Case Report

Drill bit failure in Mandible fracture Fixation- A case report and Management

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ABSTRACT

Drill bit breakage during maxillofacial surgical procedures, including open reduction and internal fixation of mandible fractures, is a common but challenging complication for surgeons. While immediate retrieval is often successful, some cases require a more complex approach. This case report describes a retained drill bit fragment encountered during the fixation of mini plates and screws in a patient with a mandibular fracture. The article explores the multifaceted factors contributing to drill bit failure, encompassing drill bit characteristics, surgical technique, patient anatomy, and surgeon-related factors. Additionally, it covers techniques for removing broken drill bits and examines the decision-making process and potential issues. By examining both the causes and management of drill bit breakage, the article aims to guide surgeons in addressing this challenge.

Key words: Drill bit failure, Mandibular fractures, Fracture fixation, Surgical instruments, Iatrogenic disease

Achieving accurate reduction and stabilization is the primary criterion for successful fracture healing. The management of mandibular fractures has evolved over time, transitioning from conservative approaches, such as maxillomandibular immobilization, to open reduction and internal fixation [1]. After fracture reduction, mini plates and screws are placed to secure the fracture. Typically, a hole slightly smaller than the screw diameter is created using either a drill bit or a bur and a self-tapping screw is then inserted to hold the plate in place. Drilling the bone is a mechanical process, and various factors influence the success of this procedure. Occasionally, the drill bit may break during the drilling process. In such cases, the broken fragment must be removed, as the screw needs to be placed, and the presence of a foreign body is undesirable. When the broken end of the drill bit is visible at the bone surface, its removal can be straightforward. However, in situations where the fragment is deeply embedded and not accessible, the retrieval process becomes more challenging and requires specialized expertise.

Surgeons frequently encounter a dilemma when deciding whether to promptly extract or retain a fractured drill bit fragment encountered during maxillofacial surgical interventions. This case report aims to provide academic insights into the management strategies for addressing this complication.

CASE PRESENTATION

A 27-year-old male presented with a right para symphysis and left angle of mandible fracture sustained in a road traffic accident. Open reduction and internal fixation with arch bar stabilization were performed under general anesthesia with nasotracheal intubation. During fixation of the right para symphysis fracture using mini plates and screws, a drill bit was inadvertently broken. Attempts were made to remove the broken fragment using various techniques, such as enlarging the drill hole with a burr and side drilling, but the small, non-visualized end of the fragment could not be located.

Intraoperative imaging was unavailable at the time, and the decision was made to proceed with the planned open reduction and internal fixation to minimize further damage to the remaining bone. The surgery was completed, and the situation was explained to the patient. A radiograph obtained the next day revealed a small piece of the drill bit deeply embedded near the lingual cortex (Figure 1a). The immediate postoperative period was uneventful, and the patient was advised to report any persistent pain, swelling, or discharge from the wound. The patient subsequently went abroad for employment.

After 12 months, the patient developed swelling, pain, and serous discharge following a trivial trauma and returned to India for consultation. The patient was well nourished and without any comorbid conditions. Examination revealed a swelling in the chin with a discharging sinus exposing the tip of the implant, but without signs of infection (Figure 2). The intraoral examination revealed the mandible to be firm and indurated, without any visible signs of inflammation or

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infection. Radiographic evaluation showed a loosened plate with the retained drill bit in situ (Figure 1b).

The patient underwent surgery under general anesthesia, where the sinus was excised, and the mini plates and screws were removed. Thorough wound lavage was performed, and the fracture was found to have healed well. The enlarged previous drill hole was inspected, but the retained drill bit could not be visualized properly (Figure 3a). C-arm imaging was then used, and the drill bit was found to be deeply situated near the lingual cortex (Figure 3b). Careful etching of the callus at the enlarged drill hole was done, and the tip of the drill bit was identified at the depth of the pit. Gradual etching along the sides of the drill bit tip was performed, and the visible tip was grasped with a fine-tipped needle holder. The drill bit was then successfully retrieved by a slight anticlockwise rotation and gentle pulling (Figure 3c). The retrieved drill bit was inspected and found to be intact up to the tip (Figure 3d). Confirmation with C-arm imaging was performed.

The implants were removed and surgical wound was closed in layers. The postoperative period was uneventful, and the wound has healed well.

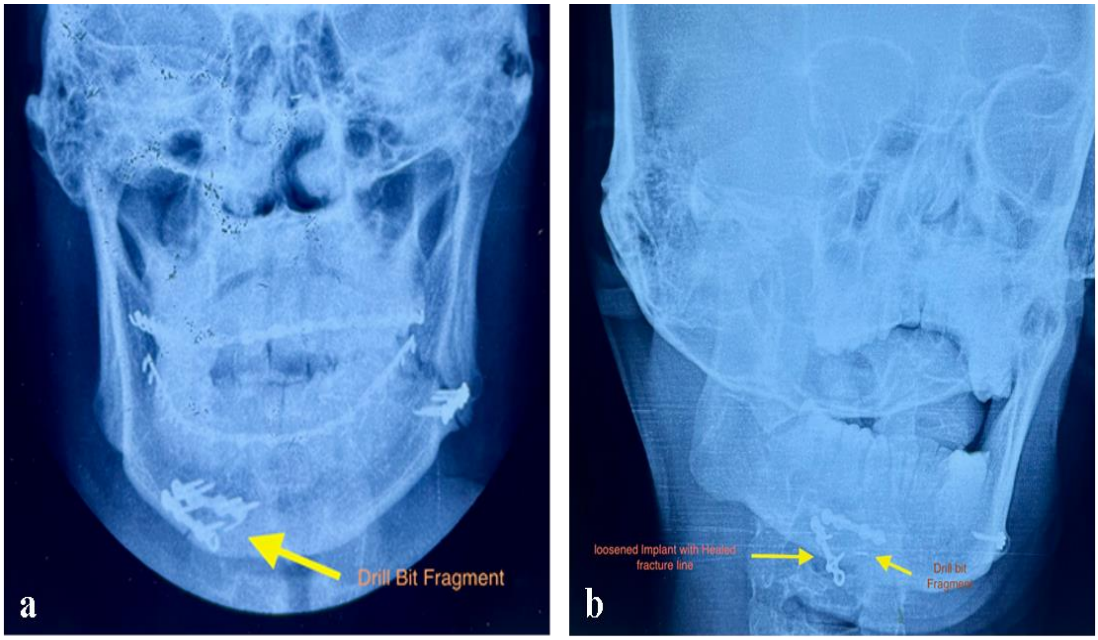

Figure 1: (a) Postoperative X-ray showing the broken drill bit; (b) X-ray showing loosened implant and retained drill bit

Figure 2: Presentation with sinus and exposed implant

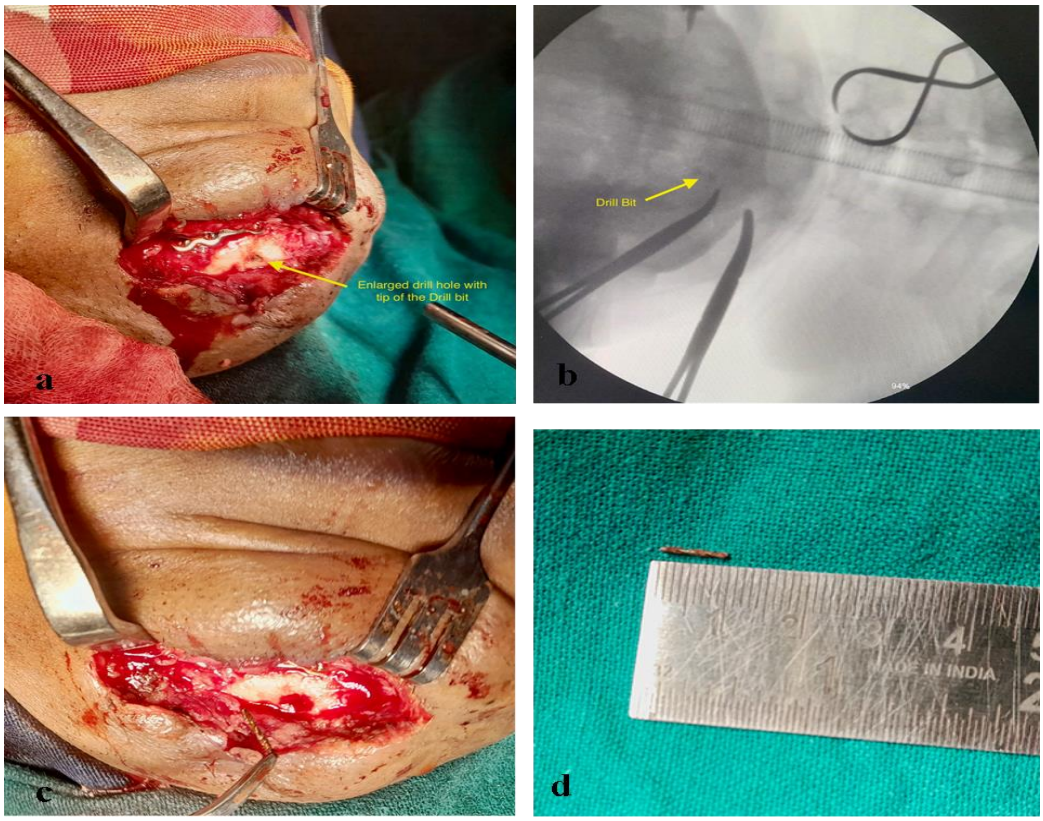

Figure 3: (a) Visualisation of retained drill bit; (b) C- Arm imaging to localise the drill bit fragment; (c) Removal of drill bit; (d) Retrieved Drill bit fragment

DISCUSSION

Open reduction and internal fixation has transformed the management of mandibular fractures, becoming the standard approach. However, this technique presents certain drawbacks, including potential complications such as iatrogenic injury to the inferior alveolar nerve, devascularization of bone segments, hardware failure, and inadvertent breakage of drill bits during the drilling process [1, 2].

Breakage of drill bits during surgical procedures is a common occurrence encountered by many surgeons. In the majority of cases, immediate retrieval of the broken fragment is successfully achieved. Consequently, instances of retained drill bit pieces being reported in the literature are infrequent [3-7]. Moreover, there is a lack of clear guidelines regarding the management approach when the drill bit cannot be promptly removed. The contributing factors to drill bit failure during surgical procedures can be categorized into several domains, including the characteristics of the drill bit, the employed surgical technique, the patient's anatomical considerations, and the surgeon's condition.

Several factors related to the drill bit itself can contribute to its failure. These can be broadly categorized into material properties, design, and usage. Lower-quality materials or less durable alloys are inherently weaker and more prone to breakage. Stainless steel, cobalt-chromium, and titanium alloys as common materials. The specific composition within these categories can significantly affect strength and durability. A higher tensile strength indicates greater resistance to breakage under tension. This is a crucial factor for drill bits, which experience significant forces during use. The overall geometry and construction of the drill bit play a vital role. This includes factors such as the length and diameter of the shank, the shape and size of the flutes, the web, and the design of the cutting tip which collectively contribute to its overall strength and performance characteristics.

The flute design affects chip removal, the web provides structural support, the shank transmits torque, and the tip engages with the material being drilled [8]. Flaws or weaknesses in any of these components can lead to failure. Small Size and Narrow Diameter drill bits are inherently more fragile and susceptible to breakage due to their reduced cross-sectional area and lower resistance to bending forces. Drill bits are commonly reused and repeated use weakens drill bits due to wear and tear. This can lead to decreased cutting efficiency and increased risk of breakage [9, 10]. Single-use drill bits are often preferred for critical applications to minimize this risk.

The critical factors in bone drilling include the cutting conditions, the geometric characteristics of the drill such as

the helix angle, rake angle, clearance angle, tool material, diameter, and wear, as well as bone-specific parameters like bone sex, density, and material, and the use of irrigation [11, 12]. Excessive force applied during drilling, particularly in dense bone, can lead to drill bit breakage. Incorrect drilling angle increases stress on the bit, potentially resulting in breakage. Inadequate irrigation can cause overheating and weaken the drill bit. The mandibular regions characterized by dense, highly calcified osseous structures, such as the angle and para symphysis, require heightened drilling force, thereby elevating the potential for drill bit fracture.

Surgeon fatigue, particularly during late-night surgeries, can increase the likelihood of errors and applying excessive force. Less experienced surgeons may also be more prone to drill bit breakage. Several techniques exist for removing a broken drill bit, depending on the location and accessibility of the fragment. Manual retrieval techniques can be employed if the fractured drill bit is accessible. Forceps or pliers may be utilised to directly extract the exposed portion of the drill bit, representing the most straightforward approach but limited to specific scenarios. Alternatively, a fine-tipped needle holder can be used to grasp and remove the broken drill bit, particularly when the fragment is situated near the surface [13]. When the broken drill bit is flush to the surface or embedded within the bone, a range of techniques may be employed for successful retrieval. These include enlarging the drill hole using a bur, performing lateral drilling, and utilizing sharp-tipped instruments such as needles or hooks to grasp and extract the fractured drill bit fragment.

Bassi's Technique for Broken Drill Bit Removal utilizes a K-wire bent at a right angle, which is inserted into the broken cannulated drill bit and rotated to engage the proximal end, enabling the retrieval of the fragment. This approach is specifically tailored for the management of broken cannulated drill bits [14]. Employing real-time imaging modalities such as fluoroscopy or C-arm can effectively guide the process of removing deeply embedded broken drill bit fragments. These imaging technologies enable precise localization of the fragment and facilitate a cautious retrieval approach, thereby minimizing the risk of further injury [13, 14].

The decision to remove a broken drill bit depends on several factors, including location, accessibility, implant presence, and technical difficulties. Drill bits near joints, nerves, or tooth buds should ideally be removed. If the fragment can be removed easily without causing further damage, removal is always recommended. If the drill bit is not in contact with implant and immediate removal is not technically feasible, it can be left in situ [8]. It's important to note that if the broken drill bit is not causing any immediate issues and is not easily accessible, it may be left in situ, especially if removal would risk further damage [3,8,13]. Following the attainment of fracture union, the retained drill bit fragment should be removed concurrently with the implant hardware, unless the procedure presents undue technical complexities [15].

CONCLUSION

Drill bit failure is an undesirable complication during mandible fracture fixation procedures. The broken fragment should be extracted promptly, taking care to avoid further harm to the surrounding bone. Repeated use of the same drill bit is inadvisable. Surgical techniques must be enhanced to mitigate the risk of drill bit breakage. Preparedness, including familiarity with various retrieval methods and access to intra operative imaging, is crucial for managing these scenarios effectively during the surgical intervention. It is critical to engage in consultation with experienced peers and thoroughly evaluate the unique contextual factors pertaining to each individual case.

REFERENCES

1. Abreu M, Viegas VN, Ibrahim D, *et al.* Treatment of comminuted mandibular fractures: a critical review. Medicina oral, patologia oral y cirugia bucal. 2009; 14(5):E247-51.
2. Ravikumar C, Bhoj M. Evaluation of postoperative complications of open reduction and internal fixation in the management of mandibular fractures: A retrospective study. Indian Journal of Dental Research. 2019; 30(1):94-6.
3. Bodner L, Woldenberg Y, Puterman M. Drill failure during ORIF of the mandible: Complication management. Medicina Oral, Patología Oral y Cirugía Bucal (Internet). 2007; 12(8):591-3.
4. Karikal A. Fractured drill bit in ORIF mandible-precautions and developing guidelines for its management. Research. 2014.
5. Delattre VF. The Dangers of Dental Devices as reported in the FDA MAUDE Database. J Am Dent Assoc. 2015; 146(2):102-10.
6. Rajaran JR, Rajandram RK. Iatrogenic displacement of high-speed bur during third molar removal. Case Reports. 2017; 2017:bcr-2017-221892.
7. Dadá AHM, Fernandes GC, Inácio N, *et al.* Foreign body in the mandi-ble: a case report. Brazilian Journal of Case Reports. 2024; 4(3):35-9.
8. Bertollo N, Walsh WR. Drilling of bone: practicality, limitations and complications associated with surgical drill-bits. Biomechanics in applications. 2011; 4:53-83.
9. Ashford RU, Pande KC, Dey A. Current practice regarding re-use of trauma instrumentation: results of a postal questionnaire survey. Injury. 2001; 32(1):37-40.
10. Montero-Aguilar M, Sibaja-Ruiz L, Avendaño E, *et al.* Evaluation of surgical bur deformation and bone surface roughness after multiple uses. Journal of Oral and Maxillofacial Surgery. 2019; 77(9):1894-903.
11. Pandey RK, Panda S. Drilling of bone: A comprehensive review. Journal of clinical orthopaedics and trauma. 2013; 4(1):15-30.
12. Islam MA, Kamarrudin NS, Daud R, *et al.* A review of surgical bone drilling and drill bit heat generation for implantation. Metals. 2022; 12(11):1900.
13. Manikandhan R, Anantanarayanan P, Mathew PC, *et al.* Incidence and consequences of bur breakage in orthognathic surgery: a retrospective study with discussion of 2 interesting

clinical situations. Journal of oral and maxillofacial surgery. 2011; 69(9):2442-7.
14. Bassi JL, Pankaj M, Navdeep S. A technique for removal of broken cannulated drill bit: Bassi's method. Journal of orthopaedic trauma. 2008; 22(1):56-8.
15. Nallathamby V, Lee H, Lin YY, *et al*. Retained Broken Implants in the Craniomaxillofacial Skeleton. Craniomaxillofacial Trauma & Reconstruction. 2014; 7(2):154-7.

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