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Reconstruction of an Atrophic Maxilla by using Subperiosteal Implants: Case Report

Zeinab Gholami[1], Maryam Sanaeiazar[1], Faezeh Atri[2]

[1]Postgraduate Student, Department of Prosthodontics, School of Dentistry, Tehran University of Medical Sciences, Tehran, Iran
[2]Associated Professor, Department of Prosthodontics, School of Dentistry, Tehran University of Medical Sciences, Tehran, Iran

Corresponding Author:
Maryam Sanaeiazar
Department of Prosthodontics, School of Dentistry, Tehran University of Medical Sciences, Tehran, Iran
Tel: +989148747161
Email: m.sanaei72@yahoo.com

ABSTRACT

This clinical case report documents the rehabilitation of a patient presenting with advanced maxillary ridge resorption, managed through the placement of a subperiosteal implant in the maxilla. A one-year follow-up evaluation confirmed favourable clinical outcomes and functional stability of the prosthetic rehabilitation.

KEYWORDS: Alveolar bone loss, Overdenture, Subperiosteal dental implantation, Resorption

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INTRODUCTION

Implants, as a promising replacement for edentulism, have an outstanding success rate [1]. Endosseous implants can become unfeasible in cases of chronic and severe alveolar ridge resorption. To overcome this challenge, various bone grafting techniques have been suggested. However, these procedures come with potential complications and limitations, including uncertain prognosis, unpredictable results, the requirement for a second surgical site in autogenous bone grafting, a long healing period, and an extended treatment timeline [2]. Subperiosteal implants (SPIs) were introduced as an alternative treatment for patients with severely resorbed ridges [3]. SPIs were first introduced in the 1940s. In the subsequent years, both clinical procedures and design underwent significant advancement [1]. The increasing popularity of these subperiosteal implants can be attributed to their less invasive nature and the lower risk of surgical complications linked to their use. Global studies have shown encouraging results, with many patients reporting improvements in oral function, aesthetic satisfaction, and overall quality of life [4].

As a result, subperiosteal implants are increasingly recognized as a reliable and preferred treatment modality for patients presenting with compromised alveolar ridge conditions. However, challenges related to insufficient mucoperiosteal integration are largely determined by the gingival biotype, which impacts the quality, quantity, and volume of the soft tissues covering these implants [5].

CASE HISTORY

A 76-year-old woman was referred to the Prosthodontics Department of Tehran University of Medical Sciences for prosthetic rehabilitation. She had been using complete dentures for about 30 years, which had now become loose and unusable. In the patient's lower jaw, two implant units were placed in the private dental office. The patient had no systemic or medical problems.

The patient's panoramic radiograph and cone-beam CT scan revealed significant resorption in the upper jaw, making it impossible to place endosseous implants (Figure 1A, 1B).

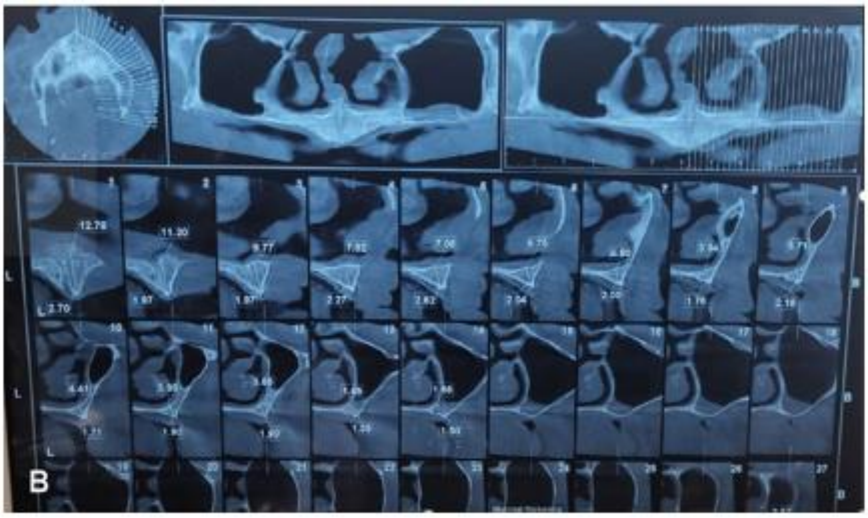

Figure 1. A) Panoramic view before surgery; B) CBCT maxilla

Consequently, the use of SPIs was considered for the treatment of the upper jaw. All procedures were performed with the patient's informed consent. The patient's diagnostic work included a primary impression, vertical dimension assessment, centric record, try-in of teeth, pronunciation analysis, and esthetic evaluation. Then the teeth were marked with opaque foil, and the patient was referred for a CT scan with this radiographic guide. In the scan process, a bite registration material (Granit D45, Betasil, Germany) was used to prevent scattering of the jaws (Figure 2A). The subperiosteal implant was designed in two segments for overdenture, each typically featuring two prosthetic connection points. These connections were linked to the main framework via two supporting arms. The connection form was non engaged morse taper (Figure 2B).

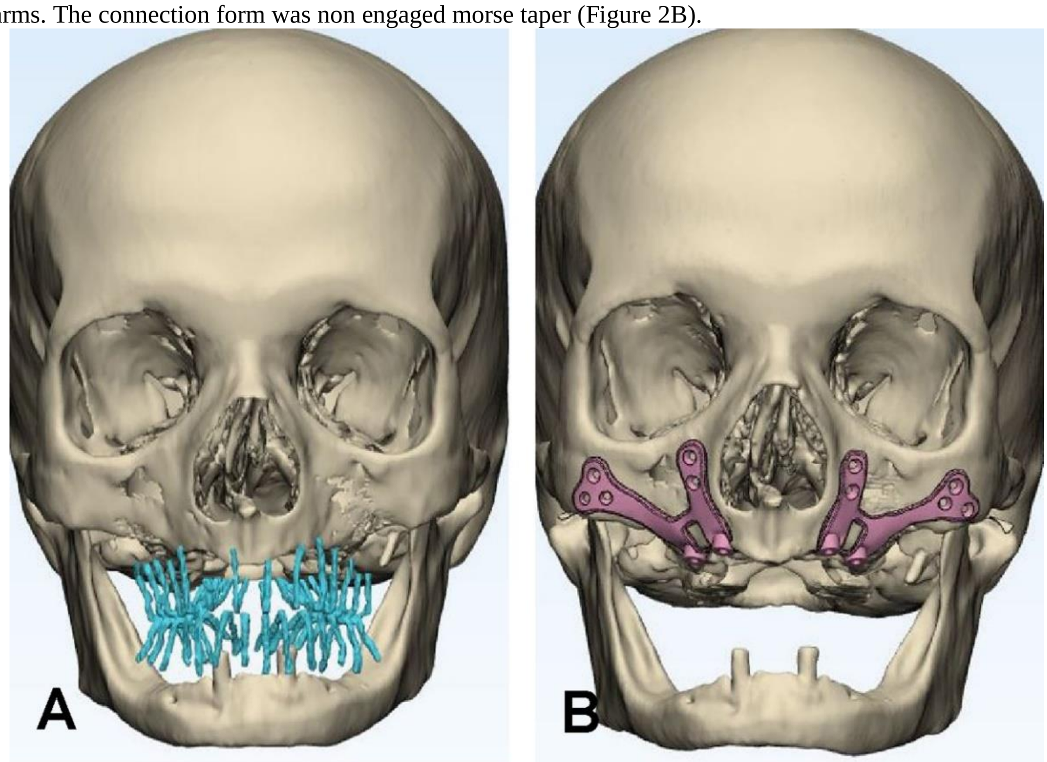

Figure 2. A) CT scan with marker; B) Design of subperiosteal implant

The main framework was designed with two extensions aligned with the midfacial buttresses, each intended to anchor three osteosynthesis screws. To enhance osseointegration, the interface between the flanges and the underlying bone surface was engineered with a porous scaffold-like architecture. The subperiosteal implant was additionally manufactured in titanium grade 23 ELI (extra-low interstitial, PTD, Tehran, Iran). Six months post-surgery, and following surgical healing, the patient returned for impression taking and delivery of the definitive prosthesis (Figure 3). Primary impressions of both the maxilla and mandible were made at the healing abutment level using a prefabricated tray and irreversible hydrocolloid material (Alginate, Zhermack, Badia Polesine [R.O.], Italy). Using these impressions, a custom tray was created with auto-polymerizing acrylic resin (GC, Japan), and border molding was performed with green modeling plastic impression compound (Kerr Corp., Bioggio, Switzerland) to obtain a more precise final impression. The final impression was made at the implant level by using medium-body polyvinyl siloxane impression material (Betasil, Germany).

Figure 3. Panoramic view after surgery

The jaw relationship was registered with a record base and wax rims. After the tooth setup and trial, a putty index was created from the teeth on the cast to analyse the available space, considering the position of the implants and the vertical space. Locator attachments (KERATOR, Seoul, Korea) were selected for both the maxilla and mandible, based on the gingival height and parallelism with the occlusal plane. The overdentures were processed using heat-polymerizing acrylic resin (Meliodent; Heraeus Kulzer). The attachments were torqued to 30 N/cm and placed chairside using Tokuyama hard acrylic resin (REBASE II, FAST, Japan) (Figure 4 A, 4B).

Figure 4. A) Intraoral view; B) Intaglio surface of prosthesis

DISCUSSION

Subperiosteal implants (SPIs) were initially developed in the 1940s but were soon abandoned due to difficulties in fabrication and a high rate of failure. The early designs consisted of custom-fabricated implants made from cobalt-chrome, positioned beneath the periosteum to support a dental prosthesis. However, these implants often did not fit properly and tended to move, leading to peri-implantitis and other issues [6].

In the past decade, the idea of subperiosteal implants has gained renewed attention, largely due to advancements in digital technologies used for dental and prosthetic manufacturing. The integration of imaging methods such as CT and CBCT scans has been a key contributor to this revival. Additionally, the use of additive manufacturing in producing SPIs has greatly enhanced their fitting accuracy, which in turn has significantly increased bone-to-implant contact. As a result, the rate of implant failures has markedly decreased [2, 6, 7].

According to the literature, customized subperiosteal implants represent a viable alternative in cases where standard implants are not feasible or when substantial bone augmentation procedures are required [7].

Digitally designed and fabricated subperiosteal implants represent a promising short-term treatment approach, especially for patients with complex anatomical challenges. Attention should be directed to decreasing the biological complications. Correct designing, fixing, and patient selection and maintenance are critical for the success of the treatment [8].

In the 2018 study by Cerea et al, 70 patients with subperiosteal implants (SPIs) were followed over two years; the survival rate of SPIs was approximately 96%. The authors of the study indicated that just three SPI implants experienced failure because of recurrent infections that could not be treated [9]. The most common complications of SPIs included issues like metal exposure and infection [4].

In a more recent case series, all 10 subperiosteal implants placed in partially edentulous patients showed a 100% survival rate after a 12-month follow-up. Although one implant encountered a minor postoperative issue shortly after surgery, it was effectively treated with antibiotics and analgesics. The researchers attributed the low rate of complications and high implant survival primarily to the precise fit of the SPIs [10].

This treated case has a 20-month follow-up with patient satisfaction although we did have a small amount of exposure of the metal frame in small spots (Figure 4). Despite the presence of metal exposure, which is generally considered a treatment failure, in cases with advanced resorption the outcome is evaluated in terms of survival rather than success. This approach was specifically targeted at patients exhibiting advanced alveolar bone resorption, for whom conventional bone grafting procedures were considered highly unpredictable due to the diminished osteogenic potential of the recipient site, particularly in cases classified as Cawood and Howell Class IV to VI edentulous ridges [7].

CONCLUSION

Recent improvements in the design of subperiosteal implants (SPIs), especially through the application of selective laser melting and finite element analysis, have led to enhanced clinical performance and a decrease in complication rates. This case demonstrates that custom-made SPIs represent a promising and less invasive option for treating severely resorbed jaws, with favourable clinical outcomes.

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