INTRODUCTION

When there is an adequate alveolar ridge, conventional endosseous implants are predictable and allow appropriate dental restoration with high rates of success with long-term prosthetic rehabilitation. The problem arises when the bone structure is not sufficient in advanced alveolar bone atrophy stages (Cawood and Howell class V–VI) [1].

For advanced stages, the classical solution generally foresees several surgical techniques such as guided bone regeneration techniques or alveolar distraction with soft tissue grafts [2,3], usually waiting for more than nine months for the final prosthesis. The patient has to endure a lengthy process adding many times a second or third surgery. Surgical options to avoid bone grafting procedures may include the use of zygomatic implants, pterygomaxillary implants and tilted implants.

Subperiosteal implants have been described since 1940 [4,5]. They were made of titanium and cobalt-chromium–molybdenum alloy and the technique was labor some. Subperiosteal dissection of the area was performed in the first surgery to take the impressions, and often the fit was not precise, and adaptations were needed increasing surgery time and complications [6]. When the appropriate bone was available, endosseous implants first described by Dr Brannemark made oral rehabilitation simpler and more reliable for the last 30 years [7].

Additive Manufactured Subperiosteal Jaw Implants (AMSJI) adds a treatment option shortening timings of surgery, making this procedure fast and increasingly reliable [8]. The prosthesis is made of sintered titanium with a basal looped frame with lingual or palatal support, arms from which the post emerges and two wings provide the osteosynthesis fixation [9]. In the case of peri-implantitis, the posts can be easily individually removed under local anesthesia, leaving functional the rest of the implant.
CLINICAL FINDINGS

We present a 35 years old male patient with severe mandibular post-traumatic atrophy, multiple antibiotic resistances due to prolonged stay in the intensive care unit, and a history of recurrent mandibular fistulas (treated removing the previous osteosynthesis) and a failed attempt to reconstruct the area with autologous iliac crest bone graft a year before the implant placement. The patient rejected any additional bone grafting technique, and his main concern was to have a fixed dental prosthesis.

During clinical evaluation, mandibular bone resorption was classified as level V of Cawood and Howell. We ensured that at least four millimeters of attached gingiva were present to reduce the risk of periimplantitis, so a standard free palatal graft was performed three weeks before the surgery without incident.

Since this is a unilateral implant, some steps in the analysis that commonly have to be made like vertical dimension at rest, midline, lipline, tooth display on smile, or canine position can be hindered. Hybrid restoration was chosen as the distance between the bone to the occlusal plane was greater than 15 mm.

A maxillo-mandibular ct scan from the infraorbital rim to the lower border of the mandible is requested using <1 mm slices (0.5–0.7 mm is preferred; 0° gantry tilt in occlusion, in centric relation, maximal occlusion but no clenching).

The patient had no previous dental prosthesis, so mirroring was performed from the fourth quadrant to make the missing dental prosthesis. If a complete prosthesis were required, radiopaque bone graft a year before the implant placement. The patient rejected any additional bone grafting technique, and his main concern was to have a fixed dental prosthesis.

The patient was given antibiotics (Clyndamicyne 150 mg TID for one week), and the clinic subsided. The patient has been followed for one year (Figure 4, Video 1).

SURGERY

Under general anesthesia, a crestal incision is made keeping five mm of fixed gingiva around natural teeth with an anterior and posterior vestibular relaxing incision. If desired, a 3D printed cutting guided can be provided. In this case it was not necessary. Subperiosteal dissection is carried and after proper hemostasia, the prosthesis is inserted and tightly fitted around the crestal bone. No modifications were needed. Four holes were designed for 8-10 mm self-tapping 2.3 Surgi-Tec screws. The lengths of them were previously determined (Figure 3).

The mucosal flaps are tensionless sutured in two layers as watertight as possible with resorbable vycril 4-0 suture.

Temporary suprastructure is placed with the hexagonal screwdriver provided for the Straumann CrossFit screws with a torque of 15 Ncm. A small amount of GC glass ionomer adhesive can be applied to fix the temporary 3D printed prosthesis to the suprastructure. If done so, a periodontal dressing like Coe-pak should be placed lingually and through the vestibule.

Our patient was used to be edentulous on this quadrant, so we left the bar alone. Eight weeks after the setting of the implant, the final screw-fixed hybrid prosthesis was made removing the temporary bar and later using the final hybrid suprastructure provided with the implant.

The third week after surgery, swelling over the left parasymphyseal area was noticed, without fever, tenderness or fluctuation. CT scan was performed, showing nothing remarkable. The patient was given antibiotics (Clindamycin 150 mg TID for one week), and the clinic subsided. The patient has been followed for one year (Figure 4, Video 1).

DISCUSSION

Demands for dental rehabilitations continue to increase as the quality of life in elder patients improves parallel to life expectancy. Patients come to the office very aware of current technologies and seek for a comfortable and fast-fixed prosthesis. Classic Gold standard treatments in patients with severe bone resorptions Cawood and Howell class V-VI aiming for an implant-supported fixed dental hybrid prostheses usually imply bone grafting during or prior endosseous implants or zygomatic implants. A couple of aspects of these treatments must be considered. Evidence-based literature on long-term survival (more than ten years) of implant-supported full arch fixed dental hybrid prosthesis is substantially scarce for conventional and zygomatic implants [10,11]. To the later ones, maxillary sinunitis can develop many years after the surgery [4].

![Image 1: Finite element analysis of the Subperiosteal jaw implant applying 100 Newtons clamping the four screw holes](image-url)
Figure 2: Lateral view of the final design of the subperiosteal jaw implant and the temporary suprastructure

Figure 3: Intraoperative view of the subperiosteal jaw implant

Figure 4: Final hybrid prosthesis after eight weeks of surgery. Video 1 Complete occlusal view of the patient with the fixed hybrid prosthesis
Fears of complications in subperiosteal implants when first used in the 1950s were related to poor care of the fixed gingiva, the use of materials with no osteointegration such as Vitallium alloy and poor stability of the structure. All these issues are now appropriately addressed, using titanium grade 23 ELI, conservative soft tissue surgery and 3D printed precise fit [9]. Similar treatment techniques have been described by Gelrich, et al. [12]. The advantages we have with the current design are overall less titanium structure (over the ridge the removable post are placed apart from the frame) with FEA for 100 Newtons, with microroughness on the bone surface for adequate osteointegration and high polished pink anodized posts for optimal adherence of the mucosa and pleasing esthetics.

When two-stage surgeries (three if soft tissue grafts are needed) are proposed to the patient or a previous failure of a bone graft surgery has marked its readiness to operation, additively manufactured subperiosteal jaw implants are an exciting option which so far is giving reliable medium-term results [13].

A similar technique is also used for facial symmetry corrections, oncology and facial reconstruction whenever support and volume are needed with the same satisfactory results. As with any novel treatment, appropriate follow up is a must. The main advantages we see relies on providing a fixed denture in a single procedure in patients with severe bone resorption and on the possibility to remove an abutment if infection settles, without causing significant morbidity to the bone or the soft tissues.

Additive Manufactured Subperiosteal Jaw implants provide a fast and reliable alternative for dental rehabilitation in cases where conventional implants are not feasible.

BIBLIOGRAPHY