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Abstract

The posterior maxillary area frequently presents challenges for conventional implant placement due to diminished residual vertical bone height. Elevation of the maxillary sinus floor is a potential solution to this issue, though it entails certain drawbacks.

Alternatively, the novel IPG-DET technique provides a minimally invasive, safe, and efficient approach. This protocol intentionally perforates the sinus membrane, leveraging the healing and augmentative potential of autologous concentrated growth factors (CGF). This article presents a case report detailing the application of immediate implant placement using the IPG-DET technique, incorporating autologous CGF and OT Seeger technology.

Keywords: Bone Augmentation; IPG-DET Technique; Sinus Membrane Intentional Perforation; CD34 - Stem Cells; Autologous CGF; Immediate Implant Placement; Immediate Loading with OT Seeger ring technology, OT Equator System

Abbreviations

SFE: Sinus Floor Elevation; CGF: Concentrated Growth Factors; CD34+: CD34- stem cells; LPCGF: Liquid Phase of the Concentrated Growth Factors; MUA: Multi-Unit Abutment; CBCT: Cone Beam Computed Tomography

Introduction

Edentulism, an irreversible and debilitating condition, has long served as a profound indicator of the oral health burden, often termed the "ultimate indicator" of disease impact [1]. Historically, complete mandibular and maxillary dentures have been the conventional treatment approach for edentulous patients over the past century. While upper dentures usually pose minimal issues, lower dentures frequently present challenges with mobility, particularly during eating. The McGill Consensus Statements propose as a gold standard of care for the edentulous mandible, the use of overdenture supported on 2 implants [2]. Contrary, the shortcomings of conventional removable dentures have been addressed by implant-retained overdentures, which have completely changed dental prosthetics [3]. Mandibular overdentures held in place by implants offer better retention, more effective mastication, and psychological advantages. Several attachment systems are recommended in the literature to help with overdenture retention, stability, and support [4]. Various

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systems are currently available for connecting implant fixtures to the prosthetic framework in screw-retained rehabilitation. Among these, the most popular system for full-arch rehabilitations is the Multi-Unit-Abutment (MUA) system, which comes in a range of sizes and angulations to accommodate implant disparallelism while still achieving a passive prosthetic fit. The OT-Bridge system is a respectable substitute for MUA [5]. Introduced in 2020 by Montanari., et al. the OT bridge system is a recently developed abutment system. The OT bridge system was utilized to address the issue of maligned implants, as detailed in their case report. Two components make up the OT bridge system: the "OT equator," which is an implant-tightened stud attachment part, and the "elastic Seeger," an extra-grade, smalldiameter titanium sleeve with an intermediate elastic piece [6]. In relation to the maxilla, the loss of teeth may result in the expansion of the maxillary sinus, most likely due to pneumatization (the creation of positive air pressure during breathing). Not only can alveolar crestal bone resorb, but pneumatization can also cause the maxillary sinus floor to migrate to a more inferior position, making it impossible to place dental implants. In order to integrate and insert dental implants, a number of surgical techniques have been proposed that target the posterior maxilla's bone height [7]. For posterior maxilla implant rehabilitation, the Sinus Floor Elevation (SFE) technique is regarded as a well-proven treatment protocol, particularly in challenging cases of severe bone resorption. However, the complications associated with SFE include partial or total graft loss, sinusitis, dehiscences of soft or hard tissue, Schneiderian membrane perforation, bleeding from damaged vessels, wound infection, and wound infection. Following either transcrestal approaches or lateral window approaches, patients also frequently reported headache, temporary swelling/edema, discomfort, and hematoma [8]. Because of the aforementioned drawbacks, other approaches must be introduced in order to yield more precise and repeatable outcomes, improve patient comfort, and save costs.

In light of this, it has been established that the newly introduced "IPG"-DET is a strong and trustworthy substitute for SFE. Concentrated Growth Factors (CGF with stem cells CD34+), bone grafting, and purposeful sinus membrane perforation are all combined in the well-researched and effective "IPG"-DET dental implantation protocol to enable a speedy implant insertion. CGF, a novel autologous biological matrix derived from venous blood centrifugation, promotes osteoblast differentiation and *in vivo* bone regeneration, offering potential benefits for dental implant procedures [9]. The "IPG" DET protocol enables sinus adjustment and new bone growth without the need for traditional sinus floor augmentation, offering a more precise, repeatable outcome, improved patient comfort, and cost savings. With options for surgical or flapless implant placement following "IPG" DET, this protocol represents a significant advancement in implant dentistry, promising enhanced outcomes for patients with challenging maxillary conditions [9,10].

Case Report and Materials and Methods

Patient information

In this study, diagnostic and surgical procedures begin with visual diagnosis using Orthopantomogram (OPG) and Cone Beam Computed Tomography (CBCT) images, followed by obtaining the patient's medical history. Subsequent consultations between our team and the patient help determine the best course of action. Despite being a heavy smoker with poor oral hygiene, the 52-year-old patient engaged in the study and received counseling on oral hygiene and smoking cessation, resulting in significant improvements. The patient, who also suffered from severe posterior atrophy, opted for the "IPG-DET" procedure with the CGF protocol as the surgical implant solution. A total of six (6) implants TC-R 4,2 x 10 mm (MultySystem, Lissone (MB) Italy) were placed. The Helsinki Declaration ethical guidelines were followed, and a written informed consent was obtained from the patient participating in the study.

"IPG-DET" technique and CGF protocol

In the initial stage, the patient's blood is processed using the Medifuge MF200 centrifuge (Silfradent, Italy) in sterile tubes of 9 ml capacity. After centrifugation, the middle fraction, containing a fibrin-rich gel with platelets, concentrated growth factors (CGF), and stem cells CD34+, is selected from the three produced blood fractions.

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Following this, the procedure commences with the extraction of both the upper and lower jaws due to severe mobility and infection. Osteotomy is then performed with the following drills: a) Pilot drill 2,3 mm, b) First drill 2,55, c) Trimming drill 2,85 [optional followed by (MultySystem, Lissone (MB) Italy) bone compactor - expanders (MultySystem, Lissone (MB) Italy] until intentionally perforation of Schneiderian membrane. Drilling procedure must be performed during copious irrigation with saline solution at room temperature in order to avoid overheating, that could eventually cause tissue damage, and to maintain perfect visibility on the operating field. To this purpose, the control unit of surgical micro-motor rotation must be able to reach 300-400 rpm to avoid necrosis of the bone, which would deteriorate osseointegration. In addition, torque must be 50 Ncm for drilling and 35 - 40 Ncm for fixture screwing.





a)



c)

Figure 1: (a) Initial OPG (b) CBCT scan of maxilla before rehabilitation (c) CBCT scan of mandible before rehabilitation.





c)

d)



e)

Figure 2: (a) Pre-operation maxilla and mandible, (b) Pre-operation maxilla (c) Implant placement with "IPG- DET" Technique and CGF fibrin-rich gel placement into the sinus cavity prior implant insertion (d) CGF placement (d) Suturing technique with simple interrupted sutures for wound closure with CGF.



b)



c)



Figure 3: (a) Pre-operation mandible, (b) CGF fibrin-rich gel placement into the socket (c, d) suturing technique with simple interrupted sutures for wound closure with CGF (e) Post-surgical impression with impression copings (individual tray) for immediate loading with temporary bridge.



b)



a)

c)



Results

The patient participated in this study demonstrated absence of complications, both intra- and post- operatively, into the sinus area. No signs of excessive pain, infection, abscesses, fistula formation, dehiscence, bleeding, or facial hematoma were observed. Additionally, there were no signs of implant exposure or displacement, oroantral communication, vertigo, or any other adverse events [11]. All implants, except for the posterior upper left (#26) utilizing the IPG-DET technique, were immediately loaded and exhibited high primary stability throughout the duration until the completion of the final fixed prosthetic rehabilitation.



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Advantages, disadvantages, indications and characteristics of MUA (Multi-unit abutment) and OT equator system

	MUA	OT Equator system
Advantages:	 Much easier More predictable seating of the final restoration They provide surgical flexibility by allowing the posterior implants to be tilted following the mesial or distal wall of the sinus, avoiding the sinus cavity and eliminating the need for grafting. Correction of disparallelism between implants They move inflammation at tissue level Creating reduced stress translated into the restorative system due to the passive nature of the seating process of multi-unit abutments. Clinicians can determine the angulation correction needed in the patient's mouth rather than on a model in the dental technician lab, as it was described in our case. Clinicians are able to evaluate the vertical clearance that they have available. This allows them to evaluate the prosthetic options early in the process. Dental technician can predictably place multi-unit analogs in the model, which will simplify lab procedures and facilitate more predictable results. 	 Minimum overall vertical height and diameter (2.1-mm height and 4.4-mm diameter) Biological advantage: maintenance the fibromucosal adherence, emphasizing the formation of gingival barrier thus preventing the inflammation and peri- implantitis. The titanium nitride coating provides maximum resistance to wear, the small scale metal housing and nylon caps, offer various retention levels and easy replacement of retention caps. Resilient and self-aligning attachment system with stable retention. Due to its low profile, it can be easily used in patients with severely compromised inter-arch space The elastic material of the retentive matrix of OT Equator allows distributing the retentive capacity over a larger surface, resulting in long-lasting retention due to the wear reduction at the circumference Allow for the compensation of implant divergence of up to 30°, which may be beneficial in severe mandibular atrophies and where axial implant placement is compromised without bone reconstruction. Due to the low profile, prosthetic space can be managed properly, thus providing good esthetic results. OT-Bridge system raises the mechanical properties of the framework because of its smaller size and spread tension stresses more uniformly than MUA. Overcoming implant disparallelisms, even in extreme cases of over 80° Exceptional stability and superior retention when compared with other attachment systems. The use of the OT Equator associated with the Elastic Seeger seems to be a suitable treatment to obtain good passivation of the bar when an implant-supported overdenture is made. In fact, this device compensates for the space between the bar and the retentive equator of the abutment, creating a solid system.
Disadvantages:	 Wide emergence profile for esthetics, Maximum 15 Ncm of prosthetic torque Reduced interarch space for the prosthesis. 	• Does not allow anti-rotational connection and hence not indicated for single-unit restoration
Indications:	 When the implants are anchored to the zy- gomatic bone. The quality or quantity of the maxillary bone is inadequate or insufficient and the im- plant needs to be placed on an atypical angle. 	 Implant-supported overdentures Implant placement in compromised bone Enhancing retention and stability Facilitating hygiene and maintenance Preservation of existing anatomy

	 Full arch replacement, such as All-on-4®, All-on-6[®], or All-on-8[®] is needed. When slight misalignments is present in teeth. In the presence of height disparities in their jawbone. 	 Provision of prosthetic versatility Immediate loading protocols
Characteristics:	• For various soft tissue anatomies – both straight and angled 0°,17°, 30° and 45° variants are available in several different collar heights. [12-15].	 Due to its lower radius, it is indicated to correct divergence up to 28 degrees between implants without affecting the functionality of the elastic nylon cap, which is available in a wide variety of retention levels. OT-Equators are the smallest overdenture and removable denture attachments on the market. The low-profile design and wide variety of retentive options Feature a Titanium Nitride (TiN) coating for maximum resistance to wear, a small-scale metal housing and replaceable nylon inserts suitable for various retention levels. Retention inserts can be replaced easily within seconds. Made up of a low profile attachment for overdentures known as the OT-Equator, a sub-equatorial component known as an interchangeable undercut acetal ring known as the Seeger ring, and a cylindrical titanium abutment with a cavity at the retentive extremity that is designed for the insertion of the acetal ring. A safe and effective elastic retention system of the abutment is offered by the Seeger ring in This manner. This safeguards the abutment against the possibility of the prosthesis unscrewing [16,17].

Table

Discussion

This case report presents a clinical case which incorporates the CGF protocol in conjunction with the relatively new IPG-DET technique, alongside with the application of the OT Equator system for the prosthetic rehabilitation. The IPG-DET technique is a viable replacement for the conventional SFE technique, mitigating any potential side effects and offering the patient a more expedient, non- invasive, and comfortable outcome. The intentional perforation of the Schneiderian membrane alongside with CGF application is now emerging as a viable treatment option due to various reasons [18].

CGF

Firstly, the biological properties of CGF include its ability to release growth factors over an extended period of time can have a more significant impact on improving wound healing around implants [19]. Its dual purpose is to aid in osseointegration and can be utilized either by itself or in conjunction with synthetic graft materials [20,21]. In addition to being affordable, it is also simple to prepare and handle [22]. The fact that CGF does not present a risk of allergic or transmissible diseases and may help lessen postoperative edema and implant relapse is also important to emphasize. Nevertheless, it is important to mention that no postoperative pain or swelling was reported by the patient in our clinical case [23,24]. Recently, Taschieri., *et al.* conducted a prospective comparison study with the goal of determining the impact of CGF on quality of life, comparing standard implant treatment to the combined application of implants and CGF. According to the authors, CGF reduced post-operative discomfort and improved patient quality of life when it came to implant

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rehabilitation of mandibular molars [25]. A study conducted by Yang., *et al.* [26], demonstrated improved buccal bone width following a year after immediate implant implantation. This has been linked to the GFs in CGF, which control cell migration, proliferation, and wound healing. Additionally, after immediate implant placement, a different study showed vertical bone gain on all four aspects (lingual, distal, mesial, and buccal) [20]. Due to its ability to agglutinate fibrinogen, factor XIII, and thrombin, CGF was used to fill the jumping distance, resulting in increased fibrin tensile strength and stability [27]. In addition, CGF functioned as a barrier membrane to quicken the healing of soft tissues and, when combined with bone graft, it could quicken the formation of new bone [20].

IPG-DET/advantages

Regarding the IPG-DET technique, a recent study conducted by Georgakopoulos., *et al.* assessed the safety and validity of the "IPG" DET protocol using Osstell readings and radiographic scans. The implant stability quotient (ISQ) values ranged from 63 to 72, and there was a 50% decrease in micro-mobility, per the results. Additionally, radiographic examination verified the development of new bone at the implant-bone interfaces. The IPG-DET technique has the advantages of being a simple, safe, and a cost- effective protocol that also results in less painful and traumatic experience for the patient [28]. This technique utilizes CGF-CD34+ Matrix concentrated growth factors and stem cells, along with intentional perforation of the Schneider's membrane. Its purpose is to enhance regenerative sinus procedures, bypass oroantral communication, utilize a CG bioactive membrane to promote better osseointegration, expedite implant placement, and minimize bleeding [29].

0Т

The retention system known as OT Equator emerged as a progressive development from the spherical system. Notably, its distinguishing feature lies in the inclusion of the Seeger. The subequatorial element facilitates the insertion of an interchangeable acetal ring, the Seeger, within the cylindrical abutment. This configuration offers a systematic alternative to both screwed and cemented solutions [30]. This concept also enables a reduction in the number of screws required to support the prosthesis. Typically, one to two screws can be omitted when utilizing four to six implants respectively, which is preferable compared to screwed alternatives. Another advantage of the OT Equator concept (Rhein'83) is its ability to accommodate high implant divergence, even in extreme cases exceeding 80 degrees [31]. Preclinical *in vitro* studies have demonstrated that the OT Equator (Rhein'83) provides effective retention systems when supporting an overdenture. Its design distributes strength evenly over the retainer's head, resulting in minimal stress on the peri-implant bone tissue and fixture [32].

Conclusion

The "IPG-DET Technique," enhanced by the regenerative capabilities of autologous CGF-CD34+, has demonstrated both safety and efficacy in the limited dataset studied, positioning itself as a viable alternative to Sinus Floor Elevation (SFE) procedures, irrespective of regularity conditions. However, to fully elucidate the positive clinical impact of this innovative combination, further studies are warranted. Adequate training on how to perform this technique is considered valuable before any effort is made to execute it. These future investigations are crucial for providing a more comprehensive understanding of the benefits and potential applications of the "IPG-DET Technique" in dental implantology. Furthermore, the OT bridge system, a recently developed abutment system, stands as a commendable alternative to the Multi-Unit Abutment (MUA). It has been effectively utilized to address the challenge of misaligned implants.

Conflict of Interest

None.

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