

# Immediate implant placement with guided bone regeneration following dentoalveolar trauma – a case report

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**Received:** 6 March 2025 ♦ **Accepted:** 29 April 2025 ♦ **Published:** 3 April 2026

**Citation:** Rogova VVG, Konstantinova DA, Georgiev TD. Immediate implant placement with guided bone regeneration following dentoalveolar trauma – a case report. *Folia Med (Plovdiv)* 2026;68(2):e152126. doi: 10.3897/folmed.68.e152126.

## Abstract

Dentoalveolar trauma is a common cause of tooth loss, especially in the anterior region of the maxilla. The restoration of teeth in this area is invariably challenging due to aesthetic considerations. A variety of treatment modalities are available for clinicians to select from. These include tooth-supported solutions, such as fixed (dental bridges) or removable (partial dentures) prosthodontics, as well as implant-supported restorations. Implant dentistry is an evolving field with expanding indications. The case under consideration is that of head trauma, accompanied by injuries to the soft intra- and extraoral tissues, as well as fractures to teeth #11, #12, and #13. The patient underwent a surgical procedure involving the immediate placement of two implants, accompanied by simultaneous guided bone regeneration. A provisional removable partial denture was fabricated. The placement of the implants occurred six months prior to the subsequent extraction of the teeth. The dentition was subsequently restored with an implant-supported metal-ceramic bridge.

## Keywords

barrier membrane, bone substitute, dental traumatology, GBR, implants

## Introduction

Trauma in the maxillofacial region most commonly affects the upper jaw, namely its frontal region, due to its anatomic position.<sup>[1,2]</sup> Restorations in this area are challenging because of the high esthetic demands.<sup>[1]</sup> Traumatic injuries can damage the hard dental tissues, periodontal ligament, and alveolar bone, as well as jaw and facial bones.<sup>[3]</sup> Fractures of the dental crown are usually restored conservatively.<sup>[2,3]</sup> Teeth with fractures of the crown and root, depending on the level and course of the fracture line, are often subjected to extraction.<sup>[3]</sup> If there are indications for such, the following treatment modalities include fixed prostheses such as bridges, removable partial dentures, or various implant-supported restorations.<sup>[4]</sup>

Tooth loss causes resorption of the alveolar bone proper in the respective region, as well as collapse of the soft tissues.<sup>[2]</sup> Extraction of maxillary frontal teeth is of particular clinical significance, as the thin buccal plate undergoes subsequent resorption. The result is a horizontal and/or vertical bone deficiency.<sup>[2]</sup> This is evident especially when the buccal plate is fractured from a traumatic injury. Contemporary approaches in such cases include alveolar ridge preservation and immediate implant placement following tooth extraction.<sup>[5,6]</sup> The latter approach reduces the number of visits, preserves bone volume and soft tissue contour, and limits further bone resorption.<sup>[2]</sup>

The International Team for Implantology (ITI) has proposed a classification of protocols based on the timing of implant placement relative to tooth extraction, categorizing

them into immediate, early, and delayed placement. Based on the combination of implant placement and loading options, 12 protocols have been formulated.

1. Immediate implant placement – implants are placed on the day of tooth extraction.

2/3. Early implant placement – implants are placed after a healing period following tooth extraction either with soft tissue healing (4-8 weeks post extraction) or with partial bone healing (12-16 weeks post extraction).

4. Delayed implant placement – implants are placed after a longer healing period, with complete bone healing (over 6 months post extraction).

Implant loading protocols could be classified as follows:

A. Immediate – implants are connected to a prosthesis within a week after placement.

B. Early – between 1 week and 2 months.

C. Conventional – after 2 months.

In some instances, guided bone regeneration simultaneous with implant placement is required.<sup>[7,8]</sup> It entails applying a barrier membrane, usually combined with a bone substitute material, in order to eliminate the possibility of ingrowth of epithelial and connective tissue cells, allowing for the regeneration of bone.<sup>[8]</sup>

The aim of this article is to present a case report of a patient with dentoalveolar trauma treated by immediate implant placement with simultaneous guided bone regeneration, provisionalized with an acrylic denture and conventionally loaded with a metal-ceramic bridge.

## Case description

A 71-year-old woman visited the University Medico-Dental Center (specialized Oral Surgery Clinic – acknowledgement FDM) in Varna with an anamnesis of a collapse and subsequent trauma to the head. Upon clinical examination, injuries of the soft tissues of the upper lip were documented. Intraorally, teeth #11, #12, and #13 were fractured, as well as the fixed prosthetic restoration they had (Fig. 1). No clinical findings suggested brain injury.

The working diagnosis included complicated crown-root fractures of teeth #11, #12, and #13, as well as a buccal plate fracture in region 11.



Due to edema and pain in the soft tissues, the surgical procedure of tooth extraction and immediate implant placement was undertaken 2 weeks after the injury.

The procedure was conducted after the patient had signed a declaration of informed consent. Due to the patient's anxiety and fear of surgical interventions, the procedure was conducted under venous sedation. With additional local infiltration of 4% dentocaine (1:200,000), a trapezoid mucoperiosteal flap in region 13-21 was reflected. The roots of teeth 11, 12, and 13 were luxated and extracted. Thorough curettage and lavage with 3% hydrogen peroxide solution and sterile saline followed. Under constant irrigation with sterile saline, implant osteotomies were prepared in the post-extraction sockets of 12 and 13. Straumann BLT 3.3×12 mm (NC, SLA, Roxolid) implants were placed in the respective regions. Cover screws were inserted (Fig. 2).

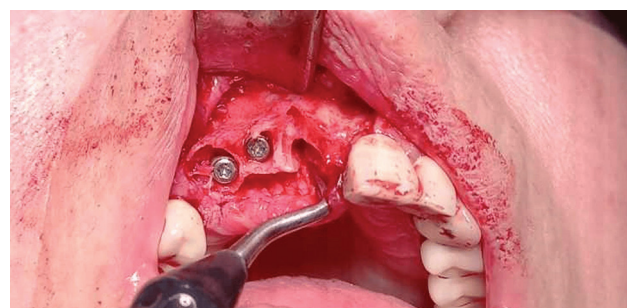


Figure 2. Dental implants with cover screws in place.

A synthetic bone substitute material MaxResorb Inject was placed around and over the implants, which was then covered with a resorbable collagen membrane (Jason Membrane, 15×20 mm) to facilitate guided bone regeneration (Fig. 3).

The flap was sutured without tension with non-resorbable monofilament sutures (Dafilon 5/0, Braun) (Fig. 4).

Hemostasis was achieved and no intraoperative complications were documented.

The patient was prescribed an antibiotic (augmentin 2×1000 mg) for 7 days, a probiotic, an analgesic if needed (nimesulide), as well as an antiseptic mouth rinse with chlorhexidine (Eludril Classic) for 14 weeks.

Sutures were removed 7 days after the procedure (Fig. 5).

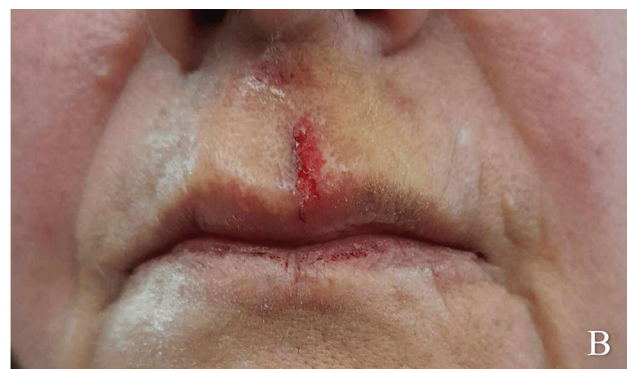
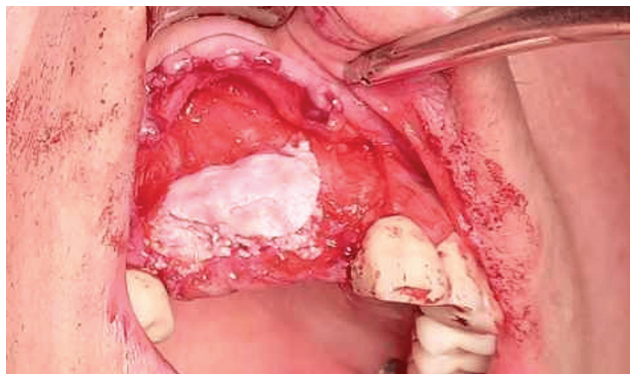
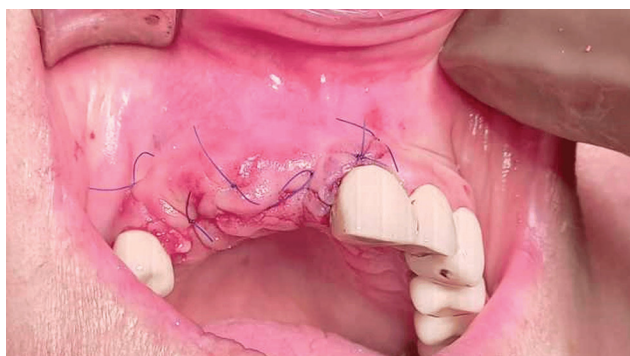


Figure 1. Intraoral (A) and extraoral (B) views of the patient 7 days after the trauma.



**Figure 3.** Placement of bone substitute material and collagen membrane.



**Figure 4.** Flap sutured in place.



**Figure 5.** Intraoral view of suture removal.

During the period of osseointegration, a temporary acrylic removable partial denture was made (Fig. 6). The denture was placed immediately after extraction; the saddle over the surgical area was relieved to avoid excessive pressure on the healing tissues. A soft lining (tissue conditioner) was used for better adaptation and comfort. Adjustments were needed in the next 10 days to prevent sores and discomfort. The patient was monitored regularly during the first few weeks, and the denture was polished.

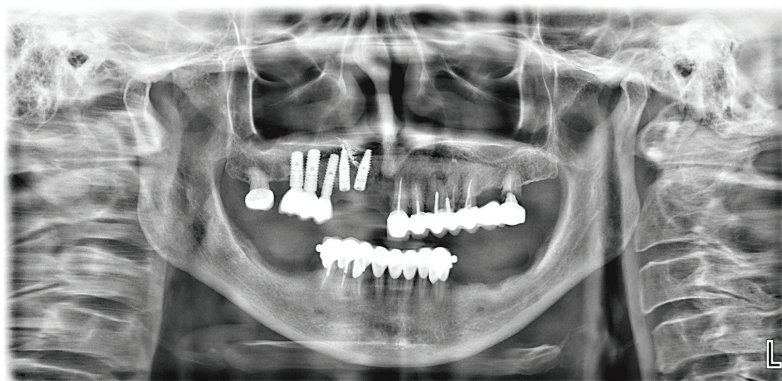
Six months postoperatively, a panoramic x-ray was taken (Fig. 7). The implants were uncovered under local anesthesia with 4% dentocaine (1:200,000), for which an envelope flap was prepared with a horizontal crestal incision in region 11-13. After flap retraction, the cover screws of Straumann BLT implants in regions 12 and 13 were unscrewed, and healing caps were placed. The flap was sutured with non-resorbable monofilament sutures (Dafilon 5/0, Braun).

To preserve the existing prosthetic restorations mesially and distally, and at the patient's request, we designed a conventional fixed metal-ceramic bridge with a cantilever mesially.

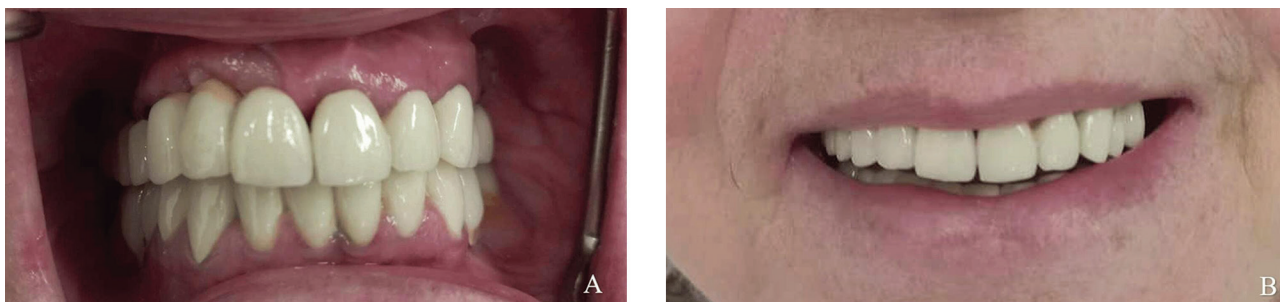
An impression was taken with the open tray technique and polyether impression material (Impregum). Standard NC 15° anatomic abutments were screwed. A metal-ceramic bridge was done (Fig. 8). A conventional cement-retained bridge was chosen instead of a screw-retained restoration due to several factors, including esthetics—lack of visible screw



**Figure 6.** Extraoral photograph with the temporary acrylic denture in place.



**Figure 7.** A control panoramic X-ray prior to the uncovering of implants.



**Figure 8.** Intraoral (A) and extraoral (B) views with the final metal-ceramic restoration at the time of placement.

access holes and reduced mechanical complications such as risk of screw loosening and chipping of the ceramic restoration. Additionally, the cement layer absorbs part of the mechanical load.

*The outcome we achieved met three medico-biological requirements: prophylactic, functional, and esthetic.*

*The patient was feeling satisfied with the results, as reported at the first and third months. The adaptation period was uneventful, with normal function (eating, speaking, etc.) being restored in a short period of 2-3 days.*

## Discussion

Tooth loss causes resorption of the alveolar bone proper and soft tissue collapse in the respective region.<sup>[2]</sup> The extraction of upper frontal teeth is particularly clinically significant due to the thinness of the buccal plate and the subsequent resorption that occurs. Studies suggest that about 50% of the width of the alveolar bone is lost during the first year, of which 30% is lost in the first three months, mainly from the buccal side.<sup>[9]</sup> The result is a horizontal and/or vertical bone deficiency.<sup>[2]</sup> This is especially prominent if the buccal plate is fractured due to trauma. Immediate implant placement reduces the number of visits and preserves bone volume and soft tissue contour while limiting further bone resorption<sup>[2,10]</sup>, which was confirmed in our clinical case.

The results of a 1- to 4.5-year follow-up of implant placement with the different protocols have been published, and reportedly no significant differences were found regarding crestal bone resorption and clinical probing depth.<sup>[10]</sup> In addition, no significant differences in bone healing were noted when placing immediate versus delayed implants with regard to the height and width of the defect.

In the current article, protocol 1C has been implemented—immediate implantation with conventional loading. This designated combination is reportedly successful in 91.8%–100% of cases (ITI) and is the only approach that is clinically and scientifically established.<sup>[11]</sup> In a review article, Lang et al. report a success rate of 98% for immediately placed implants at 2-year follow-up.<sup>[12]</sup>

The indications for immediate implant placement include tooth loss due to trauma, with or without bone loss;

tooth loss due to extensive carious lesions; inability to conduct endodontic treatment; absence of purulent exudate; and sufficient soft tissue volume in order to achieve primary closure of the wound.<sup>[13]</sup> To the latter could be added atraumatic tooth extraction, minimally invasive technique, and achieving sufficient primary stability.<sup>[14]</sup> Contraindications include the presence of pus in the post-extraction socket or adjacent soft tissues, lack of sufficient bone apically to the alveolus, and unfavorable anatomy of the remaining bone.<sup>[13]</sup>

Implantation in the esthetic region requires thorough analysis of the contour and morphology of the gingiva, crestal bone level, smile line, distance between the planned implants, and occlusal relationships.<sup>[15]</sup> Immediate implantation requires minimal preparation of the osteotomy, as the root-form implants have a similar shape to the natural alveolus. Schropp et al. recommend placing implants 3 mm apically to the bottom of the socket and 3 mm apically to the crestal bone in order to achieve adequate primary stability.<sup>[16]</sup> The latter is an essential factor determining the success of immediate implantation.<sup>[15]</sup> In addition, long-term implant survival depends on the health of the peri-implant soft tissues and, thus, on the quality of the fixed prosthetic restoration.<sup>[17]</sup>

Immediate implant placement is often accompanied by simultaneous guided bone regeneration, especially when there is a preceding bone deficiency or fracture of the buccal plate. Several studies suggest that this method aids in the preservation of the height and width of the alveolus and reduces the subsequent marginal bone loss.<sup>[15,18]</sup>

Animal studies suggest that the space between the bone and the implant, as well as the surface characteristics of the latter, are key for blood clot stabilization.<sup>[10]</sup> If there is a bone deficiency or lack of intact bony walls, the application of barrier membranes separately or combined with bone substitute materials allows for bone regeneration to occur and improves osseointegration, increasing bone-implant contact.<sup>[19,21]</sup>

Studies have shown that implant placement with simultaneous guided bone regeneration with DFDB and a non-resorbable membrane shows significantly better bone healing and limited crestal bone loss, compared to the cases where a biomaterial was not applied and the implants were only covered with a membrane. A disadvantage to non-re-

resorbable membranes, however, is the common occurrence of dehiscences, which has been linked with reduction of volume of the augmented bone. Unlike the non-resorbable ones, resorbable collagen membranes present fewer such complications.<sup>[10]</sup> Zitzmann et al. compared collagen and non-resorbable ePTFE membranes for guided bone regeneration and reported better bone fill of the space around implants when using resorbable membranes.<sup>[21]</sup>

In the current case we used a resorbable collagen membrane made of pericardium (Jason Membrane, Botiss) and biphasic calcium-phosphate ceramic (60% hydroxylapatite and 40% beta-tricalcium phosphate—MaxResorb Inject, Botiss). In vivo studies suggest that resorbable collagen membranes fulfill their barrier function for 8-12 weeks, thus allowing enough time for the regeneration process to occur. In addition, unlike non-resorbable membranes, they do not require a second-stage surgery to be removed.<sup>[22-25]</sup> MaxResorb Inject is a bone substitute material in paste form, allowing for easier handling. It is essentially an alloplastic material with inorganic origin and osteoconductive<sup>[26]</sup>, as well as, according to some authors, osteoinductive qualities<sup>[27,28]</sup>. Beta-tricalcium phosphate is resorbed completely in 6-24 months<sup>[29]</sup>, which allows for apposition of new bone in the freed spaces, while hydroxylapatite provides the required mechanical properties<sup>[30]</sup>.

The adaptation period to fixed restorations, such as implant-supported bridges or conventional fixed prostheses, typically lasts from a few days to several weeks, depending on individual patient factors, occlusion, and previous prosthetic experience.<sup>[31]</sup> The standard adaptation period for fixed restorations is typically 2 to 4 weeks, but the described approach facilitates a smoother transition, potentially reducing discomfort and functional challenges, leading to a shorter adaptation time compared to cases where no interim prosthesis is used.

## Conclusion

The treatment of dentoalveolar trauma often requires a multidisciplinary approach and collaboration between several specialists – prosthodontists, pediatric dentists, endodontists, orthodontists, periodontists, oral and maxillofacial surgeons. Restoration of teeth in the esthetic zone of the upper jaw is challenging and for the practitioner due to many specifics, individual for each patient. The current article reaffirms that immediate implant placement with simultaneous GBR is a reliable method for restoring missing teeth in the premaxilla in a patient with trauma in the maxillofacial region. In this particular case the aim was minimally invasive technique and preservation of functional regions from previous prosthetic treatment. All of this improves patient comfort and shortens the adaptation period to a new prosthesis.

## Conflict of interest

The authors have declared that no competing interests exist.

## Ethical statements

- The authors declared that no clinical trials were used in the present study.
- The authors declared that no experiments on humans or human tissues were performed for the present study.
- The authors declared that written informed consent had been obtained from the patient before his inclusion in the study and for the publication of this case report and any accompanying images.
- The authors declared that no experiments on animals were performed for the present study.
- The authors declared that no commercially available immortalised human and animal cell lines were used in the present study.

## Use of AI

Not applicable.

## Funding

The authors have no funding to report.

## Author contributions

T.G. and D.K. conceived the study. V.R. and D.K. developed the theoretical framework. V.R. and D.K. aided in the analysis. T.G. and D.K. supervised the project. All authors discussed the results and contributed to the final manuscript.

## Data availability

All data generated or analyzed during this study are included in this published article.

## Acknowledgements

Not applicable.

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