CASE REPORT/KAZUISTIKA

Distal Radius Intra-Articular Malunion Corrected with Arthroscopy Assisted Open Osteotomy: a Case Report

Korekce intraartikulární malpozice distálního radia pomocí artroskopicky asistované otevřené osteotomie: kazuistika

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SUMMARY

Distal radius malunions, particularly those involving both intra-articular and extra-articular components, present significant surgical challenges. While extra-articular osteotomies are well-established, intra-articular corrections – especially at the sigmoid notch – are rarely described and difficult to execute. This case report introduces a novel technique combining arthroscopic and open approaches for the correction of a complex distal radius malunion.

A patient with persistent pain and functional impairment following conservative treatment of a distal radius fracture was diagnosed with a complex malunion, featuring dorsal angulation, an intra-articular die-punch fragment, and distal radioulnar joint (DRUJ) incongruity with a 2 mm articular step-off at the sigmoid notch. A combined extra- and intra-articular osteotomy was performed under arthroscopic guidance using a dry technique via posterior DRUJ portals. The intra-articular fragment was mobilized and repositioned under arthroscopic and fluoroscopic visualization, followed by osteosynthesis with a dorsal plate. Postoperative imaging confirmed alignment correction.

At 12 months, the patient reported full, painless prono-supination, near-complete wrist range of motion, and satisfaction with the outcome. The technique allowed for precise osteotomy execution despite challenges including limited DRUJ visualization.

This is the first documented case of a sigmoid notch osteotomy guided by dry arthroscopy through DRUJ portals. The approach demonstrates the feasibility of combining arthroscopic visualization with traditional osteotomy techniques to address complex distal radius malunions. Despite technical limitations, this method offers a promising avenue for precise intra-articular correction and joint preservation in select patients.

Key words: distal radius malunion, sigmoid notch osteotomy, DRUJ incongruity, wrist arthroscopy, nanoscopic surgery, intra-articular fracture, complex wrist reconstruction.

INTRODUCTION

The mismanagement of distal radius fractures often leads to malunions, which can be classified as extra-articular, intra-articular, or mixed – Haines and Bott (10). The criteria for surgical intervention vary across the literature, but commonly accepted indications for extra-articular malunions include: (1) more than 10° of dorsal tilt, (2) less than 15° of radial tilt, and (3) ulnar shortening exceeding 3 mm. These parameters should always be compared with the unaffected limb. For intra-articular malunions, an articular step-off greater than 2 mm is a widely recognized criterion for surgical correction – Cognet and Mare (5).

Techniques for extra-articular osteotomies are well-documented and yield favorable outcomes (3, 4). However,

Fig. 1. **Postraumatic radiographs: a, b – posteroanterior and lateral projections before close reduction; c, d – the same projections after closed reduction.**

intra-articular and mixed malunions pose significant technical challenges during osteotomy, often leading to osteoarthritis and necessitating salvage procedures. Two primary methods for guiding the osteotomy line are 3D-printed surgical guides and arthroscopic visualization (2, 7).

To the best of our knowledge, this is the first documented case of a mixed malunion involving a 2 mm step-off at the sigmoid notch of the radius and an incongruent distal radioulnar joint (DRUJ) treated with a combination of extra-articular and intra-articular osteotomy, guided by dry arthroscopy through DRUJ portals.

CASE REPORT

A patient presented following a fall from a train, sustaining a distal radius fracture. The fracture was initially reduced and treated with six weeks of immobilization in a cast (Fig. 1). Despite subsequent physical therapy and magnetotherapy, the patient continued to experience persistent symptoms and was referred to our Hand Surgery Unit.

On examination, wrist flexion was limited to 45°, extension to 60°, and ulnar deviation was reduced by 50% compared to the contralateral side. Pronation and supination were painful, restricted at the end range, and accompanied by clicking. Both wrists' computed tomography (CT) scan revealed significant dorsal inclination, a die-punch fragment, and DRUJ incongruity (Fig. 2). Surgery was scheduled five months post-injury.

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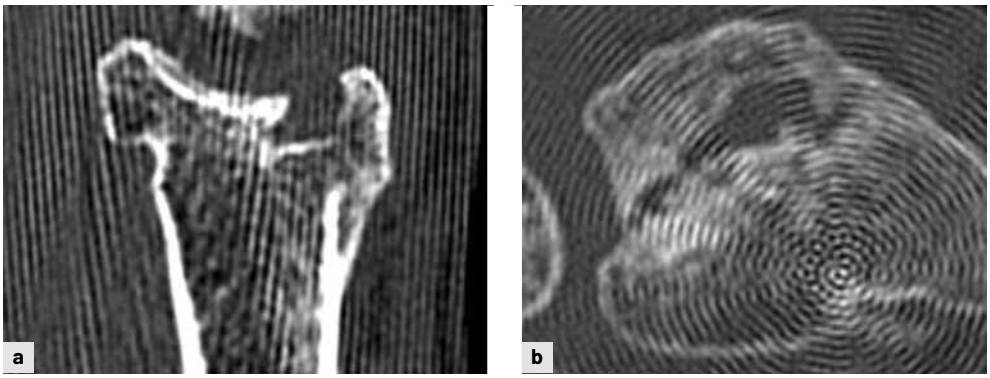

Fig. 2. **Preoperative CT: a – dorsal radial tilt and die punch deformity; b – 2.5mm step off in the sigmoid notch.**

The procedure began with the patient's arm secured in a traction tower under a 250-mmHg tourniquet. Arthroscopic visualization (NanoScope, 1.9 mm, Arthrex) of the radiocarpal joint was performed via a 4/5 portal, revealing cartilage damage in the die-punch region. The triangular fibrocartilage complex (TFCC) was intact, with no injuries detected in the scapholunate (SL) or lunotriquetral (LTq) ligaments. The traction was released, and a p-DRUJ portal was created through the exposed joint capsule to assess DRUJ incongruity. Arthroscopy was performed in a dry environment.

A dorsal approach to the distal radius was performed. The extensor pollicis longus (EPL) tendon was mobilized, and the posterior interosseous nerve was identified and neurectomized. Two K-wires were placed to mark the osteotomy line, confirmed under nanoscopic visualization via the p-DRUJ portal and C-arm fluoroscopy (Fig. 3). Osteotomy was performed using a chisel along the K-wire guide. The die-punch fragment was visualized on the radiocarpal articular surface of the mobilized fragment. An additional osteotomy was performed on this fragment, allowing mobilization and temporary fixation with K-wires. However, arthroscopic control of the fragment's position in the DRUJ was limited due to blood clots within the joint. Attempts to improve visualization by inflating the joint with a syringe and converting to wet arthroscopy yielded only partial improvement.

The main fragment was secured with a 2.7 mm lag screw, while the die-punch fragment was stabilized with a K-wire. An extra-articular osteotomy was then performed and fixed with a plate, enabling further screw fixation of the lunate facet fragment. C-arm imaging confirmed the correction of distal radius alignment. Final arthroscopic inspection through the 4/5 portal ensured that the K-wire did not protrude into the articular surface (Fig. 4).

Postoperatively, a plaster cast was applied for two weeks. CT imaging confirmed the correction of deformities but identified a free bony fragment in the DRUJ, necessitating consideration of early arthroscopic revision (Fig. 5). At follow-up, the patient exhibited a full arc of painless pronation and supination, unrestricted wrist extension, and wrist flexion limited to 60°.

Five months postoperatively, the patient presented with dorsal wrist synovitis, and the plate was removed 10 days later. Arthroscopy confirmed proper alignment of the die-punch fragment, although Outerbridge grade II cartilage damage was observed.

At the 12-month follow-up, the patient remained satisfied with the outcome.

DISCUSSION

To our knowledge, this is the first reported case of a radius sigmoid notch osteotomy assisted by arthroscopic control. Several technical challenges were encountered. Initial DRUJ visualization was complicated by synovitis and the absence of an appropriate shaver to debride the malunion site.

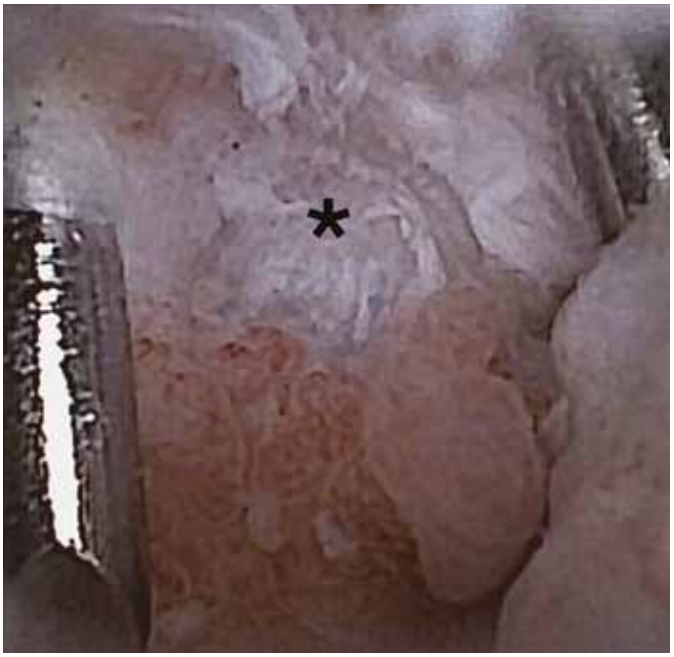

Fig. 3. **Arthroscopically visualized step off in the sigmoid notch (marked by *).**

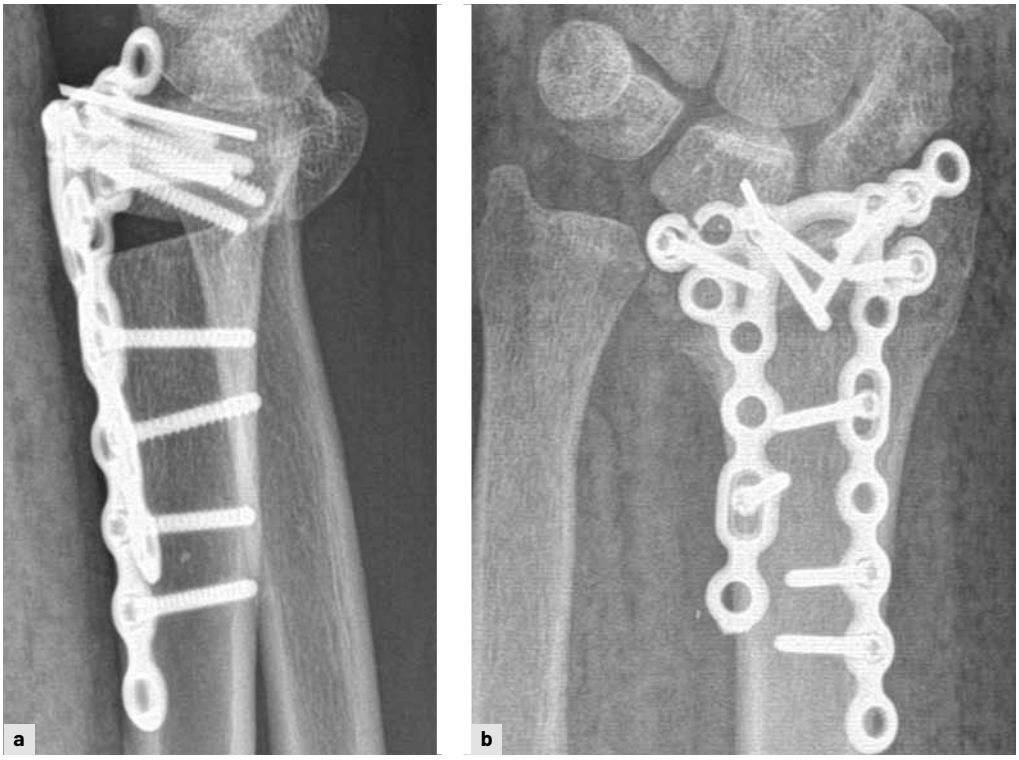

Fig. 4. **Postoperative radiographs: a – lateral projection; b – posteroanterior projection.**

Performing the osteotomy with a chisel guided by two K-wires proved challenging, leading to minor fragmentation and the retention of a bony fragment within the joint. The procedure lasted 160 minutes, requiring tourniquet deflation after 90 minutes, which impaired further DRUJ visualization due to blood clot formation within a joint.

Intra-articular malunion of the distal radius presents many difficulties. The treatment window is narrow, as progressive cartilage damage necessitates eventual salvage procedures. Visualization and osteotomy planning are very challenging; even extensive approaches fail to provide adequate visualization while significantly compromising capsular blood supply (7).

Arthroscopy-guided osteotomy has been described by Abe and Fuji for distal radius malunions affecting the radiocarpal joint. Technical difficulties include fragment repositioning, commonly managed with joystick, clamping, or push-up techniques (1). Debate persists regarding the superiority of dry versus wet arthroscopy. Advocates of dry arthroscopy cite reduced edema and improved visualization, whereas proponents of wet arthroscopy emphasize the benefits of clot and debris removal and reduced thermal damage when using radiofrequency devices (1, 7).

No previous reports in the literature have described an arthroscopy-guided osteotomy of the sigmoid notch via the DRUJ. DRUJ assessment is notoriously difficult due to the narrow joint space, and acute fractures involving either the ulna head or sigmoid notch are generally considered contraindications for this approach (9).

3D-guided techniques for distal radius osteotomies are well established, with multiple studies demonstrating their

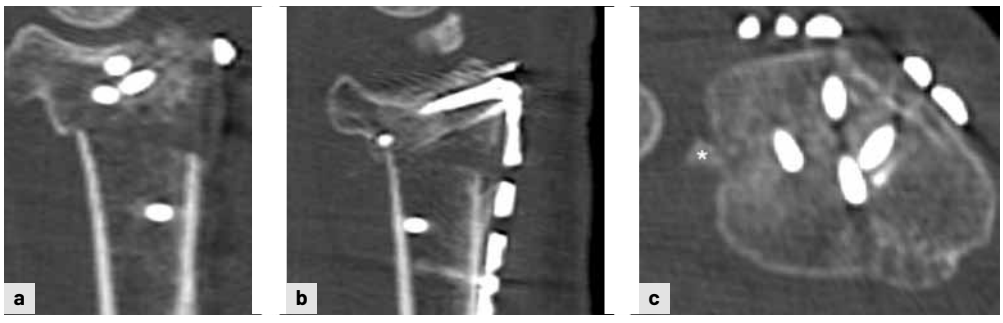

Fig. 5. **Postoperative CT: a – correction of the dorsal radial tilt; b – correction of the die punch fragment and c – correction of the step off on the sigmoid notch. During the osteotomy small fragmentation occurred (*).**

accuracy in achieving preplanned alignment (6). Stockmans et al. found an average deviation of 1 ± 5° in radial inclination and 1.3 ± 0.4 mm in maximum step-off when comparing planned versus achieved corrections (13). The combination of 3D-guided and arthroscopic visualization techniques has also been explored by Satria et al. (12).

Few techniques for sigmoid notch osteotomy are documented. Cheng and Chanf described a closed-wedge osteotomy via a volar approach (11), while Thomas et al. reported a similar osteotomy for malunions associated with DRUJ luxation (14). Del Piñal et al. described open sigmoid notch reconstruction via combined volar and dorsal approaches, incorporating radioscapholunate arthrodesis for severely comminuted distal radius malunions (8). ■

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