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Case report

Buccal plate fracture during dental implant insertion after mandibular alveolar ridge splitting and expansion managed with bone grafting alone: A case report

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ABSTRACT

Introduction and importance: After tooth extraction, horizontal bone loss and a reduction in the bucco-lingual ridge dimension may occur. This often necessitates bone augmentation to enable implant placement. For this reason, techniques such as ridge splitting and expansion have been developed; however, they present challenges in single-tooth sites and in the mandible. Complications such as buccal plate fractures remain a concern.
Case presentation: A 49-year-old female, seeking fixed replacement of a missing mandibular molar, presented with a narrow alveolar ridge at the extraction site. Alveolar ridge splitting and expansion were performed to facilitate simultaneous implant placement. During the procedure, a buccal plate fracture occurred. Management did not involve plate fixation; instead, the resulting gap was filled with bone graft. Four months after the procedure, a significant net horizontal bone gain of 3.6 mm was observed. A follow-up at 10 months post-surgery showed successful clinical and radiographic results for both the implant and the prosthetic restoration.
Clinical discussion: A buccal bone fracture occurred during implant placement following ridge splitting. Such fractures can result from mechanical stress exceeding the bone's structural integrity, particularly after splitting and expansion procedures. The mandibular buccal cortical plate is more susceptible to fracture. Management typically involves rigid fixation of the fractured plate with screws, especially in cases of complete fractures. In this report, bone grafting alone was sufficient. The fracture was incomplete, so no fixation was needed. The wound was securely sutured, which allowed for predictable graft containment and healing.
Conclusion: Alveolar ridge splitting is an effective technique for managing narrow ridges and facilitating implant placement. However, complications such as buccal plate fractures may occur. Non-fixation can be considered a viable management strategy in cases where the fracture is incomplete, stable, and soft tissue closure is secure and free of tension. Despite potential challenges, alveolar split can be performed in mandibular single-tooth sites. Careful follow-up is crucial to ensure predictable healing.

1. Introduction

In implant dentistry, it is generally accepted that a minimum volume of bone is required at the implant insertion site for the procedure to be effective. For the placement of an implant with a diameter of 3.5 to 4 mm, a bone width of 6 to 7 mm is necessary. This ensures that at least 1 to 1.5 mm of bone is present on both the buccal and lingual (or palatal) sides of the implant, which is essential for achieving predictable outcomes [1]. After tooth extraction, a significant reduction in the bucco-lingual dimension of the alveolar ridge can be observed. This horizontal resorption can range from 3.8 to 6.1 mm over a period of 3 to 12 months, respectively [2]. This reduction may account for 50 % loss of the original bone width [2]. As a result, various bone augmentation procedures may be required, including guided bone regeneration (GBR) using non-resorbable membranes with autologous or non-autologous bone materials, autogenous block onlay grafts (harvested intraorally or extraorally), distraction osteogenesis, or alveolar ridge splitting/expansion with or without the use of GBR [3–7].

In recent years, various techniques for ridge splitting have emerged, such as split-crest osteotomy and ridge expansion, along with numerous other modifications [8]. Additionally, a diverse range of tools has been introduced for these procedures, including hammers, motorized ridge

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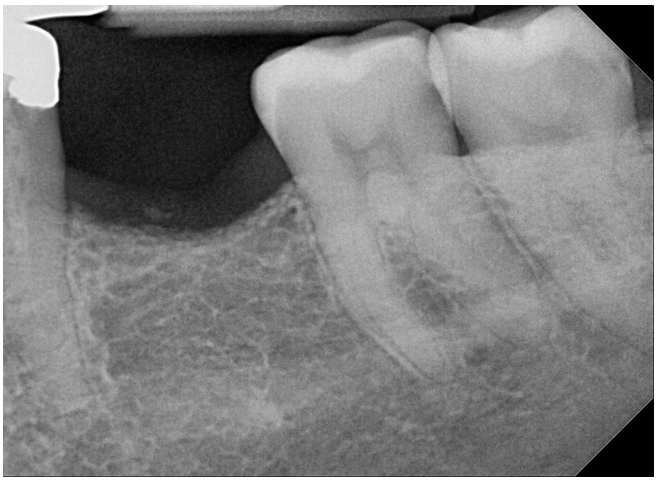

Fig. 1. Preoperative periapical X-ray demonstrating the need for implant restoration at a single-tooth site. The mandibular first molar was extracted 9 months prior.

expanders, magnetic mallets, piezosurgical instruments, and both rotating and oscillating saws [1,7–9]. Clinical, histological, and animal studies have demonstrated excellent outcomes for alveolar ridge splitting and expansion techniques [1]. However, no clinical technique is without complications. Studies have identified buccal plate fracture as the primary complication associated with alveolar ridge splitting [10,11]. Buccal bone fractures have been reported in up to 14 % of cases following alveolar ridge splitting [11]. Proper management of this complication typically involves rigid fixation of the fractured bone plate, as adverse outcomes such as delayed healing, bone resorption, or implant failure are usually of concern.

Herein, we present a clinical case involving a patient with a narrow alveolar ridge who underwent simultaneous implant placement following alveolar ridge splitting. During the procedure, a buccal plate fracture occurred during implant insertion. This case demonstrates that fixation of a fractured buccal plate may not be necessary in certain situations. This case report has been prepared in accordance with the SCARE guidelines, ensuring compliance with established standards for case report reporting [12,13].

2. Case description

A 49-year-old woman, medically healthy and a non-smoker, presented with a narrow alveolar ridge that required surgical intervention to facilitate implant placement. She sought consultation at the Department of Oral and Maxillofacial Surgery, Faculty of Dental Medicine (Damascus University). Her non-restorable mandibular left first molar had been extracted nine months earlier (Fig. 1). Radiographic assessment using cone-beam computed tomography (CBCT- PaXi3D Green, Vatech Co. Ltd.; Gyeonggi-do, South Korea) revealed a narrow alveolar ridge at the extraction site, with a horizontal width of approximately 4.1 mm—insufficient for placing a dental implant of adequate diameter (Fig. 2a). After clinical and radiographic evaluation, and in consideration of the patient's expectations and preferences, alveolar ridge splitting was selected as part of her rehabilitation treatment plan.

The patient underwent the surgical procedure. The surgical area was disinfected with 10 % povidone-iodine extraorally and 0.12 % chlorhexidine intraorally. Local anesthesia was administered at the surgical site using 4 % articaine with 1:100,000 epinephrine. A full-thickness mucoperiosteal flap was reflected to provide access to the alveolar bone. A midcrestal osteotomy approximately 8 mm deep was performed using a piezoelectric device (PIEZOSURGERY® white, Mectron; Carasco, Italy) with a piezosurgical microsaw tip (OT7). The osteotomy was extended mesiodistally for about 8 mm, maintaining a distance of at least 1 mm from the adjacent teeth. Two vertical releasing osteotomies were then performed at the mesial and distal ends of the midcrestal osteotomy, extending to the cancellous bone, using the same OT7 tip employed throughout the osteotomy. The IM1S piezosurgical insert was

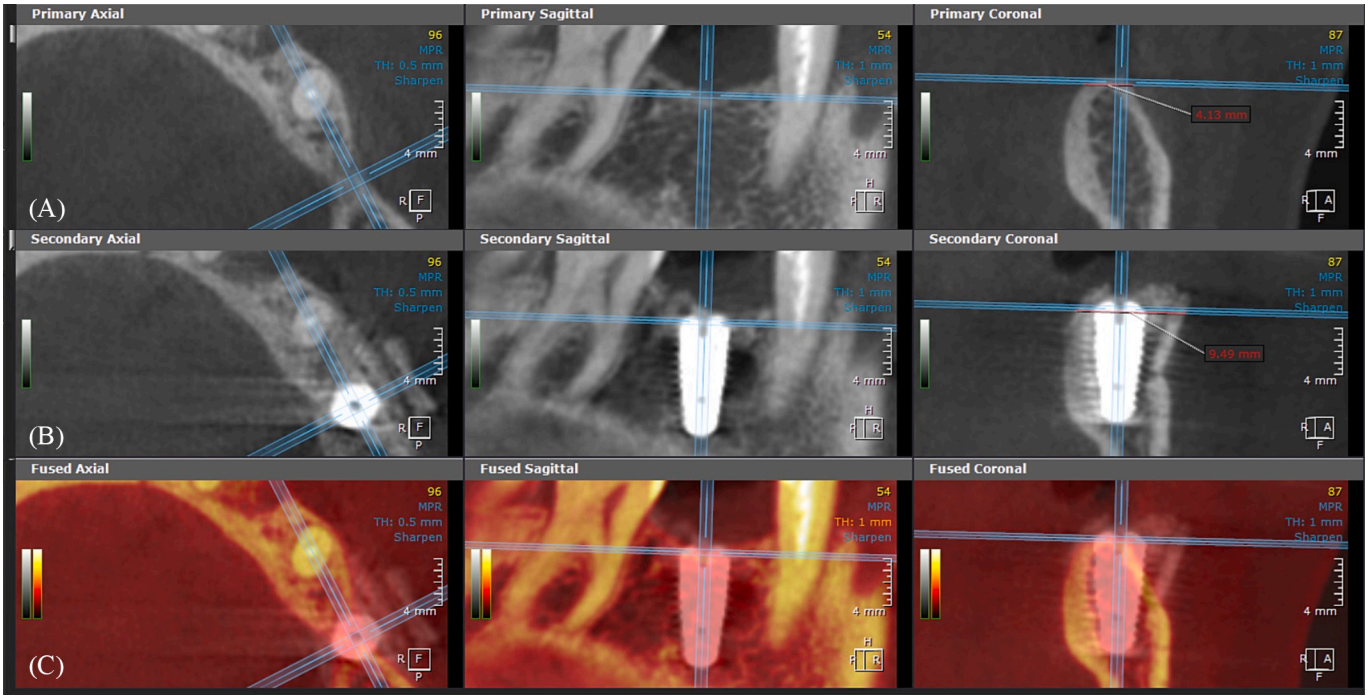

Fig. 2. CBCT images showing multiple views of the implant site before and after implant placement. A: Preoperative CBCT image demonstrating a narrow alveolar ridge. B: Postoperative CBCT image taken immediately after ridge splitting and expansion, showing a buccal plate fracture along with bone grafting. C: Superimposed images illustrating the initial increase in alveolar ridge width following ridge splitting. (Note: The sagittal and coronal axes have been adjusted and rotated to display the implant with optimal clarity.)

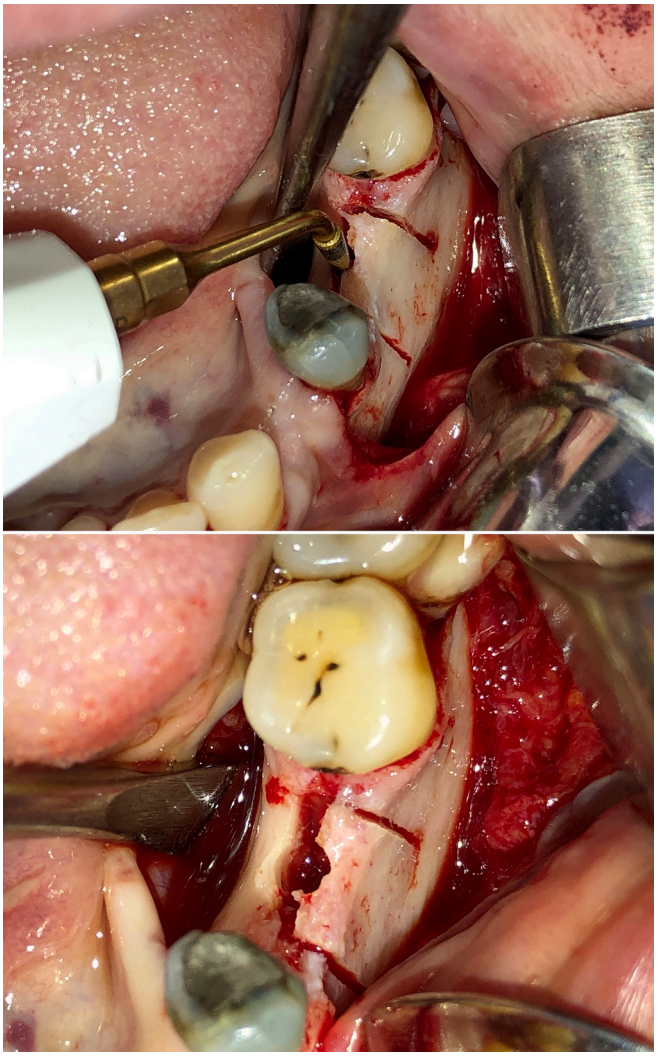

Fig. 3. Clinical photographs showing the cortical osteotomy lines and the ridge expansion technique using piezosurgical expansion tools.

used to prepare the implant placement site (initial pilot osteotomy) for subsequent instruments. The piezosurgical bone expander kit (Mectron; Carasco, Italy) was then used to expand the alveolar ridge and prepare the implant bed (Fig. 3).

An implant measuring 10 mm in length and 4 mm in diameter (AnyOne® System, MegaGen Implant Co., Ltd.; Dalseong-gun, Korea) was placed in the prepared site. During implant placement, a fracture of the buccal bone plate was observed, and it was slightly mobile (Fig. 4). A xenogeneic bone substitute (Botiss Cerabone®, Botiss Biomaterials GmbH; Zossen, Germany) with particle sizes between 0.5 and 1 mm was used to fill the gap between the buccal and lingual plates (Fig. 4). The wound was then securely closed using horizontal mattress and simple interrupted sutures, which were removed 12 days post-surgery. Post-operative instructions included adherence to a soft diet for two weeks, a seven-day course of antibiotics, analgesics as needed, and 0.12 % chlorhexidine rinse for two weeks. A CBCT scan taken immediately after surgery confirmed the buccal plate fracture (Fig. 2b). Four months later, a follow-up CBCT showed significant healing of the fractured buccal plate (Fig. 5), and the implant was successfully osseointegrated. Resonance frequency analysis (MEGA ISQ® II, MegaGen Co., Ltd.; Dalseong-gun, Korea) performed at re-entry (after 4 months) revealed an ISQ value of 76, indicating sufficient secondary stability to commence the prosthetic phase.

The implant was restored with a porcelain-fused-to-metal crown. Radiographic analysis showed that the alveolar ridge had a horizontal width of 4.1 mm prior to surgery. Immediately after the procedure, the width increased to 9.5 mm. However, due to natural bone remodeling and healing, the ridge width decreased to 7.7 mm at the four-month follow-up. This reflects a net horizontal bone gain of 3.6 mm.

The patient's primary concern was the restoration of the missing tooth. During the surgical procedure, she remained comfortable and was kept well-informed about each step, including the occurrence of the buccal plate fracture. Postoperatively, she recovered without any significant complications or discomfort beyond the expected healing process. Follow-up at 10 months post-surgery demonstrated successful implant and prosthetic outcomes, both clinically and radiographically. The patient expressed a high level of satisfaction with the treatment outcome, stating that both the procedure and the care provided by the medical team met her expectations. The patient provided her informed consent for the inclusion of her clinical details and images in this case report.

3. Discussion

The clinical need for fixed prosthetic rehabilitation on a narrow alveolar ridge poses a considerable challenge for both prosthodontists and oral surgeons. In this case, horizontal bone loss was evident. Prior to the intervention, the patient was thoroughly informed about the advantages and disadvantages of alveolar ridge splitting for horizontal ridge expansion. Alternative treatment options—including intraorally harvested onlay grafts and GBR—were also discussed. However, ridge splitting and expansion were ultimately selected as the treatment approach for this case due to the patient's preference for a single-stage surgery. Additionally, the bone in this situation met the necessary criteria for the procedure.

The alveolar ridge expansion technique was first described by Hilt Tatum in 1986, while the ridge splitting technique by Simion et al. was later developed to provide a more conservative surgical approach [14,15]. This method can eliminate the need for two-stage procedures such as GBR, autogenous block onlay grafts, or distraction osteogenesis, along with their associated disadvantages [1,16]. The complication rate associated with ridge splitting is relatively low, with studies reporting an incidence of approximately 6.8 % [10]. Certain prerequisites must be met for ridge splitting to be considered, including a minimum alveolar bone width of 3 mm or more and a vertical height of at least 10 mm without significant concavity [1]. When the bone width is less than 3 mm, the risk of bone fracture increases, as the split is confined primarily to cortical bone. Ideally, the ridge split should allow for exposure of the cancellous bone between two buccal and lingual cortical plates [17]. When sufficient residual horizontal bone is present, ridge splitting demonstrates a high clinical success rate. A meta-analysis reported an average horizontal bone width gain of approximately 4 mm [16]. A similar outcome was observed in this case, with a net increase of 3.6 mm in the width of the alveolar ridge following the splitting osteotomy and bone expansion procedure.

Buccal plate fracture is the most common complication associated with alveolar ridge splitting and expansion procedures [11]. The greater the horizontal bony defect, the thinner the alveolar ridge and the higher the risk of buccal plate fractures during splitting and expansion [18]. It was reported that fractures in the mandible are more difficult to control due to the increased thickness of the cortical plates, which heightens the risk of fracture [19]. In contrast, the incidence of fractures in the maxilla is lower, owing to the presence of softer medullary bone [19]. As a result, a two-stage treatment approach is often recommended for the mandible. However, single-stage mandibular ridge splitting and expansion—allowing for immediate implant placement and reduced treatment time—has been reported [7,20].

In this case presentation, we observed complete healing of an incomplete buccal plate fracture that occurred during implant insertion, confirmed four months after the procedure. This outcome may be

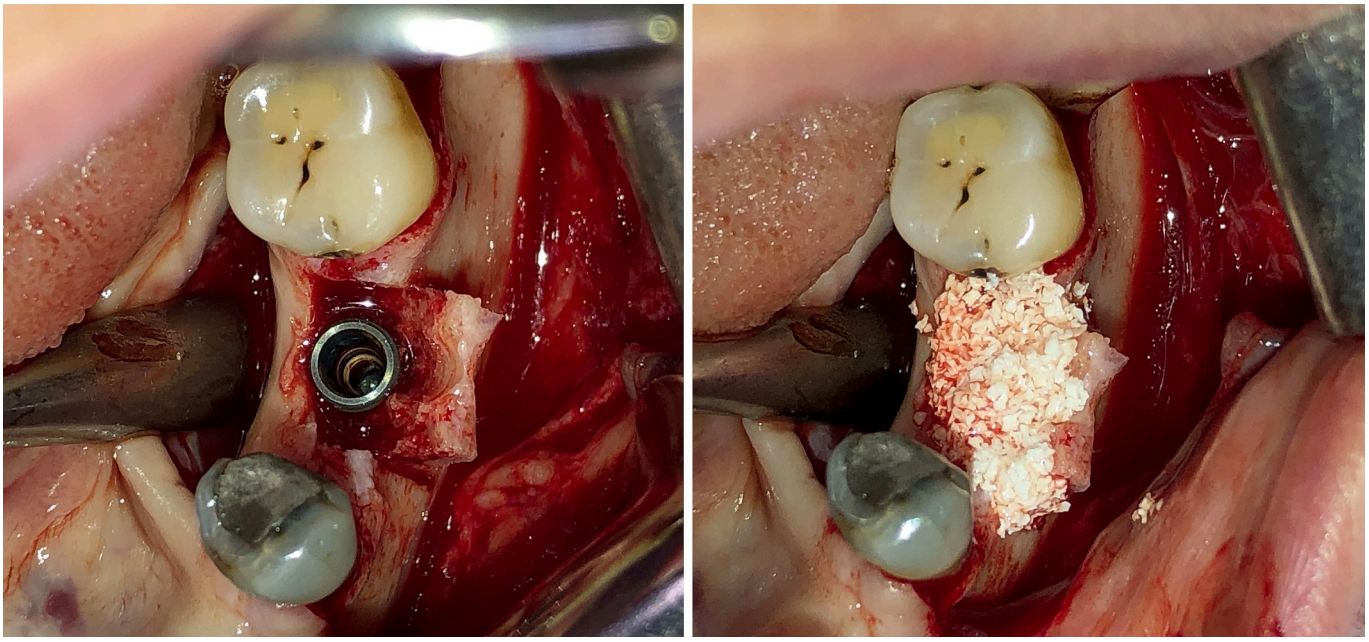

Fig. 4. Clinical photograph showing a buccal plate fracture complication that occurred during implant placement. A bovine-derived bone graft was used to fill the defect created by the fracture.

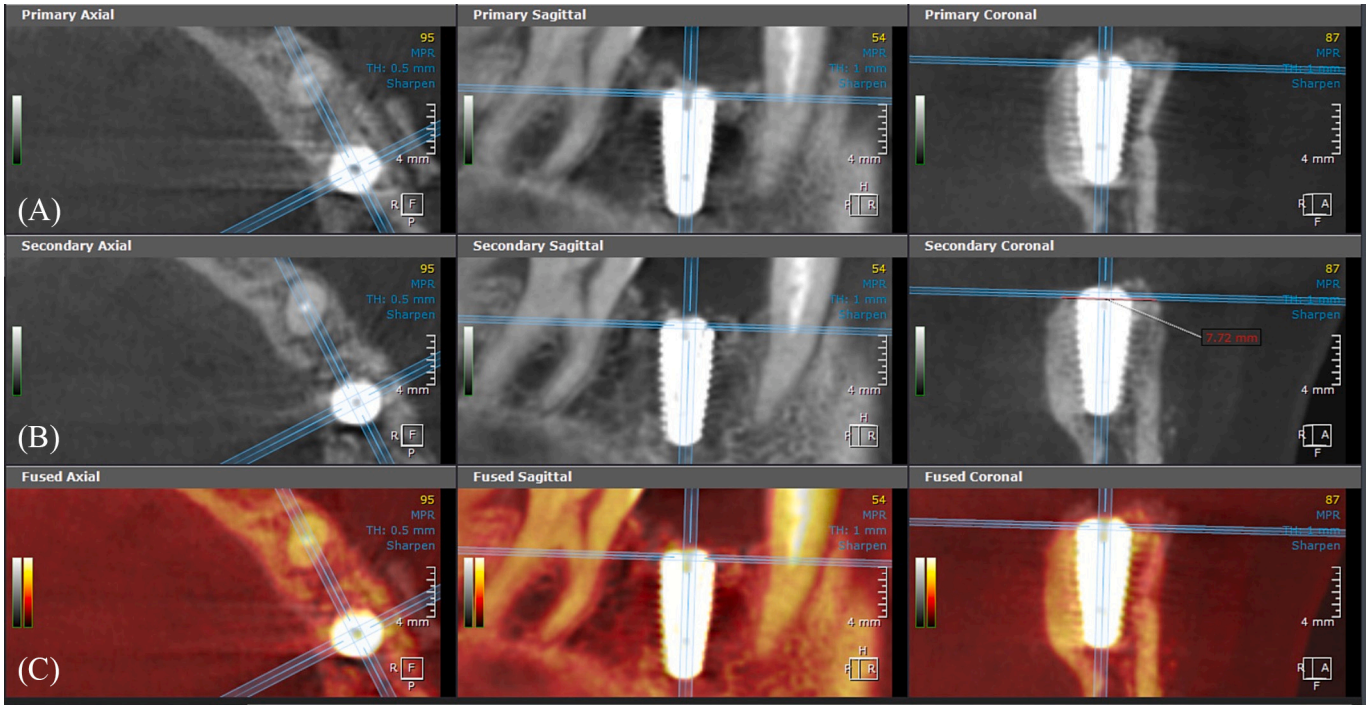

Fig. 5. CBCT images showing multiple views of the implant site immediately after placement and at 4 months post-surgery. A: Postoperative CBCT image taken immediately after ridge splitting and expansion. B: CBCT image taken 4 months post-surgery, showing clear healing of the previously fractured buccal plate. C: Superimposition of the images in A and B, illustrating changes and bone remodeling over time. (Note: The sagittal and coronal axes have been adjusted and rotated to display the implant with optimal clarity.)

attributed to the typical healing pattern following alveolar ridge splitting, in which the implant and bone graft material were placed between the cortical plates. Sufficient blood supply between the two bone plates promotes healing [21]. This healing process resembles that of extraction sockets, facilitating the regeneration of new high-quality bone tissue [21]. Such bone regeneration supports implant osseointegration and may explain the successful healing of the fractured buccal plate.

Several challenges were present in this case, as the osteotomy was performed at a site of a missing single tooth. Single-tooth sites have often been considered a contraindication for ridge expansion [22]. However, the mesiodistal width of the mandibular molar site in this case was sufficiently wide to allow for ridge splitting and expansion, suggesting that, despite previous concerns, this approach could be viable in certain circumstances. During the procedure, an incomplete buccal plate

fracture occurred, possibly due to excessive stress applied during implant insertion. As the fracture was incomplete, the decision was made to leave it without fixation. The buccal bone plate fracture was described as an incomplete fracture because the broken bone remained attached to the apical side of the bone, with noticeable movement in the plate. The bone plate was not completely separated from the bone. In contrast, a buccal plate fracture would be considered complete when the bone plate is fully separated from the surrounding bone. In such cases, managing the condition would require the use of screw fixation for stabilization, as in the split-box technique [23].

Healing progressed despite the challenges associated with performing an osteotomy in the lower jaw. According to the literature, osteotomies in the upper jaw typically have a lower rate of buccal plate fractures, likely due to the greater amount of cancellous bone and thinner cortical bone compared to the lower jaw. It can be concluded that an incomplete fracture of the buccal plate does not necessarily require fixation when a bone graft is placed in the gap between the two plates and the flap is securely closed with tension-free, two-layer sutures. Consequently, after four months, the implant was functional, with no significant bone resorption visible on radiographs. It met the established clinical and radiographic criteria for success [24].

4. Conclusion

Alveolar ridge splitting and expansion is a valuable technique for managing narrow ridges, facilitating implant placement. However, as with any surgical procedure, it is not without potential complications. One such complication is the risk of buccal plate fractures, which can occur during the osteotomy process, bone expansion, or implant insertion. This case highlights that, while buccal plate fractures can be concerning, they can often be managed effectively without the need for rigid fixation. In this instance, the use of bone grafting materials combined with meticulous soft tissue closure ensured stable healing. Notably, despite the fracture, successful bone regeneration and osseointegration of the implant were achieved, demonstrating that with careful technique and appropriate postoperative care, favorable outcomes are still possible even in the presence of intraoperative complications. Further studies are needed to better understand the factors that contribute to buccal plate fractures and the long-term implications of non-rigid fixation in such cases. Additionally, research exploring optimal bone grafting materials and soft tissue management strategies could further enhance the predictability and success of alveolar ridge splitting procedures.

Author contribution

All authors have contributed substantially to the work.

Conceptualization, A.A., N.M.A and M.Z.; methodology, A.A.; investigation, A.A. and N.M.A.; data curation, A.A.; writing—original draft preparation, A.A. and N.M.A.; writing—review and editing, N.M.A and M.Z. All authors have read and agreed to the published version of the manuscript.

Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

Ethical approval

Ethical approval was provided by the Ethical Committee of Damascus University, Damascus, Syria (Approval No. UDDS-OMFS-01-2023).

Guarantor

All authors accept full responsibility for the work and conduct of the study, had access to the data, and approved the decision to publish this work in *International Journal of Surgery Case Reports*.

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Conflict of interest statement

Each named author has no conflict of interest, financial or otherwise.

Data availability

The original contributions presented in the study are included in the article material, further inquiries can be directed to the corresponding author.

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