



Esthetic and Functional Rehabilitation with Immediate Implant Placement Using 3D Printing, Grafts, and Biomaterials: Clinical Case Report.

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Case Report

ABSTRACT

This report describes a clinical case involving a minimally traumatic tooth extraction followed by immediate implant placement in the region of an upper premolar, associated with alveolar grafting using a synthetic biomaterial and an autogenous graft harvested from the maxillary tuberosity. A 38-year-old male patient presented with a vertical root fracture in tooth 25. Atraumatic extraction was performed, followed by alveolar curettage and immediate placement of a conical implant ($\varnothing 3.5 \times 13$ mm). The buccal gap was filled with hydroxyapatite combined with β -tricalcium phosphate and autogenous bone graft obtained from the maxillary tuberosity. An immediate provisional acrylic resin crown was installed with occlusion deactivated. After six months, a definitive zirconia crown with a lithium disilicate infrastructure was fabricated and cemented. Immediate post-extraction implant placement has emerged as an effective treatment strategy, particularly in esthetic zones, allowing for preservation of bone and gingival architecture, reduction of physiological resorption, and enhanced esthetic predictability. The immediate approach, when combined with biomaterials and autogenous grafts, proved to be effective for both functional and esthetic rehabilitation in this case, ensuring preservation of peri-implant tissues and yielding an excellent clinical outcome.

Keywords: Dental Implants, Dental Biomaterials, Dentistry.

Reabilitação Estética e Funcional com Posicionamento Imediato do Implante Usando Impressão 3D, Enxertos e Biomateriais: Relato de Caso Clínico.

RESUMO

Relatar um caso clínico de exodontia minimamente traumática com instalação imediata de implante na região de pré-molar superior, associado ao preenchimento alveolar com biomaterial sintético e enxerto autógeno da tuberosidade maxilar. Paciente do sexo masculino, 38 anos, apresentou fratura radicular vertical no dente 25. Foi realizada exodontia atraumática, seguida de curetagem alveolar e instalação imediata de implante cônico (\varnothing 3,5 x 13 mm). O gap vestibular foi preenchido com hidroxiapatita associada a β -fosfato tricálcico e enxerto autógeno obtido da tuberosidade maxilar. Um provisório imediato em resina acrílica foi instalado com oclusão desativada. Após seis meses, foi confeccionada e cimentada uma coroa definitiva em zircônia com infraestrutura em dissilicato de lítio. A instalação imediata de implantes pós-exodontia tem se consolidado como uma abordagem eficaz, especialmente em regiões estéticas, permitindo preservação da arquitetura óssea e gengival, redução da reabsorção fisiológica e melhor previsibilidade estética. A abordagem imediata associada ao uso de biomateriais e enxerto autógeno demonstrou-se eficaz na reabilitação estética e funcional do caso, com preservação dos tecidos peri-implantares e excelente resultado clínico.

Palavras-chave: Implantes Dentários, Biomateriais Dentários, Odontologia.

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INTRODUCTION

Immediate dental implant rehabilitation following tooth extraction has become a predictable and reliable treatment modality, primarily aimed at reducing overall treatment time and preserving the architecture of hard and soft tissues [1,2]. This approach seeks to minimize the physiological bone resorption that typically follows tooth loss and to maintain gingival contours, which is particularly relevant in esthetically sensitive areas such as the anterior and maxillary premolar regions [3]. The predictability of outcomes depends on careful case selection, precise surgical execution, and appropriate management of the biomaterials used [4].

Studies have shown that alveolar bone remodeling after tooth extraction can result in significant loss of ridge volume, especially in the buccal bone plate, often leading to undesirable esthetic consequences [5,6]. To mitigate such effects, minimally traumatic extractions are recommended to preserve the bony walls of the socket and reduce the risk of structural fractures or collapse [7]. Additionally, socket grafting with osteoconductive or osteoinductive biomaterials has proven effective in stabilizing the blood clot, promoting new bone formation, and maintaining alveolar volume over time [8].

Immediate implant placement requires adequate primary stability, a critical factor for successful osseointegration and, in many cases, for enabling immediate provisional loading [9]. The literature suggests that insertion torques above 30–35 Ncm are generally considered suitable for the placement of provisional restorations with non-functional occlusion, thereby reducing the risk of excessive micromovement and early failure [10]. This approach provides not only functional advantages but also esthetic benefits, by allowing early emergence profile shaping and supporting peri-implant tissue preservation [11].

The use of biomaterials to fill the buccal gap in immediate implant placement is well-documented as an effective technique to compensate for physiological resorption of the buccal bone and maintain soft tissue support [12]. Materials such as hydroxyapatite, β -tricalcium phosphate, and autogenous grafts are frequently combined to promote osteoconduction and provide volumetric support and soft tissue



stability [13]. Autogenous grafts harvested from the maxillary tuberosity offer significant advantages due to their biocompatibility and osteogenic potential, being rich in both cortical and cancellous bone—ideal for small-scale three-dimensional reconstructions [14].

The literature also emphasizes the importance of reverse planning, combined with digital technologies, to ensure proper three-dimensional implant positioning and to avoid complications such as bone fenestrations and dehiscence [3,15]. Cone-beam computed tomography (CBCT) is an essential tool in this context, enabling accurate assessment of buccal bone thickness and available bone volume, as well as assisting in the selection of implant diameter, length, and design to optimize insertion torque and primary stability [4,9]. The integration of these digital resources with a minimally invasive surgical technique significantly enhances clinical predictability and medium- to long-term success rates.

In this context, the present article aims to report a clinical case involving minimally traumatic tooth extraction followed by immediate implant placement in the maxillary premolar region, associated with alveolar grafting using a synthetic biomaterial and an autogenous graft from the maxillary tuberosity. The report seeks to demonstrate the clinical applicability of this integrated approach for esthetic and functional rehabilitation, with emphasis on the preservation of alveolar architecture and the long-term success of osseointegration [1–15].

CLINICAL CASE REPORT

The patient A.C.S., a 38-year-old male, presented to the Advances School Clinic Specialization Program, complaining of tooth mobility associated with discoloration of tooth #25, with a negative impact on smile esthetics. During anamnesis, the patient reported a history of trauma in the region, with no recent episodes of pain or purulent discharge. Clinical examination revealed no signs of fistula or suppuration, marked mobility of the affected tooth, and slight chromatic alteration of the crown. The gingival biotype was classified as medium, with preserved gingival morphology.

Cone-beam computed tomography (CBCT) imaging (i-CAT®) confirmed the diagnosis of a vertical root fracture in tooth #25, with preservation of the buccal bone

plate favorable conditions for planning a surgical protocol involving immediate implant placement. Based on the clinical findings, a treatment plan was proposed consisting of minimally traumatic extraction, complete alveolar curettage, immediate implant placement, and bone reconstruction, associated with immediate provisionalization for esthetic purposes. After discussing the proposed treatment and obtaining informed written consent, the surgical procedure was initiated.

Local anesthesia was administered using 4% articaine with 1:100,000 epinephrine (Septanest[®], Septodont). Atraumatic extraction of tooth #25 was performed using periotome-type elevators (Indusbello[®]) to preserve the adjacent bone structures. Alveolar curettage was carried out with Lucas currettes to ensure complete removal of granulation tissue. A conical implant (\emptyset 3.5 × 13 mm, Plenum[®]) was then placed with a final insertion torque of 40 Ncm, achieving good primary stability.

To fill the buccal gap and preserve bone contours, particulate bone graft composed of hydroxyapatite and β -tricalcium phosphate (Bio-Oss[®] Collagen, Geistlich[®]) was used. Additionally, an autogenous bone block harvested from the maxillary tuberosity using trephine burs (Implacil De Bortoli[®]) was adapted to provide additional three-dimensional support for the bone reconstruction and ridge stability [9,10]. To preserve the emergence profile and achieve immediate esthetics, a provisional acrylic resin restoration was fabricated and installed over a conical healing abutment (Plenum[®]), with carefully deactivated occlusion to prevent premature loading during the osseointegration period [11].

Postoperative care included a medication regimen of amoxicillin 500 mg every 8 hours for 7 days, ibuprofen 600 mg every 8 hours for 3 days, and 0.12% chlorhexidine digluconate mouthwash (Periogard[®]) twice daily for 10 days. The patient was followed up periodically with clinical and radiographic evaluations of the region.

After six months of healing, the provisional restoration was replaced by a definitive zirconia crown with a lithium disilicate infrastructure (IPS e.max CAD[®], Ivoclar Vivadent[®]). Cementation was performed using a self-adhesive resin cement (RelyX[™] Unicem, 3M ESPE[®]), ensuring proper retention and effective marginal sealing. The final clinical outcome demonstrated stable gingival contours, favorable esthetic results, preservation of peri-implant tissue volume, and absence of local or systemic complications [12,13].



Figure. 1 - Digital workflow, titanium, zirconia and lithium disilicate.



Figure. 2 - Provisional made, titanium, zirconia and litio dissilicate alveolo ready to

receive the crown.



Figure. 3 - Tooth 25 with indication of extodontics for the installation of dental implant. OdontoSection performed to preserve the bone walls of the alveolo.



Figure. 4 - Tooth 25 extracted, with preservation of bone boards, parallel to install the implant.

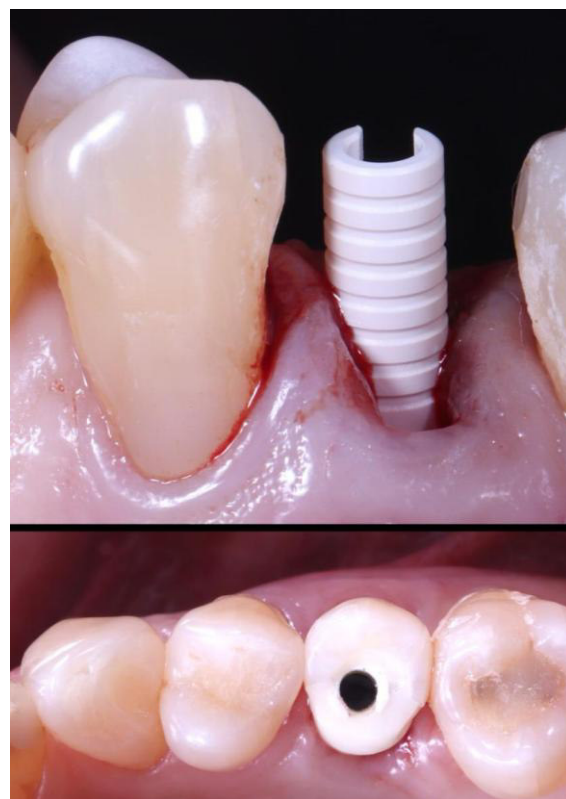


Figure. 5 - Implant being installed, implant system plenum bioengineering, installed

crown.



Figure. 6 - Definitive crown of element 25.

DISCUSSION

The management of post-extraction sockets with immediate implant placement has become a widely adopted strategy in contemporary dentistry, particularly in esthetically sensitive regions. This technique aims to preserve the alveolar bone and gingival architecture as much as possible, minimizing physiological resorption and maintaining soft tissue harmony [1,2]. The success of this approach largely depends on the execution of a minimally traumatic extraction, which helps prevent additional damage to hard and soft tissues, facilitates healing, and contributes to achieving adequate primary implant stability [3,4,6].

One of the main challenges associated with immediate implant placement is the inevitable presence of gaps between the implant and the socket walls, especially in the buccal region. Physiological remodeling of the alveolar bone particularly the buccal plate can compromise soft tissue stability and affect the final esthetic outcome. To mitigate



this process, filling the buccal gap with osteoconductive biomaterials, such as hydroxyapatite combined with β -tricalcium phosphate, has proven effective in preserving bone volume and supporting the peri-implant mucosa [5,9,14]. These biomaterials provide a stable matrix for new bone formation and reduce the rate of resorption, creating a more predictable foundation for esthetic rehabilitation.

Furthermore, the combination of these biomaterials with autogenous grafts especially those harvested from the maxillary tuberosity enhances the quality of the reconstruction. The tuberosity provides highly vascularized, dense cortico-cancellous bone with excellent osteogenic potential, making it particularly suitable for three-dimensional correction of small defects or ridge width augmentation [10]. In the present case, the use of an autogenous graft combined with particulate bone contributed to greater tissue volume stability and supported a natural contour of the region.

Immediate provisionalization, even with deactivated occlusion, is a critical step for achieving successful esthetic and functional outcomes in immediate implant therapy. In addition to restoring esthetics early in the healing process, the provisional acts as a biological template for shaping the peri-implant soft tissues, guiding the emergence profile and maintaining space for the final crown [8,11,12]. However, to ensure the safety of this approach, adequate primary implant stability must be achieved. Insertion torque values above 35–40 Ncm are generally considered ideal for supporting immediate provisionalization, provided that functional occlusion is deactivated to prevent microtrauma that could compromise osseointegration [13–15]. In the present case, a final insertion torque of 40 Ncm was deemed satisfactory to support the immediate acrylic resin provisional, with no complications observed during the healing period.

Overall, the combination of minimally invasive techniques, osteoconductive biomaterials, and immediate prosthetic planning allows for predictable outcomes in terms of bone stability, peri-implant tissue health, and esthetic excellence. The careful execution of each step of the protocol was crucial for the favorable clinical outcome observed in this case.

FINAL CONSIDERATIONS



The present clinical report demonstrates the feasibility and predictability of a protocol involving minimally traumatic tooth extraction, immediate implant placement, the use of biomaterials, and autogenous grafting from the maxillary tuberosity. This integrated approach enabled efficient esthetic and functional rehabilitation, with adequate preservation of the alveolar bone architecture and successful osseointegration after six months of clinical follow-up.

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DATA AVAILABILITY

All data analyzed during this study are available from the corresponding author upon reasonable request.

DISCLAIMER OF LIABILITY AND DISCLOSURE

All data analyzed during this study are available from the corresponding author upon reasonable request. The authors report no conflicts of interest regarding any of the products or companies discussed in this article.

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