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A rare post-traumatic pseudocyst within a humeral shaft non-union: A two-stage surgical management strategy

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Abstract

Background: Humeral shaft non-union is a challenging complication, particularly when accompanied by atypical pathology. The presence of an intraosseous pseudocyst within a non-union site is extremely rare and may mimic infection or neoplastic disease, necessitating careful diagnostic evaluation.

Case Presentation: A 65-year-old female presented with persistent pain, swelling, and abnormal mobility 18 months after a mid-shaft humeral fracture treated with open reduction and internal fixation. Radiographs and CT imaging revealed an atrophic non-union with a large lytic cystic lesion. Initial surgery through a posterior approach demonstrated a cystic cavity containing 30 mL of serous fluid. The lesion was excised, and the implant was removed. Histopathology confirmed a pseudocyst lacking epithelial lining, and cultures were negative. After exclusion of infection and neoplastic pathology, definitive fixation was performed in a second stage using a posterolateral distal humerus locking compression plate with an onlay fibular graft. Postoperative recovery was uneventful, and functional improvement was achieved.

Conclusion: Post-traumatic pseudocyst formation at a humeral non-union site is a rare but important differential diagnosis. A staged surgical approach with diagnostic clearance followed by rigid fixation and biological augmentation can successfully restore stability and function. This case emphasizes the need for high suspicion and thorough workup when lytic lesions are encountered in persistent non-union.

Keywords: Humerus non-union, Pseudocyst, locking compression plate, fibular graft, post-traumatic cyst, staged surgery, bone healing

Introduction

Non-union is a well-recognized and often debilitating complication following humeral fractures, particularly in cases where vascularity, stability, or biological environment are compromised. The incidence of humeral shaft non-union ranges between 2-10% following operative fixation and may be even higher with conservative treatment strategies, depending on fracture configuration, patient comorbidities, and surgical factors [1]. Most non-union typically present as hypertrophic or atrophic variants with fibrous tissue or sclerotic bone occupying the fracture gap. However, the presence of a concurrent intraosseous cystic lesion specifically a pseudocyst within the non-union site is exceedingly uncommon, with limited documentation in the literature.

A pseudocyst is pathologically defined as a fluid-filled cavity without a true epithelial lining. It is thought to arise from chronic inflammation, persistent micro-motion, or repetitive trauma in a contained space, resulting in gradual accumulation of serous fluid within the fibrous region of a non-union [2]. Such lesions may mimic infection or neoplastic pathology on imaging, leading to diagnostic uncertainty. Radiographically, they may appear as well-demarcated lytic areas, prompting further evaluation to exclude osteomyelitis, parasitic cysts, or primary bone tumors [3]. Due to the rarity of this phenomenon, its true incidence is unknown, and individual case descriptions are valuable to guide clinical awareness and treatment strategy.

This case report describes the clinical presentation, diagnostic challenges, and successful staged management of a large pseudocyst associated with an atrophic humeral shaft non-union. It highlights the importance of maintaining vigilance for atypical pathology in recalcitrant fractures and the role of a structured approach incorporating debridement, rigid fixation, and biological augmentation in achieving a successful outcome.

Case Presentation

A 65-year-old female presented with persistent left arm pain, swelling, and abnormal mobility 18 months following a fall that resulted in a closed mid-shaft humeral fracture. The fracture had initially been treated with open reduction and internal fixation using a dynamic compression plate through an anterior approach. Despite operative fixation, her symptoms persisted, significantly affecting daily function, prompting referral to our institution.

Clinical examination revealed localized tenderness, palpable crepitus near the distal diaphyseal region, and visible swelling. Shoulder and elbow movements were restricted due to pain and prolonged disuse. Distal neurovascular status remained intact. Plain radiographs demonstrated an atrophic non-union with a well-defined cystic, lytic lesion occupying the fracture gap and evidence of implant failure [Figure 1].

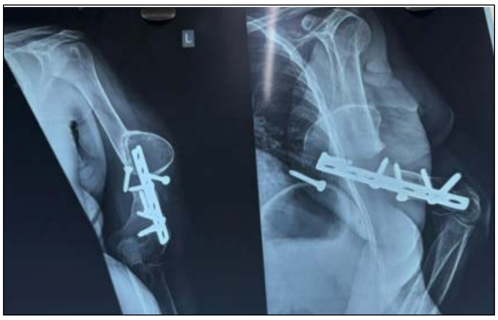

Fig 1: Pre-operative X ray suggesting pseudocyst implant removal and non-union

A CT scan confirmed the presence of a sizeable fluid-filled cavity within the non-union site. Laboratory tests including ESR, CRP, and complete blood count were normal, suggesting an aseptic process. MRI could not be performed due to implant incompatibility.

Stage 1: Diagnostic and Debridement Phase

Initial surgical exploration through a posterior approach revealed a well-circumscribed cystic cavity containing approximately 30 mL of yellow, serous fluid. The implant was removed, and the cystic lesion was meticulously debrided. The underlying bone ends were sclerotic and avascular [Figure 2].

Fig 2: Post-Stage 1 radiographs showing removal of previous hardware and cyst debridement at the humeral shaft

Samples from the cyst wall were sent for histopathology, while cyst fluid was sent for culture and cytology. Because pseudocyst formation is an uncommon entity with uncertain etiology, definitive fracture fixation was deferred until infectious and neoplastic causes were excluded. The limb was immobilized in a U-slab until reports were available.

Histopathological examination confirmed a post-traumatic pseudocyst, characterized by the absence of an epithelial lining. Cultures and cytology were negative, ruling out infection and malignancy.

Stage 2: Definitive Fixation and Biological Augmentation

After exclusion of infection, definitive fixation was undertaken in a second stage. The non-union site was re-exposed through the posterior approach. Sclerotic bone was debrided, and viable bone ends were prepared. A posterolateral distal humerus locking compression plate (LCP), applied in locking mode, was used to provide stable fixation. A structural onlay fibular graft harvested from the ipsilateral leg was used to fill the defect and augment biological healing potential [Figure 3].

Fig 3: Stage 2 radiographs showing debridement of non-union, structural fibular graft placement, and fixation with locking compression plate

Postoperative recovery was uneventful, and the patient was discharged following physiotherapy consultation. At follow-up, radiographs demonstrated progressive callus formation [Figure 4].

Fig 4: Two-month postoperative radiographs showing visible callus formation around the fracture site

The patient demonstrated improved shoulder and elbow function with absence of pain during activities of daily living, and regained satisfactory range of motion by 2 months postoperatively [figure 5].

Fig 5: Clinical photographs at 2 months' post-surgery showing restoration of active shoulder elevation and abduction.

Discussion

Atrophic humeral non-union is typically the result of inadequate biological response at the fracture site, compounded by pain, instability, and disuse. The additional development of an intraosseous pseudocyst represents an unusual and poorly recognized sequela. Similar cystic changes have been described in long bones following trauma, often linked to sustained micromotion, chronic inflammatory exudate, or impaired venous drainage near the fracture site [4]. The contained nature of the non-union gap facilitates gradual fluid accumulation, eventually forming a cystic cavity.

Radiographically, pseudocysts can be mistaken for infection or neoplasm, making preoperative evaluation essential. Infection was ruled out in this case by normal inflammatory markers and negative cultures. Histopathology remains the gold standard for confirming pseudocyst, demonstrating absence of true epithelial lining [5]. Differential diagnoses include unicameral bone cyst, osteomyelitis, metastasis, aneurysmal bone cyst, and parasitic disease, all of which must be systematically excluded before surgical reconstruction [6].

Treatment of atrophic non-union requires a combination of mechanical stability and biological support. Locking compression plates provide fixed-angle stability and have shown favorable outcomes in Osteopenic bone and revision surgery [7]. Structural fibular graft serves a dual purpose: filling the defect and providing osteoconductive scaffold to promote bone healing. Utilization of a staged approach allowed safe exclusion of infection prior to final fixation and grafting, a strategy supported by literature in cases with diagnostic uncertainty [8].

Successful union in this patient highlights the importance of tailored surgical planning. Early identification of atypical pathology prevents complications and ensures restoration of limb function. Given the scarcity of published cases, this report adds to the existing knowledge base and underscores the necessity for vigilance when encountering persistent non-union with lytic changes.

Conclusion

Pseudocyst formation at a humeral shaft non-union site is a rare complication that requires a high index of suspicion. Thorough diagnostic evaluation including imaging, cultures, and histology is essential to differentiate it from infection or neoplasm. A two-stage surgical strategy involving cyst excision, implant removal, followed by rigid fixation with locking plate and structural fibular grafting resulted in successful healing. This case reinforces that comprehensive surgical planning combining mechanical stability with biological enhancement can achieve satisfactory outcomes in complex non-union.

Conflict of Interest

Not available

Financial Support

Not available

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