago 1985. p. 199-209.
11. Carl E Misch. Contemporary implant dentistry. Mosby. 2007.
12. Becker W, Becker BE, Newman MG, Nyman S. Clinical microbiologic findings that may contribute to dental implant failure. Int J Oral Maxillofac Implants. 1990;5(1):31-8.
13. Sekine H, Komiyama Y, Hotta H, Yoshida K. Mobility characteristics and tactile sensitivity of osseointegrated fixture-supporting systems. In: van Steenberghe D, editor. Tissue integration in oral maxillofacial reconstruction. Amsterdam: Excerpta Medica; 1986.
14. Zitzmann NU, Berglundh T. Definition and prevalence of peri-implant diseases. J Clin Periodontol. 2008;35(8 Suppl):286-91.
15. Stefano DD. Il prelievo dalla faccia mediale della cresta iliaca. 2008.
16. Ahlmann E, Patzakis M, Roidis N, Shepherd L, Holtom P. Comparison of anterior and posterior iliac crest bone grafts in terms of harvest site morbidity and functional outcomes. J Bone Joint Surg Am. 2002;84(5):716-20.
17. Carini F, Greco F, Ingrosso R, Monai D, Ciaravino M. Innesti dalla cresta iliaca anteriore in chirurgia pre-implantare: Morbilità del sito di prelievo. 2010.
18. Misch CE, Perel ML, Wang HL, Sammartino G, Galindo-Moreno P, Trisi P, et al. Implant success, survival, and failure: The International Congress of Oral Implantologists (ICOI) Pisa Consensus Conference. Implant Dent. 2008;17(1):5-15.
19. SICOI. Manuale di Chirurgia Orale, Elsevier-Masson, 2011.
20. de Souza CSV, Ortega-Lopes R, Barreno AC, de Moraes M, Albergaria-Barbosa JR, Nóia CF. Analysis of the survival of dental implants installed in reconstructed maxilla with autogenous iliac crest graft: 7- to 9-year follow- up. J Oral Implantol. 2019;45(6):427-36.
21. Maiorana C, Poli PP, Mascellaro A, Ferrario S, Beretta M. Dental implants placed in resorbed alveolar ridges reconstructed with iliac crest autogenous onlay grafts: A 26-year median follow-up retrospective study. J Craniomaxillofac Surg. 2019;47(5):805-14.
22. Sethi A, Kaus T, Cawood JI, Plaha H, Boscoe M, Sochor P. Onlay bone grafts from iliac crest: A retrospective analysis. Int J Oral Maxillofac Surg. 2020;49(2):264-71.
23. Maló P, de AraújoNobre M. A new approach for maxilla reconstruction. Eur J Oral Implantol. 2009;2(2):101-14.
24. Clayman L. Implant reconstruction of the bone-grafted maxilla: Review of the literature and presentation of 8 cases. J Oral Maxillofac Surg. 2006;64(4):674- 82.
25. Lee JH, Yeo IL. Eleven-year follow-up of reconstruction with autogenous iliac bone graft and implant-supported fixed complete denture for severe maxillary atrophy: A case report. Medicine (Baltimore). 2020;99(9):e18950.
26. Misch CE, Dietsh F. endosteal implants and iliac crest grafts to restore severely resorbed, totally edentulous maxillae-a retrospective study. J Oral Implantol. 1994;20(2):100-10.