CLINICAL ORAL SCIENCE AND DENTISTRY

RESEARCH ARTICLE ISSN 2688-7428 Open Access

Iuxta-Periosteal Implants. Current Concepts and Clinical Review

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Received date: July 13, 2023, **Accepted date:** July 21, 2023, **Published date:** July 31, 2023.

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Keywords: Iuxta-Periosteal Implants, Atrophic Maxillary Base Rehabilitations

Abstract

INTRODUCTION

Iuxta-periosteal Implantology is a technique used in implant-prosthetic restorations for more than 70 years. Dahl from Sweden was the Surgeon who first to reported scientific documentation in 1940.

It consists of custom-made grids that exploit the architecture of the basal component of the maxillary or mandibular bone on whose surface they are juxtaposed instead of penetrating the bone structure itself as is the case for traditional screwed implants. The mechanical resistance to the masticatory load is ensured by the resilience offered by the bone architecture and by means osteosynthesis fixation screws that fix the structure to the site where they lay.

It is indicated in the rehabilitation of severely atrophic bone bases, replacing the reconstruction-regenerative techniques necessary to allow the use of traditional endo-osseous implants.

MATERIALS AND METHODS

We will report the most current techniques used for the design and production of these implants. We will illustrate the diagnostic flow from the acquisition to the preparation of the data used. We will show the surgical insertion technique, and last findings on of the immediately loaded prosthetic rehabilitation that follows.

DEBATING

Implant digital project is related to the jaw anatomy of the patient to be inserted. It is the result of a complex digital workflow that starting from the local bone anatomy leads to the drawing of both the implant and restoration.

Over the years, with the transition of analogical to digital methods, it has undergone changes and improvements in design, production and above all in the functional performance offered. The technique needs a medium-high level of prosthetic and surgical skills, and equally high digital design potentiality skills. Results and Clinical experience, in our clinical practice and as reported by the literature, are comparable to conventional implantology in terms of long-term prognosis. Given the indication of applicability to strongly atrophic bone bases and the rigid respect of inclusion/exclusion criteria, it bypasses all the techniques of bone reconstructive surgery used as an essential prerequisite in rehabilitation on traditional screwed implants.

Introduction

The technical evolution of surgery, in any branch or discipline, has always been marked by a fundamental principle: the simplification of techniques and the increase of therapeutic efficacy. The real progress has been seen in the adoption of diagnostic and instrumental technical aids that have, in fact, contributed to achieve levels of technical refinement that went hand in hand with less invasiveness on the patient.

We talk about Functional Dental Rehabilitation.

A general increase in technical costs, in terms of materials and management, associated with a lower availability of time by the patient and his personal increased functional and aesthetical expectations, has brought to the fore an implant-prosthetic rehabilitation surgical technique, developed almost 60 years ago: that of juxta-periosteal implants. We are about functional dental rehabilitation. [1]

In this work few case reports will be presented, to show the evolution over the years of a technique that is forcefully making a come-back in operating theaters around the world.

Unlike traditional endo-osseous implants, the juxta-periosteal implant consists of a metal grid to which, in the appropriate position, the prosthetic emergencies related to the restoration that the patient needs are joined.

Therefore, it is an anchoring system that does not exploit the vertical dimension of the alveolar process as a rigid retention element of the fixture, but of its three-dimensional architecture. [FIG 1] [2]

Figure 1

We are all familiar with the problem of resorption of the alveolar ridges following the loss of teeth. And in addition, we have all witnessed, in recent years, a drastic change in the requests of patients who, having arrived at the clinical check-in with a situation of partial or total edentulism dating back to a shorter or longer time, accept less and less mobile rehabilitation solutions.

This has refined the reconstructive surgical techniques available to the surgeon to make the resorbed alveolar processes suitable for the placement of traditional osteo-integrated implants. [FIG2a – 2b] [3]

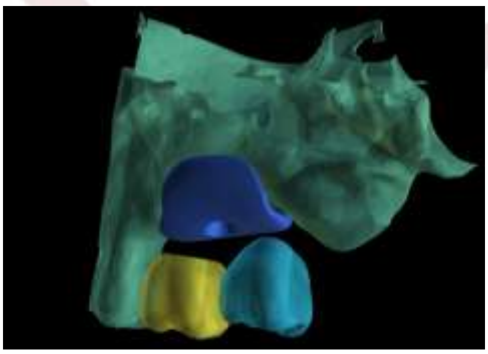


Figure 2a

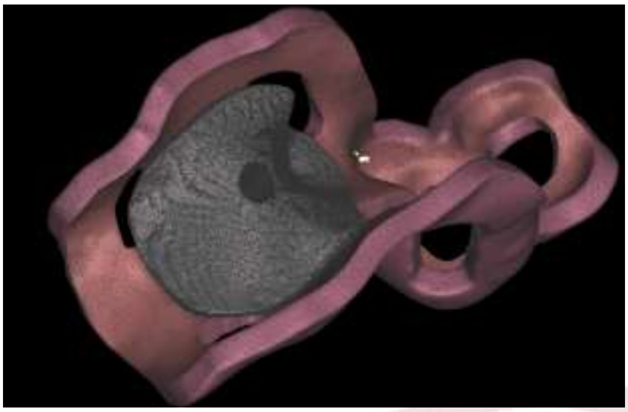


Figure 2b

The Achilles heel of alveolar reconstructive surgery is represented by the high degree of technical difficulty (and therefore a tendency to decrease in effectiveness) and by the "recovery" times necessary for the regeneration of a "biologically identical to the original" bone substrate that can represent an effective and efficient implant site.

Therefore 1) risks of failure, 2) technical difficulty combined with costs 3) long waiting times, have pushed the most enterprising Oral Surgeons to opt for solutions that could overcome these obvious problems.

Consider that management costs and waiting times, today, have become two very important parameters, not only for the general economy of the clinic but also for the logistics of the patient who found himself having less and less time available for necessary medical conditions and less and less economic potential necessary to bear the costs of dental prosthetic rehabilitation.

The juxta-periosteal implants are establishing themselves as a current rehabilitation technique, as they clearly cancel waiting times, as they do not require Reconstructive Surgical techniques to be “profitably” used as prosthetic support. Hence the definition of the “main” field of application: severe mandibular or maxillary alveolar atrophies.

The CARDINE functional principle of these implants lies in the need to carefully match these structures on the basal part of the maxillary bones. In the case of the mandible, as we well know, the basal bone is represented by a long shaped bone, therefore with a very precise structural organization and an equally particular module of resistance to the "transfer of load". Similar situation in the case of the upper jaw where in addition to the atrophic alveolar component (therefore more corticalized), very high-density structural areas are highlighted including the canine consoles, the zygomatic processes and the median raphe of the palatine vault; all these areas represent sectors with very high mechanical resistance and are fully exploited in the design of the juxta-periosteal retentive structures. [FIG 3a-3b] [4]

Figure 3a

Figure 3b

This is a rehabilitative surgical technique whose origins date back several decades. It is natural to expect that, having proved valid right from the start, it has survived to the present day undergoing even very important up-grades due to the technologies of the materials and instrumental technologies used in the diagnostic, design, and production approach, with the result of surgical simplification and effectiveness increase. experienced firsthand by the authors of this work. [FIG4] [5]

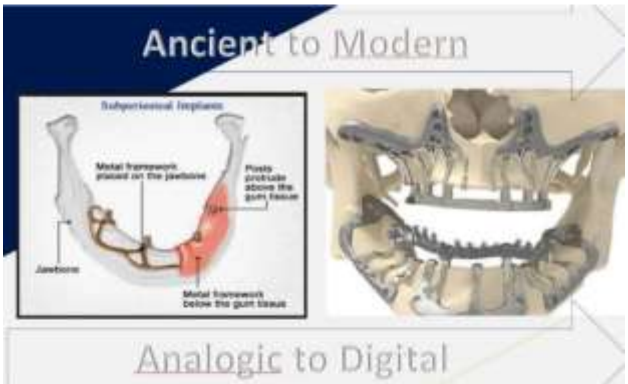


Figure 4

Typically enrolled patient: edentulous mandibular or maxillary jaws dating from several years; patient with a total mobile prosthesis who asks for a fixed solution to the problem of his mouth.

Originally, in the era of analogic approach the workflow consists of Control orthopantomography; first surgery for exposure of the site, taking the impression directly on the bone (Permlastic was used) in order to create a plaster model on which the juxta-periosteal grid was drawn following a wax model, casting and adaptation to the model. Finally, second surgery to implant insertion, suture and insertion of the temporary fixed prosthesis.

The digital data acquisition technologies, nowadays, have made it possible to eliminate the first intervention for taking impressions and transform the prosthetic rehabilitation from cemented to screwed. But above all they have upset the basic concept on which the retentivity of the metal structure on the bone architectural substrate is based.

From a structure "wedged" to the site, exploiting the natural undercuts, and retained thanks to the healing processes of the periosteum ABOVE the grid itself (hence the name of sub / juxta-periosteal) we moved to a fixture placed on the site and fixed by micro-screws for osteo-synthesis strategically placed on the entire implant surface. [FIG 5]

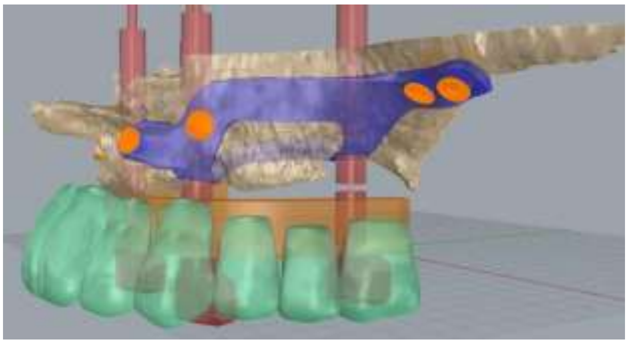


Figure 5

This led to a striking result, namely the drastic increase in retentivity, resistance to the transverse components of the occlusal load and above all the crestal resorptions (often very evident) that were found in the upper jaw.

In this work we will introduce the program that our Italian research group has undertaken, reporting in the form of case reports the last two cases treated, the result of the most recent studies conducted by us. In the coming months we will try to show the follows up, mainly focused on the control of the main complication that has always been encountered: the dehiscence of the gingival tissues overlying the implanted metal structures. We will present the methods of recruiting patients, the design flows of both the prosthetic component and the juxta-osseous aids; we will briefly talk about metallurgy and production processes.

In addition, both prosthetic and surgical assembly methods will be described, as well as the ways in which we have planned to manage the follows-ups. We will analyze the results of the first cases treated with a modern method resulting from a study of the most recent bibliography and we will anticipate the study and research program in this method that we believe can very well represent the future of a modern and safe implantology.

Materials and Methods

RECRUITMENT

Choosing patients who can be treated profitably and safely with this technique is anything but simple. In fact, as in any form of surgery, only strict compliance with the inclusion and application criteria can guarantee the prognosis over a longer distance. We can distinguish general and local recruitment criteria.

Among the GENERAL CRITERIA for the recruitment of the candidate patient, a factor stands out which excludes patients with a positive history of bisphosphonate and insulin treatments (for prudence in an initial phase of approach to the method we have decided not to include cases of associated diabetes mellitus or less with periodontal disease). Patients on immunosuppressive therapy, with chemotherapy, in the two years preceding the observation were also excluded. Among the social habits that we consider contraindicating, certainly a prominent place belongs to a priori smoking, considered as an absolute contraindicating factor. [FIG 6a – 6b]

Figure 6a

Figure 6b

As regards the LOCAL CRITERIA, it is necessary to distinguish between three main risk categories:

1) The SITE for which rehabilitation is requested must be dated at least 1 years of edentulism. This is the only way to be sure of a complete alveolar resorption.

2) OCCLUSION must be stable in the case of partial edentulism, and functional in the case of patients with mobile prosthetic rehabilitations. Hyperdivergent occlusal schemes with mechanical loads displaced in the posterior sector of the dental curves are excluded. Much attention, but not a priori exclusion, is given to hypodivergent occlusal schemes with predominantly anterior fulcrum. Conditio sine qua non is the existence of joint functional equilibrium and the absence of any sign-symptom of condylomeniscal TMJ incoordination or of displacement patterns in mandibular evolutionary movements.

3) The PERIODONTAL pattern is considered with great attention; "Thin" gingival biotypes are discarded a priori, this regarding the high probability of post-surgical gingival dehiscence. Cases of ascertained periodontal disease affecting the residual dental elements were rejected in a similar way.

ACQUISITION OF DIAGNOSTIC DATA

The diagnostic data are acquired with reference to the three main fields of investigation:

1) The required PROSTHETIC REHABILITATION; the relative data are deduced from the dental Condiction at check-in, generally represented by the patient's natural dentition and any existing mobile or fixed rehabilitations. Plaster models from traditional impressions or intra-oral digital scans provide the necessary information in this regard. In this phase, the registration of the construction bite is of particular importance, which once digitized and therefore relativized to all the other diagnostic components, will contribute in a fundamental way to the correct design of the subperiosteal structures. [FIG 7a to 7d]

Figure 7a

Figure 7b

Figure 7C

Figure 7d

2) The IMPLANT SITE represented by the bone structure of the region on which the juxta-periosteum will be designed. It starts with a three-dimensional tomographic examination, be it in the form of cbct or traditional ct (denta scan mode). From this we obtain, through various rendering steps, surfaces suitable for the design of the implant structures. [FIG8]

Figure 8

3) SOFT TISSUES represented by keratinized gingiva and oral mucosa. The information about these is very important for the correct evaluation of the prosthetic emergence. Generally, today the plaster models represent a sure way to obtain very reliable information in this regard. Digitization will take place during the preparation of the project using laboratory scanners. [FIG9]

Figure 9

PROJECT PREPARATION

The acquired data must be rendered in a format that is usable for the design phase. Basically, we work to 1) transform the Dicom files of the radiological scan into three-dimensional images and, therefore, surfaces on which it is possible, later, to design the implant structure. 2) perform a matching or superimpose the images of prosthetic restorations, soft tissues, and bone surfaces, to faithfully replicate the patient's intra-oral situation. To date, this phase is the most delicate as it requires experience to pass the collected data through different softwares, each of which is specific for different tasks, see the removal of scattering (the "cleaning of radiological images), surface rendering and the matching (the faithful spatial coupling of the three components of the operational project).

THE PROJECT

A little while ago we anticipated that the project always starts from the type of prosthetic restoration required. The vertical dimension (the available prosthetic space), the transverse relationships and the paths of exclusion in the lateral and protrusive movements are very accurately evaluated. Generally an attempt is made to maintain group contacts in order to distribute the occlusal load as evenly as possible. Occlusal stops are generally maintained on the centric cusps. Particular attention is also placed on the design of the clinical crowns of prosthetic restorations, to protect the transgingival transit of emergencies, while ensuring ease of home hygiene. Obviously, the prosthetic design is optimized on the patient's soft tissues and is also oriented to the original gingival and bone components.

Once the prosthetic rendering has been obtained, we move on to the design of the juxta-periosteal structure. Identified areas of structural resistance and highlighted the undercuts (in the most evident cases the so-called "drapping" of the bone site is performed - a technique to highlight and graphically eliminate the undercuts themselves), the longitudinal structures or support bars are first traced (drawn on the sagittal (or dorso-frontal) directives of the bone surfaces, then the seats for the fixing screws and finally the transverse connecting arms, which will also act as the support seat for the prosthetic connections. The latter are positioned in correspondence with the selected dental elements for the connection (generally, canines and molars in the case of "full arch" rehabilitations, and mesial and distal terminal elements for the partial sectors).

The prosthetic connections are screwed (this is our personal choice although in the past the solidarity of the structure to the implant was obtained through cementation) it always arranges itself, in its trans-mucosal path, in the keratinized gingiva. Generally, we start from a two-dimensional design of the plant, processing its format and adapting it to the next step on a CAD software for three-dimensional transformation, starting from calibrated thicknesses, the result of our clinical observation and from offset values between the surfaces, established in about the tolerance sought to ensure good adherence to the bone sector while facilitating an easy surgical insertion. The last stage of the design is to program the guide holes for the fixation screws. The arrangement and orientation of the same is established in strict compliance with the requirements for bearing the moments of the transverse load forces that chewing generates.

The arrangement of the fixing screws must obviously consider the bone strength at the point of insertion and the noble structures to be respected such as, for example, the NAI as regards the supports in the mandible. The virtual positioning of the fixation screws makes use of softwares dedicated to guided implantology; the surgical positioning of the same will make use of guided drilling systems of the transcortical hole. [FIG 10a to 10i] and [FIG 11a, 11b and 11c]

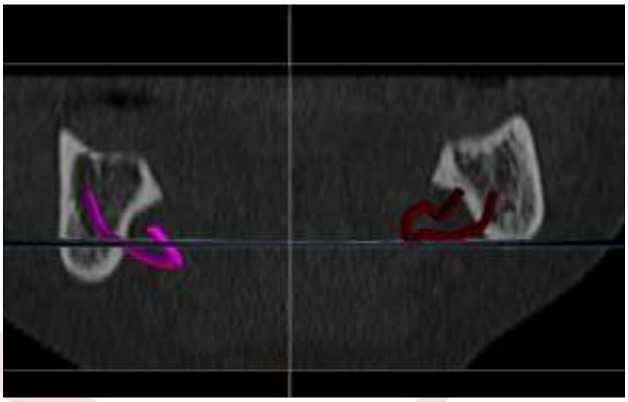


Figure 10a

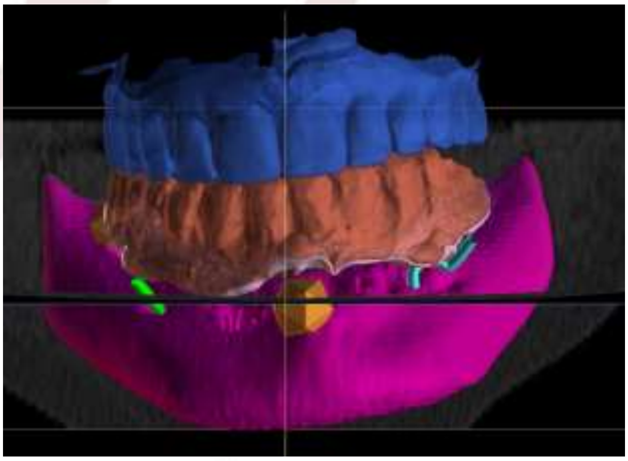


Figure 10b

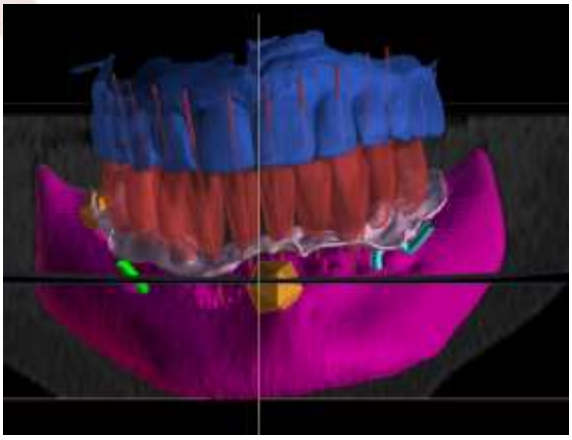
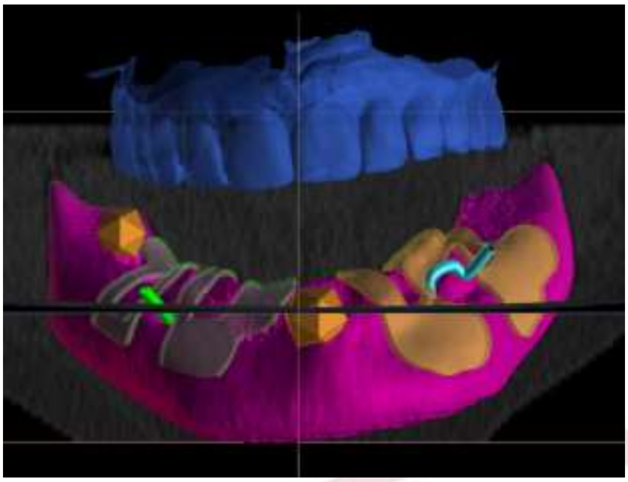


Figure 10c



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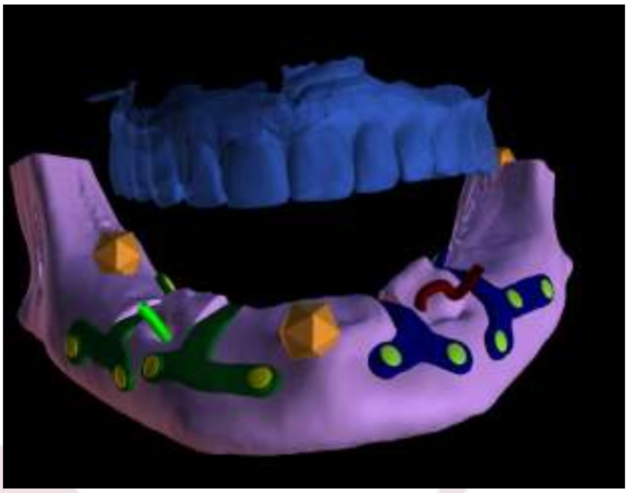
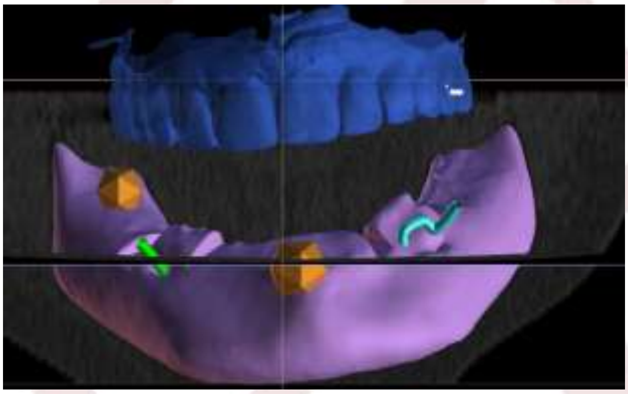


Figure 10g



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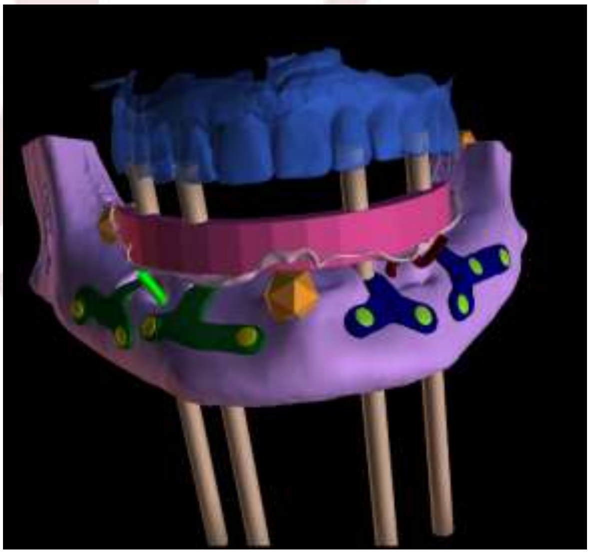

Figure 10h

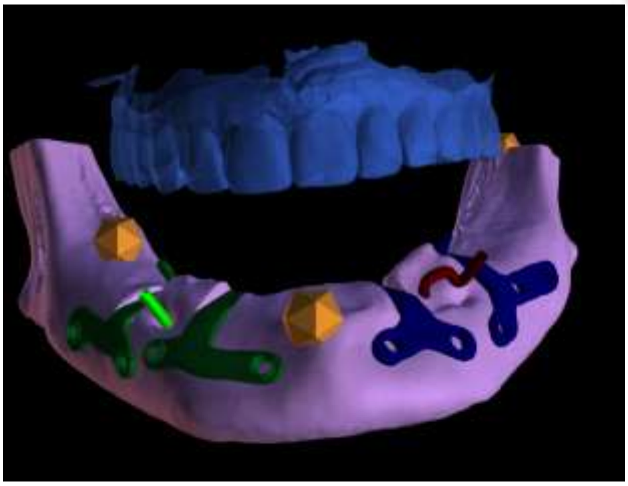

Figure 10f

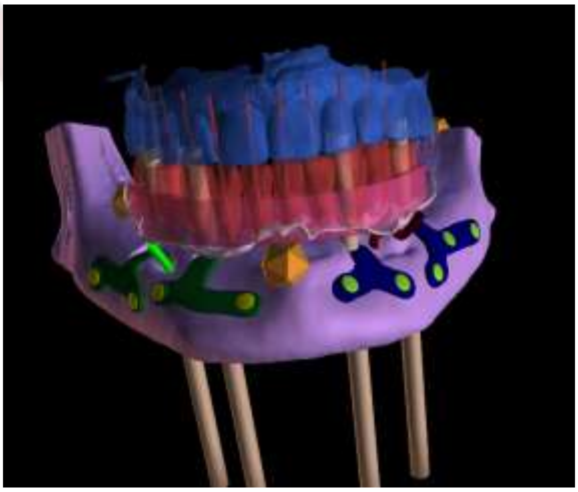

Figure 10i

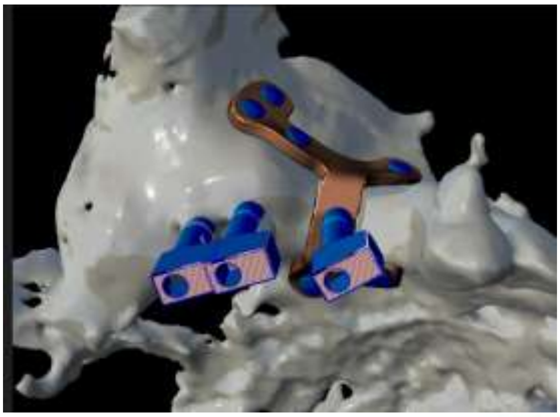

Figure 11a

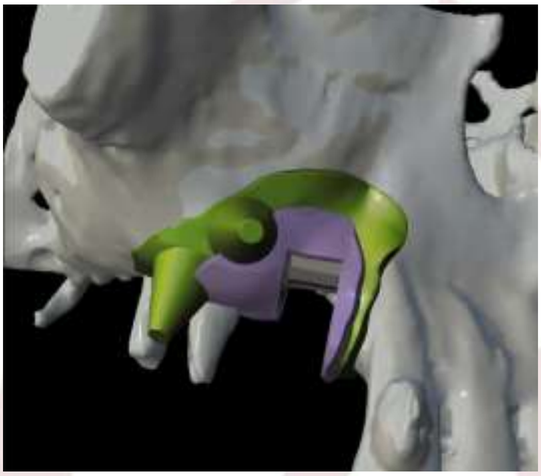

Figure 11b

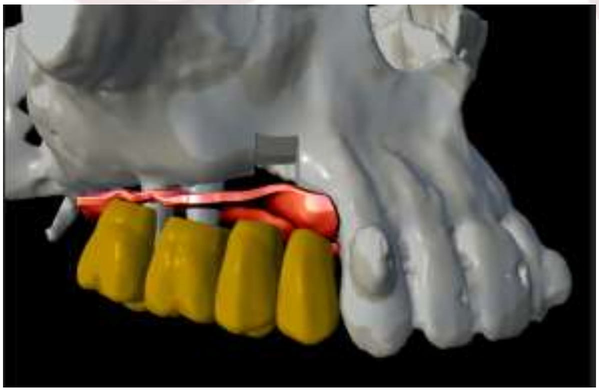

Figure 11C

THE PRODUCTION PHASE

One of the advantages of the contemporary juxta-periosteal technique lies in the flow of approach that must be completely digital and which, on the other hand, allows you to reach the surgical phase with the "chair-side" availability of everything necessary for the assembly of the implant and restoration “one-shot” prosthetic without the need for re-entry by the patient. The juxta-periosteal Mesh is produced both by laser-melting and by milling starting from grade 5 titanium in pod. The prosthetic restoration is milled in pmma already optimized on the connections and anatomies of the opposing arch, so that minimal occlusal adjustments are required once assembled in situ. All surgical material is decontaminated and autoclaved before the surgical session. As for the prosthetic, decontaminated and cold disinfected. [FIG 12], [FIG 13a, 13b, 13c]

Figure 12

Figure 13a

Figure 13b

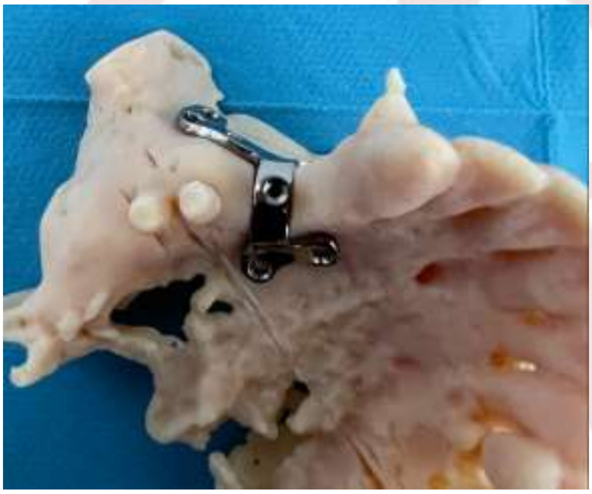

Figure 13c

THE SURGERY

The surgery consists in the preparation of the site, in the adaptation (minimum in our experience) of the prepared structure, the fixing of the same to the bone site, the suturing of the mucogingival planes.

After this, we move on to the prosthesis department, where the restoration is fixed and its occlusion with the opposing arch is optimized. The surgical team consists of two operators and one instrumentalist in the sterile field plus a sterile out-of-field assistant.

The prosthetic one is made up of a Prosthetist, Assistant and Laboratory Technician. The patient is prepared with antibiotic prophylaxis and iv pharmacological sedation. A local anesthetic approach is used for both arches.

The operating table is set up with distinct surgical sets according to the phases of 1) Preparation of the site, 2) adaptation of the implant, positioning of the fixing screws, and final suturing of the elevated gingival planes. The technical instrumentation always present in the operating room consists of DTC with bipolar forceps, Surgical motor and Piezo-Surgery, as well as a multi-parametric monitor and an automatic defibrillator. The three operators in the field work in a first-degree sterility regime.

The access flap is prepared according to traditional schemes, bearing in mind that the bone site must be adequately exposed in order to allow easy insertion of the structure and the execution of the lead holes for the osteosynthesis screws provided for fixing.

The flaps will be elevated to full thickness, ensuring a good haemostasis to facilitate all subsequent phases. In the case of mandibular sites, great care must be taken to carefully isolate the mental foramen in order to ensure that the implant does not interfere with this structure.

In addition, a generous preparation of the lingual flap will have to be made, at least up to the level of the floor muscles. The consequent release that will follow will allow the “tension-free” flaps to be reattached, avoiding the danger of suture dehiscence, which is always inconvenient to manage in the post-operative period.

The positioning of the implant is never complex, given a good initial preparation; in this phase the prosthetic restoration fixed to the implant is held. once positioned in place, the patient is invited to go into occlusion; this will bring the juxta into a final static position where support to the bone surface will be guaranteed, as complete and neutral as possible.

The juxta will be screwed to the receiving bone surface in this position. On the other hand, a special mention should be made of the execution phase of the guide holes of the fixation screws. Given the architecture, this phase is not easy in the insertions in the mandible. We generally use short drills and drivers mounted on contra-angle handpieces.

The suture is performed in detached stitches with particular care. If there are tensions in the attachment of the flaps, they are eliminated before proceeding. The patient is discharged with the prosthetic restoration fixed in place and carefully checked for occlusion. A radiological check is performed on the correct positioning of the implant. [FIG 14 and FIG 15a, 15b]

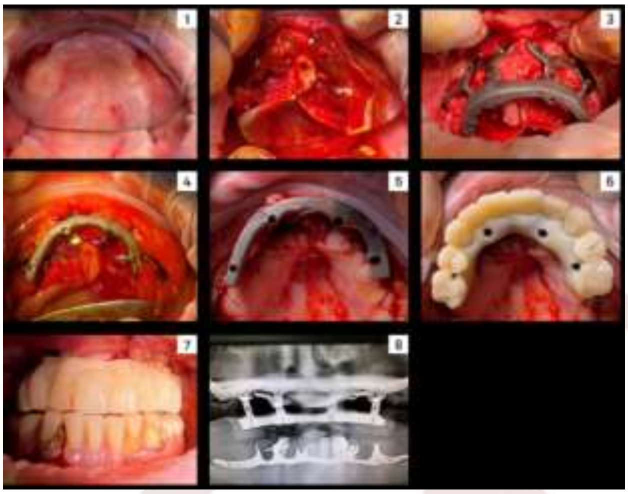

Figure 14

Figure 15a

Figure 15b

THE POST-SURGICAL follow up

The discharged patient takes antibiotic therapy for 5 days following the surgery. Pain relief therapy is prescribed as needed, alternating ice packs, white and soft diet, very light hygiene. We dismiss patient with a very tight control program to be followed. Follow up encloses sutures removal, clinical inspection to wound healing steps and occlusal check for restoration. [PIC 16]. We also collect long term follow-up controls to ensure a satisfactory survival rate of our implants.

Results

This work reports the authors' experience relating to the modern (digital) approach to the rehabilitation method, not describing the results obtained in cases operated with an analogic approach. We operated on two patients in the mandible; one on a full arch, the other on a partial arch (precisely quadrant 4 where a 45-47 restoration was required). In both cases we proceeded with the flow illustrated in the chapter on materials and methods. The only difficulty encountered in the design phase was the virtual preparation of the implant site, where the rendering of the volumes acquired through CBCT presented inaccuracies on the triangulation of the surface. For both we paid particular attention to the delicate phase of surface matching to have almost complete certainty on the correspondence between the real intra-oral situation of the patient and the virtual working model.

In both cases, the surgical phase was easy for both the patient and the operators. The truncular and plexic anesthesia performed, provided to cover the patient in a complete and lasting manner. There was no noteworthy bleeding although one of the patients was on anticoagulant therapy for outcomes of ischemic heart disease and coronary artery surgery. In the case of the partial juxta, the execution of the guide holes and the insertion of the fixation screws was more difficult.

This is in relation to the state of extreme resorption of the alveolar process and therefore to the need to position the osteosynthesis screws in a more caudal position with respect to the occlusal plane and with an unfavorable inclination with respect to the entry trajectory of the drill and driver. The surgery on the upper arch lasted a total of 75 ' despite the 90' in the case of the partial; this in relation to the time taken for fixation with the osteosynthesis screws.

The adaptation of the provisional was not investigative and this confirms the correspondence of the project carried out. The suture, on the other hand, was more difficult in the case of the full arch; this in relation to the fact that initially the operator did little depth in the elevation of the lingual flap.

Authors Photo

Post-surgery was free of pain or infectious outcomes in both cases. In the case of the full arch, a modest amount of mucogingival dehiscence was found, however, to date without compromising the "symptoms-free" functionality of the rehabilitation.

To date, both Iuxta-periosteal frames are well positioned and stable. Patients report good chewing function, free from painful symptoms. According to them, the diet of both patients is almost free and varies according to their choice.

Discussion

The case reports presented are part of a working protocol on Iuxta-periosteal implants that our research group is carrying out to optimize a rehabilitation technique, known, tested over the years and which has seen the birth of new perspectives with the advent of digital methods applied to dentistry. The balance between strengths and weaknesses constitutes the field of investigation that most commits us.

The data in favor of the research work are unequivocal and must be carefully considered. Let's start with the Treatment Times. As amply demonstrated by the literature and as found in clinical practice, the juxta-periosteal implant support allows to reduce treatment times for two reasons. First, for the possibility of implanting strongly atrophic alveolar ridges, therefore without waiting for the clinical times for the integration of reconstructive materials of any type and with any technique they are applied to the site.

Furthermore, the technical times for integrating implant fixtures are eliminated. [6] If we consider both peculiarities and considering that a bone reconstruction requires an average of 5/7 months of waiting and an implantation of 3/5 months, then we immediately see that the savings in terms of time are on average between 8 and 12 months. We keep in mind that we are in the field of large crestal resorptions and therefore we cannot neglect the technical complexity factor linked to alveolar reconstructive surgery.

Now let's consider the cost factor. Whether they are linked to the materials necessary for carrying out traditional reconstructive and implant techniques, whether they are linked to the management cost of the patient's stay in the chair, they will never be able to compete with techniques such as the one under study, which provides for shorter times and the no need to use materials of any origin and invoice for reconstruction purposes. Another not insignificant advantage is the Client Satisfaction in being rehabilitated with a fixed prosthetic restoration on the day of surgery. The general conditions of work, be they employees or freelancers, have drastically reduced the time that the patient has at his disposal for self-care and therefore for medical treatment; in this context, a method that largely ends with a meeting, finds full usability and consensus today.

Let's go further. Recovery from surgery did not prove particularly problematic. Excluding edema and a modest painful symptomatology, there were no post-surgical problems so evident as to experience the patient in his home convalescence. In the cases reported we have not witnessed copious bleeding despite having operated on one of the two patients despite the anticoagulant therapy which he underwent. About 4 months after the first positioning, we did not experience any problems with loss of stability, despite the sudden resumption of chewing reported by both patients.

We now come to the analysis of the adverse data found. First, the diagnostic data acquisition phase. The virtual design of prosthetic rehabilitation on juxta implies having well-organized data available on the anatomy of the bone site, that of intra-oral soft tissues and, finally, that of the de facto dental arches at the time of collection of the data. But not only; these three data orders (soft tissue bone and dental anatomy) will have to be collected so that the reciprocal spatial orientation is also recorded.

This represents the first difficulty, as only an expert operator of digital systems will be able to obtain data that are profitable and therefore usable; moreover, the “modus” of data acquisition depends a lot on the patient's intra-oral conditions at check-in. So, the first real difficulty lies in customizing the data collection and therefore for work done in a service regime, in giving the operator the right information on how to proceed.

Let's now analyze the Design phase. What we show in this work is part of a research path conducted by the authors for several months now. Designing Iuxta is a very complex process. This is not the proper place to describe it in detail. To get an idea of this complexity, consider that every single phase of the processes described in the chapter relating to materials and methods, passes using dedicated software and that sometimes, each single step is carried out by "processing" the file through two or more softwares.

This represents an evident difficulty, which cannot be overcome, in consideration of the fact that the final file destined for the CAM environment (therefore for production), must have characteristics of precision and absence of absolute errors, under penalty of non-reproducibility in the machine of what has been drawn. The production and preparation phases of the product do not represent a moment of technical difficulty, also because they are entrusted to third parties [7]. But let's get to surgery now. Especially for the upper jaw these are procedures that must be entrusted to expert hands.

The preparation of a flap on a full arch, the management of hemostasis and assembly of the juxta (positioning and, above all, fixing with osteosynthesis screws) could be particularly difficult for operators without adequate operational luggage behind. Even the suture phase (it is precisely on the suture that the complication recognized as the most frequent, the soft tissue dehiscence, occurs) is very delicate and laborious, therefore, to be entrusted to expert hands. Finally, let's consider the medical team. In fact, the success of the work depends on the work of highly specialized operators.

In this regard, consider not only the skills that must have those who represent the surgical sector, but also those who deal with the prosthetic part. In addition to a very close collaboration that must necessarily be in the design phase, even the execution of the work implies such a close collaboration generally obtainable only from very close-knit and equally well-established teams.

Conclusion

Recognizing innovation in a therapeutic procedure has never been a simple "path". First, a remarkable cultural background of researchers is needed. Therefore, the ability and the will to write a path, both cognitive and operational, is required, which is never simple.

The vision that prompted us to undertake this path certainly supports and encourages us. Define an operative method, a therapeutic approach, modern, characterized by a very high therapeutic efficacy and efficiency and at the same time by an equally low invasiveness and morbidity for the patient. Functional rehabilitation on Iuxta-periosteal implant structures has all the credentials to define itself as a modern technique. And this even though as a technique it was canonized several decades ago.

The difficulties remain, both in the planning and surgical-executive areas. First, the high degree of technicality that the team must possess. Costs, times, and morbidity are all to the advantage of the favorable judgment that can be attributed to them. Therefore, we are absolutely encouraged to continue the path undertaken by working on various aspects: the collection of follows-ups over time, the refinement of design protocols, especially in terms of biomechanical optimization of the structures and load response.

Another great chapter is the response of soft tissues to the presence of the metal structure in place. But on this we have already proceeded to create an appropriate working scheme. The upcoming edition of an operating manual will allow us to strictly apply a protocol and monitor its results over time. The constant review of the data in our possession, gradually accumulated, will allow us to draw profitable conclusions in the future.

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