Case Report | Journal of Orthopaedic Case Reports 2026 September:16(9):Page 394-400

Improved range of motion in three cases following axillary nerve hydrorelease after reverse shoulder arthroplasty: a case series

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Learning Point of the Article:

Hydrorelease of the axillary nerve is effective in treatment of QLS syndrome following RSA.

Abstract

Introduction: Quadrilateral space syndrome following a reverse total shoulder arthroplasty may be underdiagnosed owing to the difficulty in recognizing its symptoms. However, quadrilateral space syndrome following a reverse total shoulder arthroplasty may cause postoperative limitation of range of motion and affect clinical outcomes. The study aimed to report three cases of quadrilateral space syndrome after a reverse total shoulder arthroplasty, resulting in limited range of motion, in which hydrorelease of the axillary nerve improved the limited range of motion.

Case report: This study presents three cases of limited anterior elevation and abduction (<100 degrees) at 3 months following a reverse total shoulder arthroplasty, in which hydrorelease of the axillary nerve for quadrilateral space syndrome led to rapid improvement, sustained at 1 year postoperatively. Furthermore, the American Shoulder and Elbow Surgeons score, Constant score, and Subjective Shoulder Value improved in all three cases. All three cases involved small female patients, each <150 cm in height. Although upper limb lengthening was modest (14–19 mm), the patients' small body size may have led to proportionally greater traction on the axillary nerve, potentially contributing to quadrilateral space syndrome.

Conclusion: Hydrorelease of the axillary nerve may be effective in alleviating early postoperative limitations in anterior elevation and abduction in patients with quadrilateral space syndrome following a reverse total shoulder arthroplasty.

Keywords: Reverse shoulder arthroplasty, axillary nerve, quadrilateral space syndrome, hydrorelease, range of motion, rehabilitation

Introduction

Reverse total shoulder arthroplasty (RSA) is commonly performed for cuff tear arthropathy (CTA) and irreparable rotator cuff tear (RCT), with favorable clinical outcomes reported.[1] The biomechanical principles of RSA involve humeral distalization and medialization of the glenoid component's center of rotation. This design enhances deltoid muscle tension, thereby improving functional strength. However, humeral lowering lengthens the upper limb by approximately 15–27 mm,[2] which may lead to neurological complications in 2.0–2.8% of patients postoperatively.[1,3,4] The axillary nerve, which follows a posterior-to-anterior course around the proximal humerus, is particularly susceptible to traction stress following limb lengthening,[4] potentially leading to nerve palsy. Even in the absence of paralysis, patients may experience pain or sensory deficits.

Access this article online

Website: www.jocr.co.in

DOI: https://doi.org/10.13107/jocr.2026.v16.i09.8106

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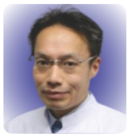
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Submitted: 15/06/2026; Review: 21/07/2026; Accepted: August 2026; Published: September 2026

DOI: https://doi.org/10.13107/jocr.2026.v16.i09.8106

Quadrilateral space (QLS) syndrome is a relatively common condition characterized by lateral shoulder pain and paresthesia due to axillary nerve compression. Although few studies have reported QLS syndrome following RSA,[5] it may be underdiagnosed owing to the difficulty in recognizing its symptoms. However, QLS syndrome following RSA may cause postoperative restricted range of motion (ROM) and affect clinical outcomes.

Hydrorelease (HR) is an ultrasound-guided technique that enables precise injections around target tissues and decreases gliding resistance force between tissues[6,7]. It is used for treating restricted shoulder external rotation via coracohumeral ligament injection and for post-reconstruction knee contracture via infrapatellar fat pad injection.[8,9] HR has also been applied in the management of peripheral nerve entrapment syndromes[10,11] and may be effective for QLS syndrome following RSA; however, no studies have yet evaluated its efficacy.

This study presents three cases of QLS syndrome following RSA, characterized by restricted ROM, in which HR targeting the axillary nerve led to ROM improvement.

Case Reports

Patient selection

Fifteen patients who performed RSA for an CTA (9 patients) or for a massive RCT (6 patients) at our institution between April 2024 and September 2024 were included. Five patients demonstrated anterior elevation (AE) and abduction <100 degrees at 3 months postoperatively, and three of them were diagnosed as QLS syndrome. QLS syndrome was diagnosed based on localized tenderness in the QLS and pain in the posterior to lateral shoulder.

Surgical method

In all cases, RSA was performed under general anesthesia in the beach chair position using a deltopectoral approach. Implant size and humeral osteotomy were determined via preoperative planning. On the scapular side, a small baseplate and a 36 mm sphere was used. On the humeral side, the stem was generally implanted without cement; however, cement was used when primary fixation was inadequate. Humeral retroversion was set at 20 degrees. The insert was selected to achieve sufficient ROM without compromising stability. Target ROM was defined as 150 degrees of AE, 40 degrees of extension, and 60 degrees of external rotation (ER) in the resting position. The subscapularis tendon was detached and reattached to the humerus using three high-strength sutures following implant placement.

Postoperative rehabilitation

A shoulder abduction brace was applied for 2 weeks. During the first postoperative week, shoulder pendulum exercises, elbow and wrist ROM exercises, and periscapular muscle relaxation were initiated. From week 1, passive shoulder exercises commenced; from week 2, active-assisted exercises; and from week 3, active exercises. Rehabilitation emphasized avoidance of arm positions with a high dislocation risk, although ROM was not restricted. Postoperative rehabilitation continued for 6–12 months.

Axillary nerve HR

HR of the axillary nerve was conducted in 3 patients who demonstrated AE and abduction <100 degrees at 3 months postoperatively, with a clinical diagnosis of QLS syndrome. The procedure was performed by an orthopedic surgeon with the patient seated and the arm in a resting position. An ultrasound probe was positioned posteriorly along the long axis of the humerus to identify the posterior circumflex humeral artery and accompanying axillary nerve (Figure 1a). A 23-gauge catheterized needle was used to inject 10 mL of saline[12] around the axillary nerve using a parallel technique (Figure 1b).

Clinical outcome

ROM in AE, abduction, ER, and internal rotation (IR) in the resting position was measured before and after axillary nerve HR at 3 months, 6 months, and 1 year postoperatively. Functional outcomes were assessed using the American Shoulder and Elbow Surgeons (ASES) score, Constant score, and Subjective Shoulder Value (SSV) at the same intervals: 3 months (prior to HR), 6 months, and 1 year postoperatively.

Imaging evaluation

Preoperative imaging included Hamada classification[13] on X-ray, and Walch[14] and Favard[15] classifications on computed tomography (CT). Postoperative imaging included assessments of upper limb extension,[16] lateral humeral offset (LHO),[17] baseplate version,[18] baseplate tilt,[19,20] and stem alignment angle.[21] X-ray and CT were obtained 1 week postoperatively. Upper limb extension was measured following the method of Jobin et al.,[16] defined as the distance from the inferolateral acromion to the midpoint of the deltoid tuberosity, calibrated against humeral shaft width. LHO was assessed using the method described by Clinker et al.,[17] as the distance between the lateral edge of the greater tuberosity and the lateral edge of the acromion, with lateralization reported as positive

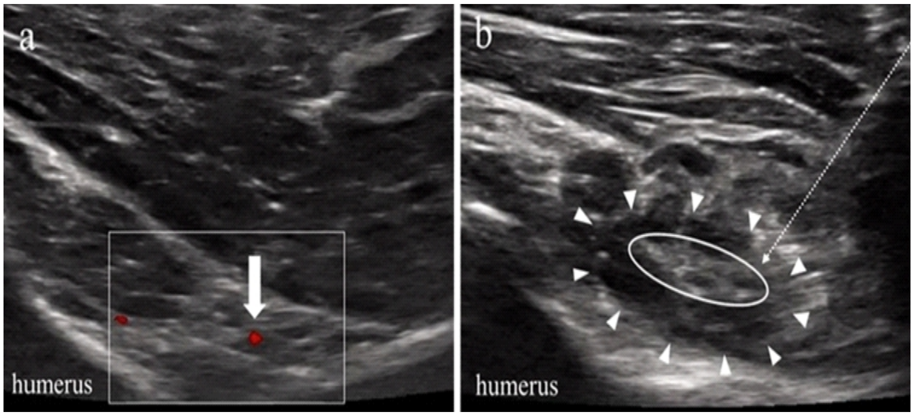

Figure 1: Ultrasound images
(a) Posterior color Doppler view aligned with the humeral long axis. The white arrow indicates the posterior circumflex humeral artery accompanying the axillary nerve.
(b) Ultrasound image following hydrorelease of the axillary nerve. The dotted white arrow indicates the 23-gauge catheterized needle inserted via the parallel method. The white-circled region identifies the axillary nerve with the posterior circumflex humeral artery. The hypoechoic area outlined by white arrowheads represents saline injected around the posterior circumflex humeral artery and axillary nerve.

values and medialization as negative values. Inferior baseplate tilt was denoted as positive, and superior tilt as negative.

Case 1

An 82-year-old female underwent RSA for a massive RCT. She was 149.5 cm tall and weighed 48.0 kg. Preoperative ROM was limited to AE: 80°, abduction: 60°, ER: 10°, and IR at the sacral level. Her preoperative ASES, Constant, and SSV scores were 19, 28, and 0 points, respectively. Imaging assessments revealed Hamada classification Type 2, Walch classification Type A1, and Favard classification Type E0.

RSA was performed using the Trabecular Metal Reverse PlusTM system on the glenoid side and the Identity® Shoulder System on the humeral side (Zimmer Biomet, Warsaw, USA). A cementless stem and a minus tray were utilized. Postoperative radiography (Figure 2a) showed an upper limb extension of 14.1 mm and an LHO of 3.1 mm. The baseplate version was 2.9° of anteversion, and baseplate tilt was –4.1°. The stem was inserted at 0.1° of valgus.

At 3 months postoperatively, ROM improved to AE: 95°, abduction: 90°, ER: 30°, and IR remained at the sacral level. The patient was diagnosed with QLS syndrome and underwent HR of the axillary nerve. ROM at 3 months (after HR)/6 months/1 year following HR was as follows: AE: 135°/135°/135°, abduction: 110°/120°/120°, ER: 30°/30°/30°, and IR: sacral level/sacral/L4. ASES, Constant, and SSV scores at 3 months (before HR)/6 months/1 year were: ASES: 62.5/85/85.2, Constant: 58/72/74, and SSV: 60/80/80. AE images at 3 months (before and after HR) and at 1 year postoperatively are shown in Figure 2b–d.

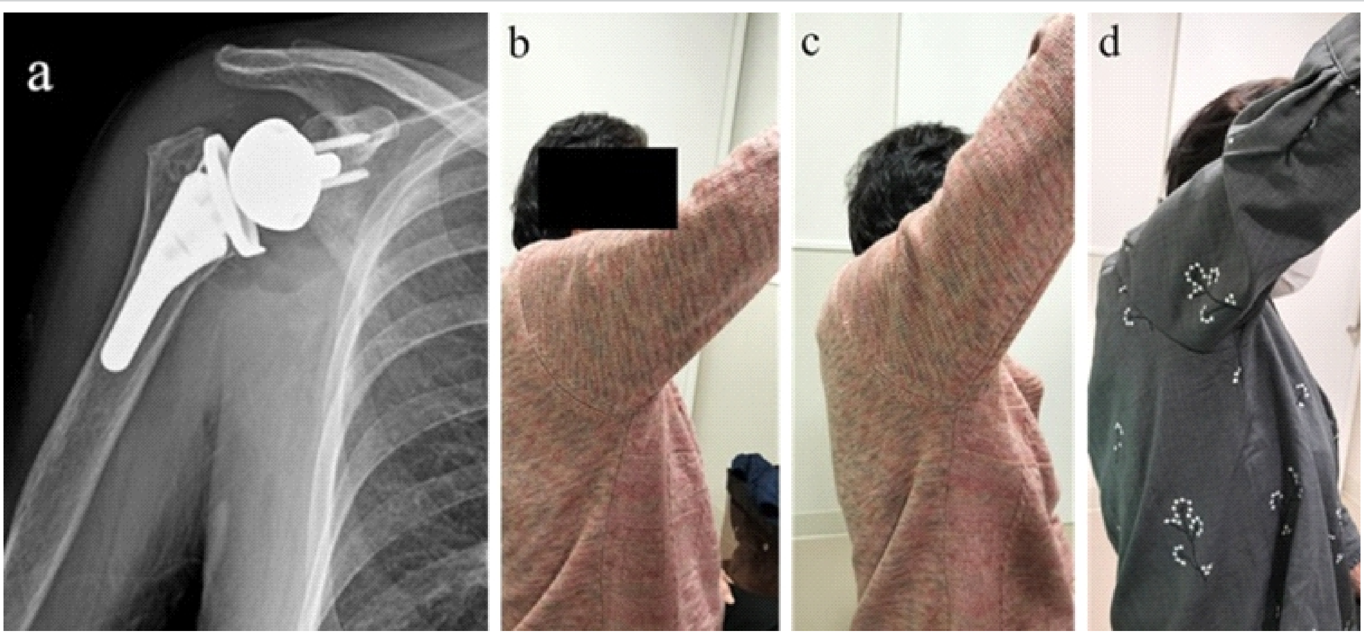

Figure 2: Imaging of Case 1
(a) Postoperative anteroposterior X-ray.
(b) At 3 months postoperative, prior to axillary nerve HR.
(c) At 3 months postoperative, immediately after axillary nerve HR.
(d) At 1 year postoperative.

Case 2

An 82-year-old female underwent RSA for CTA. She was 144.1 cm tall and weighed 44.5 kg. Preoperative ROM included AE: 80°, abduction: 60°, ER: 20°, and IR at the sacral level. Her ASES, Constant, and SSV scores were 37, 35, and 50 points, respectively. Imaging revealed Hamada classification Type 4a, Walch classification Type A1, and Favard classification Type E0.

RSA was performed using the Trabecular Metal Reverse PlusTM system on the glenoid side and the Identity® Shoulder System on the humeral side (Zimmer Biomet, Warsaw, USA). A cemented stem and a minus tray were used. Postoperative radiograph (Figure 3a) showed upper limb extension of 19.5 mm and an LHO of 3.2 mm. The baseplate version was 2.6° anteversion, and tilt was –1.2°. The stem was placed with 4° of varus.

At 3 months postoperatively, ROM included AE: 75°, abduction: 70°, ER: 20°, and IR at the sacral level. Following diagnosis of QLS syndrome, HR of the axillary nerve was performed. ROM at 3 months (after HR)/6 months/1 year after HR was: AE: 115°/120°/120°, abduction: 100°/120°/120°, ER: 20°/20°/30°, and IR: sacral/sacral/L5. ASES, Constant, and SSV scores at 3 months (before HR)/6 months/1 year were: ASES: 46.7/85/85.2, Constant: 48/72/74, and SSV: 60/80/80. AE images at 3 months (before and after HR) and at 1 year postoperatively are presented in Figure 3b–d.

Case 3

An 84-year-old female underwent RSA for CTA. She was 145.8 cm in height and weighed 48.1 kg. Preoperative ROM was AE: 20°, abduction: 20°, ER: 10°, and IR at the buttock level. Her ASES, Constant, and SSV scores were 5, 9, and 5 points, respectively. Imaging showed Hamada classification Type 4a, Walch classification Type A1, and Favard classification Type E0.

RSA was performed using the Equinoxe® platform shoulder system (Exactech, Florida, USA) with a cementless preserve stem. Postoperative imaging (Figure 4a) revealed 14.0 mm of upper limb extension and an LHO of 4.7 mm. The baseplate was positioned at 3.1° of anteversion and –2.3° of tilt. The stem was inserted with 4.1° of varus.

At 3 months, ROM was AE: 65°, abduction: 60°, ER: 30°, and IR at the sacral level. After diagnosis of QLS syndrome, HR of the axillary nerve was conducted. Post-HR ROM at 3 months (after HR)/6 months/1 year was: AE: 110°/110°/110°, abduction: 100°/100°/100°, ER: 30°/40°/50°, and IR: sacral/sacral/L4. ASES, Constant, and SSV scores at 3 months (before HR)/6 months/1 year were: ASES: 33.3/48.3/71.6, Constant: 44/56/72, and SSV: 50/70/70. AE images at 3 months (before and after HR) and at 1 year postoperatively are shown in Figure 4b–d.

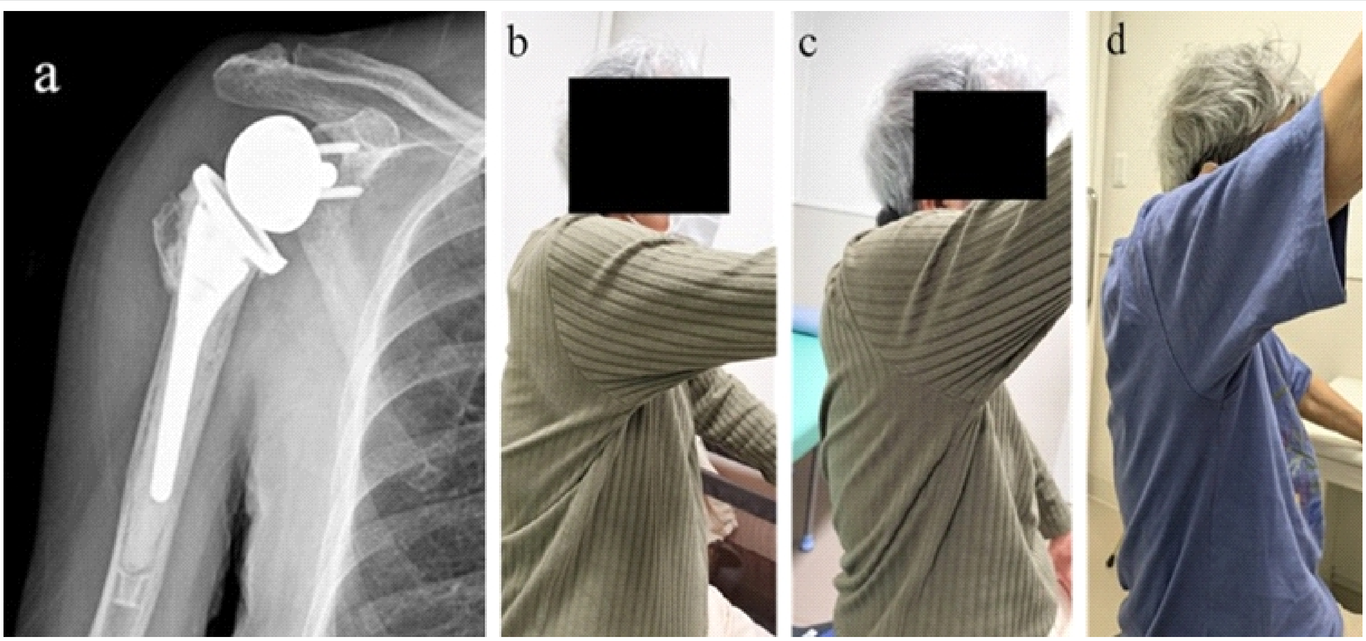

Figure 3: Imaging of Case 2
(a) Postoperative anteroposterior X-ray.
(b) At 3 months postoperative, prior to axillary nerve HR.
(c) At 3 months postoperative, immediately after axillary nerve HR.
(d) At 1 year postoperative.

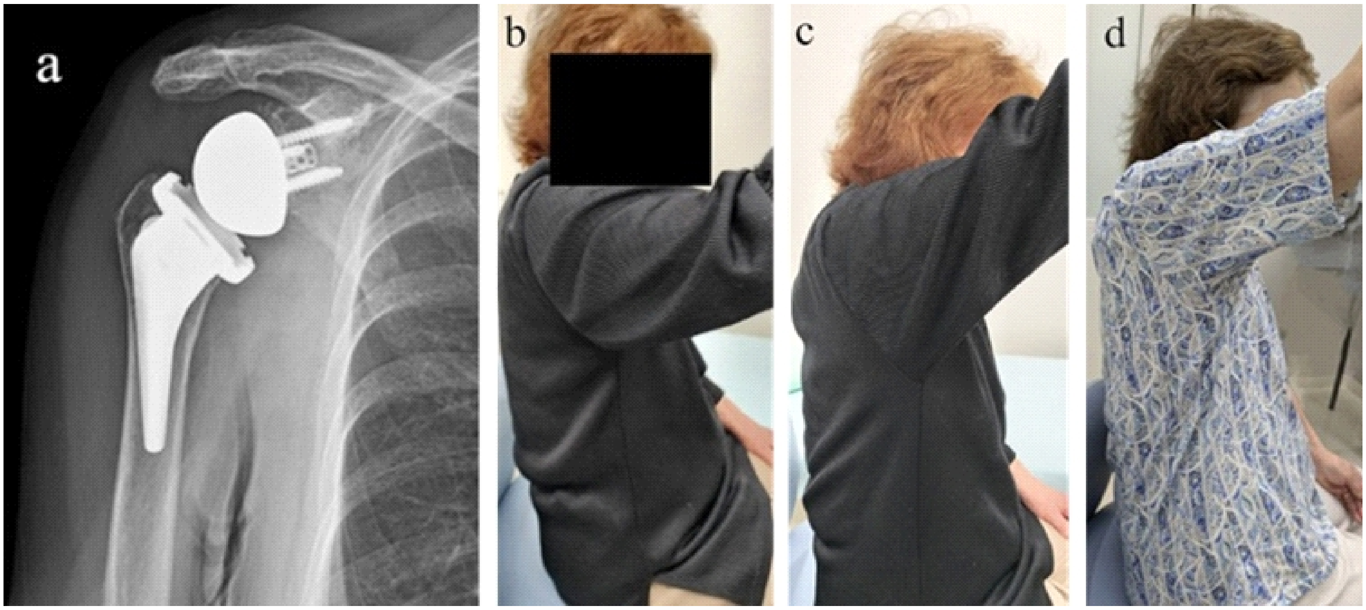

Figure 4: Imaging of Case 3
(a) Postoperative anteroposterior X-ray.
(b) At 3 months postoperative, prior to axillary nerve HR.
(c) At 3 months postoperative, immediately after axillary nerve HR.
(d) At 1 year postoperative.

Discussion

This study presents three cases of limited AE and abduction at 3 months following RSA, in which HR of the axillary nerve for QLS syndrome led to rapid improvement, sustained at 1 year postoperatively. All three cases involved small female patients, each <150 cm in height. Although upper limb lengthening was modest (14–19 mm), the patients' small body size may have led to proportionally greater traction on the axillary nerve, potentially contributing to QLS syndrome. The immediate postoperative improvement in ROM following HR suggests a reduction in axillary nerve tension.[6,7] None of the three cases demonstrated issues with implant positioning. Nevertheless, alternative causes of limited ROM after RSA—such as suboptimal implant placement, intraoperative ROM restriction, or reduced scapular mobility—should also be considered alongside QLS syndrome as contributing factors.[20] QLS syndrome following RSA has been underreported and may be underestimated[5]. Some cases may achieve early improvement in ROM with appropriate diagnosis and management of QLS syndrome following RSA.

Rehabilitation is essential for optimizing RSA outcomes. HR of the axillary nerve may facilitate earlier improvements in AE and abduction, potentially enhancing the effectiveness of postoperative rehabilitation as early as three months after RSA. Since patients undergoing RSA are often older adults who may struggle to maintain outpatient rehabilitation, early ROM improvement could help shorten the rehabilitation timeline. Future studies will assess differences in rehabilitation duration by expanding the sample size. Conversely, HR of the axillary nerve did not improve ER or IR. This may be due to unresolved muscle tightness or impingement unrelated to axillary nerve tension.

We have not yet quantified the reduction in axillary nerve stretch tension. Further research, including techniques such as ultrasonic elastography, is required for objective evaluation. Additionally, since follow-up was limited to 1 year, the long-term effects of HR of the axillary nerve warrant further investigation.

Conclusion

This study presents three cases of limited AE and abduction at 3 months after RSA, in which HR of the axillary nerve for QLS syndrome led to rapid improvement that persisted at 1 year postoperatively. HR of the axillary nerve may be effective in alleviating early postoperative limitations in AE and abduction in patients with QLS syndrome following RSA.

Clinical Message

Quadrilateral space syndrome following a reverse total shoulder arthroplasty may be underdiagnosed owing to the difficulty in recognizing its symptoms. Hydrorelease of the axillary nerve may be effective in alleviating early postoperative limitations in anterior elevation and abduction in patients with quadrilateral space syndrome following a reverse total shoulder arthroplasty.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given the consent for his/ her images and other clinical information to be reported in the journal. The patient understands that his/ her names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Conflict of interest: Nil **Source of support:** None

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Conflict of Interest: Nil
Source of Support: Nil

Consent: The authors confirm that informed consent was obtained from the patient for publication of this article

How to Cite this Article

Inagaki K, Aoki Y, Ohtori S. Improved range of motion in three cases following axillary nerve hydrorelease after reverse shoulder arthroplasty: a case series. Journal of Orthopaedic Case Reports 2026 September;16(09): 394-400.