



## Treatment of a rotator cuff tear with concomitant complete brachial plexopathy after glenohumeral dislocation: a case report



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Anterior shoulder dislocation is the most common major joint dislocation, with a reported incidence of nearly 2%.<sup>5,10</sup> Anywhere from 25% to 67% of the time that dislocation can be associated with an injury to the brachial plexus or nerves branching immediately off the plexus.<sup>1,9,13</sup> The same displacement and energy that can lead to nerve injury can also be responsible for the damage to the rotator cuff.

The “Terrible Triad of the Shoulder” – Dislocation of the glenohumeral joint with concomitant brachial plexus injury (BPI) and rotator cuff tear (RCT), was named by Groh and Rockwood in 1995 although the injury had been described in a small number of case reports prior to that time.<sup>6–8,11</sup> There have been some small case series attempting to identify the incidence of these concomitant injuries as well some possible prognostic factors of the RCT and nerve injury of the shoulder, although a vast majority of patients had isolated single nerve injuries.<sup>4,15</sup> There has been few reports concerning more substantial brachial plexus injuries with associated RCTs.

Reported here is an anterior shoulder dislocation in a patient with an immediate full brachial plexopathy with no upper extremity function before, and after, timely reduction; who also had a RCT. The patient was fully informed and gave written consent to submit the details of this case for publication in a peer-reviewed journal.

### Case

The patient is a 48-year-old female who presented to clinic two weeks after a fall at work. According to her report she fell with her

right arm abducted and extended. She immediately had total loss of arm function and sensation that did not improve with reduction performed at a local urgent care.

Initial examination revealed a right upper extremity (UE) that was nearly completely flaccid and the patient had no activity of the any muscle group distal to the deltoid (0/5). The one exception was flexion of the fingers, which the patient had a small flicker (1/5). She did not demonstrate any signs of preganglionic brachial plexus injury. The patient could endorse some detection of light touch when tested with eyes closed. Two-point discrimination was greater than 7 mm through the hand. Passive range of motion (ROM) of the shoulder was 170 degrees. Passive external and internal ROM was normal compared to contralateral. Radiographic examination (X-rays) in clinic demonstrated a reduced glenohumeral joint with mild inferior subluxation (Fig. 1).

Given mechanism of injury and examination findings, the patient was sent for both magnetic resonance imaging (MRI) of the shoulder as well as an EMG/NCV study. She was also referred to occupational therapy (OT) for extension wrist bracing to prevent contracture at the wrist and hand.

EMG/NCV demonstrated a “severe right brachial plexus lesion” though given the recency of the injury (3 weeks) “the picture may not be complete yet”. MRI demonstrated a full-thickness rupture of the supraspinatus and infraspinatus measuring 1.5 cm. Labral tearing was noted as well as a small Hill-Sachs lesion, all consistent with recent anterior dislocation (Fig. 2).

We recommended observation of the brachial plexus injury as well as occupational therapy for her hand and elbow to maintain ROM and prevent contractures. Given the patients' age, previous shoulder function, and tear size, we recommended an arthroscopic rotator cuff repair and possible biceps tenodesis vs tenotomy. After discussion of the risks and benefits, the patient consented to

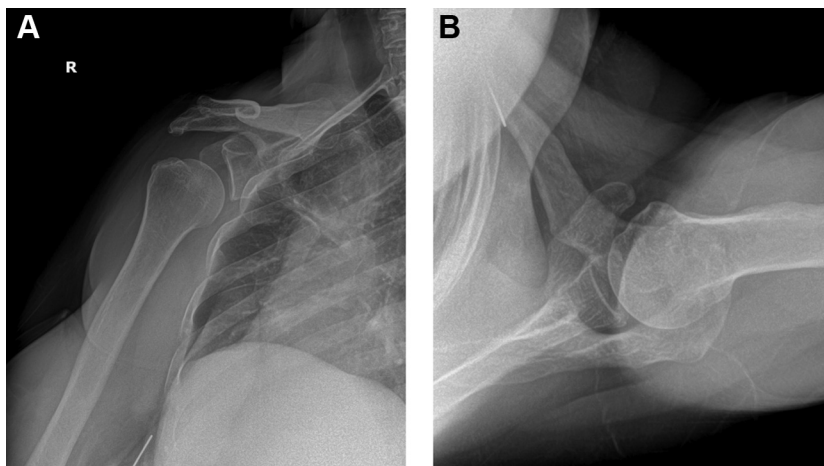
Institutional review board approval was not required for this case report.

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**Figure 1** AP and axillary view of patients' right shoulder at the first clinic visit, demonstrating an reduced joint with inferior subluxation of the humeral head when compared to the glenoid.

arthroscopic fixation of the rotator cuff and biceps tenodesis if indicated.

The patient was taken to the operating room the following week. With the brachial plexopathy, we opted to forego any regional anesthetic to avoid any further injury to the plexus. The patient was placed in a beach chair position with her arm placed at her side. Standard arthroscopic portals were used. Arthroscopic evaluation demonstrated a partially torn long head of the biceps tendon and a 1.5 cm wide tear of the supraspinatus with 1 cm of retraction. The biceps tendon was noted to be frayed with some signs of injury to the bicipital sling. The anterior inferior labrum demonstrated small tearing with not visible injury to the inferior glenohumeral ligament attachment necessitating repair. The tendon was repaired with two massive cuff tear stitches each loaded into laterally based anchors. The biceps tendon was then tenodesed in an open subpectoral fashion with a unicortical button.

The patient was placed into a standard sling and instructed to wear her wrist brace. At her 2-week follow-up, PROM of the shoulder to 90 degrees elicited pain at to a 7/10 and there was some increase in active flexion of the fingers and a small flicker of extension. Two-point discrimination remained >7 mm. Swelling in her hand and forearm had increased.

At this time, shoulder PT was initiated. Shoulder therapy consisted of passive ROM (PROM) activities as directed by her therapist focusing on pendulums as well as elevation in frontal and sagittal planes not to exceed 60 degrees. OT was continued focusing on swelling control and maintenance of ROM of fingers, wrist, and elbow.

Four weeks postoperatively, the patient reported her pain to be 0/10. PROM to 90 degrees of abduction and forward flexion. Examination demonstrated improvement in finger flexion and some active extension of the fingers. One-fifth strength in wrist flexion was noted for the first time. Two-point discrimination remained > 7 mm. PT instructions were advanced to allow for full PROM as tolerated by the patient with continued OT.

Eight weeks after surgery (11 weeks from injury), demonstrable improvements in the BPI were seen. Patient was able to fire elbow and wrist flexors and extensors with 2/5 strength. She was also able to actively abduct her shoulder to 15 degrees and actively externally rotate 5 degrees. PROM of the shoulder was painless up to 130 degrees of elevation and 30 degrees of external rotation. PT was again advanced to include active assist ROM and active ROM. OT was advanced to start aggressive hand therapy and

strengthening as well as elbow and wrist active ROM and active assist ROM.

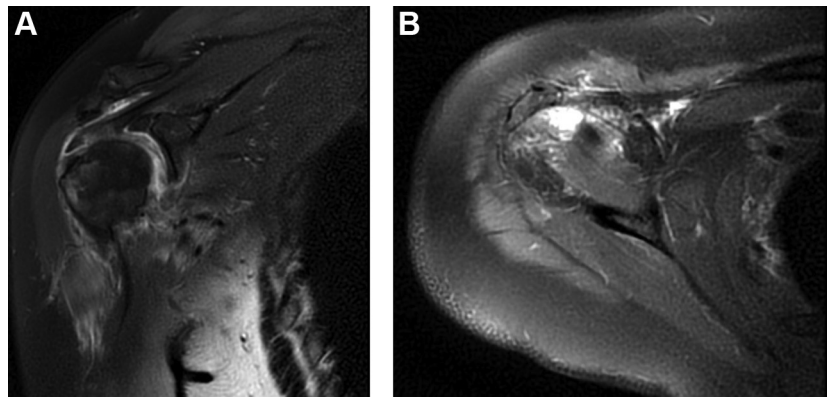
The patient missed her next in-person follow-up due to the COVID-19 pandemic and was seen at 20 weeks. Active ROM had increased substantially to 150 degrees with passive ROM up to 180 with no residual stiffness. She had minimal pain in active external ROM which increased to 35 degrees. Internal rotation was to L4. Strength examination in the shoulder measured at 4/5 in abduction, internal and external rotation. Elbow and wrist flexors and extensors similarly measured 4/5 strength. Sensation in the hand was improved with 2-point discrimination at 4 mm in the thumb and 3 mm in the rest of the distribution.

Follow-up eight months after surgery demonstrated similar ROM findings with improvement in strength from 4/5 to 5/5 and better hand ROM. American Shoulder and Elbow Surgeons (ASES) score obtained at this time: 68.

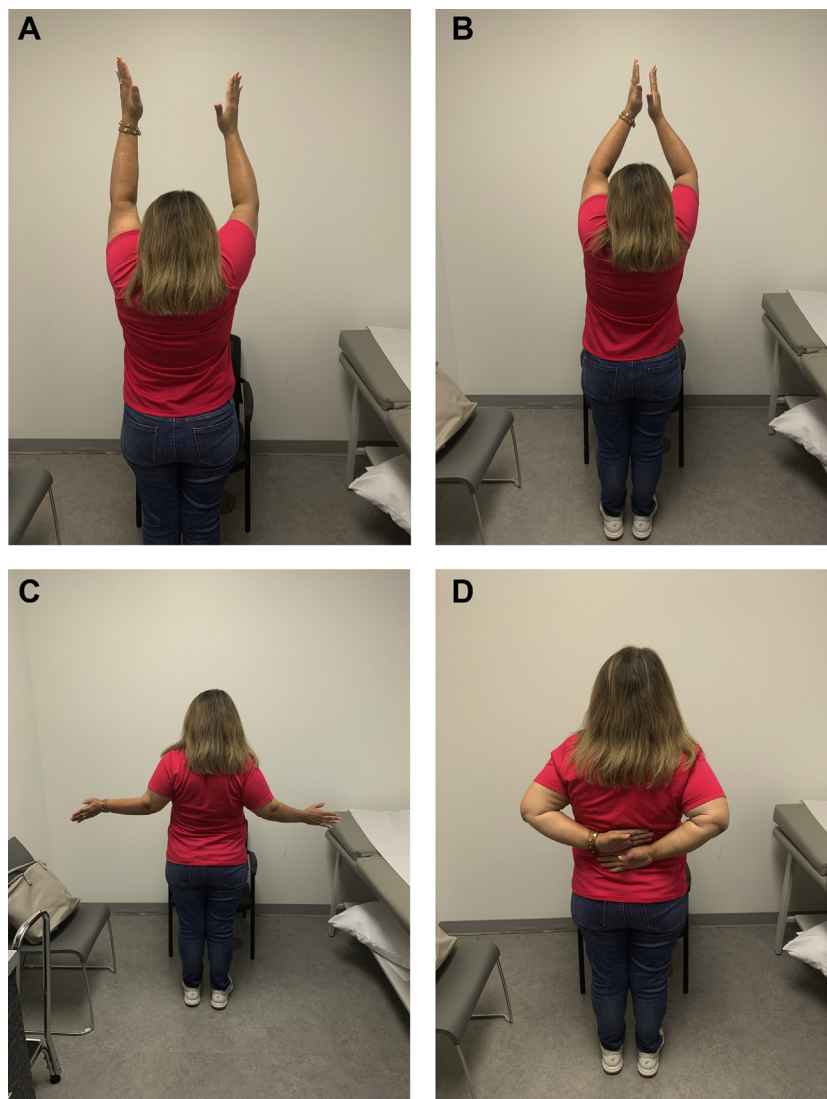
Patient's follow-up at one year since injury demonstrated improved active elevation to 175 degrees, active external ROM to 35 degrees and internal rotator to L3. Her motion was painless and strength was 5-/5 around the shoulder. Similarly, the rest of her upper extremity had full ROM and her finger ROM had fully returned. Strength was 5-/5 in the remainder of her arm and hand. Two-point discrimination was stable at 4 mm for her thumb and 3 mm throughout the remainder of the hand. ASES score at that time: 98 (Fig. 3). Subjectively while her right UE was weaker than her left upper extremity she did not feel it was inhibitory to her work and she was able to write again with near normal handwriting.

## Discussion

Case reports of similar injuries date back to the late 1980's and early 90's, with the term "terrible triad" or "unhappy triad" of the shoulder being coined by several different authors.<sup>6–8,11</sup> These case reports all described the combination of nerve injuries with RCTs, but the similarities end there. Kay et al described a single patient with a small tear and paresthesia's and an EMG/NCV study demonstrating some weakness in "the deltoid, biceps, brachialis and brachoradialis".<sup>11</sup> Groh and Rockwood described two patients with isolated axillary nerve injuries.<sup>7</sup> Gonzalez described two patients, one with weakness in elbow flexion and the other with an isolated medial cord injury in the setting of a greater tuberosity fracture, not a rotator cuff tear.<sup>6</sup> Guven described an isolated infraclavicular injury with a medium-sized RCT.<sup>8</sup>



**Figure 2** Representative coronal and axial T2 images from shoulder MRI. Full thickness disruption of the supraspinatus can be visualized. Tear measured 1.5 cm in width with 1 cm of retraction.



**Figure 3** Patient's active range of Mmotion at her 1-year follow-up. ASES score at this time was 98.

Similarly, their treatment methods differed. Some authors waited 6 months to fix the rotator cuff, others fixed it immediately; others opted not to fix the RCT. With the exception of the greater

tuberosity fracture patient, all the patients, regardless of nerve injury or RCT treatment, recovered to what was described to be a “good outcome”.<sup>6–8,11</sup> Review of these reports would suggest there

is a broad definition of what is considered a BPI. This allows for a very heterogeneous group to all qualify for the “terrible triad” of the shoulder and makes drawing conclusions from others experience difficult if, as in this case, you are treating a patient with a BPI that is different than those discussed.

Beyond case reports, some small series describing nerve injuries have been published, with a similar characteristic of broad definition of BPI. Siminovich et al published a series of patients with shoulder terrible triad (STT) in 2003 describing 6 patient courses. Five of those patients had an isolated axillary nerve palsy while the sixth patient had an axillary nerve palsy as well as a suprascapular nerve palsy.<sup>15</sup> Brown et al published a series of 17 RCTs with nerve injuries, all single nerve neuropraxias.<sup>4</sup> Both studies advocate for addressing the rotator cuff irrespective of the nerve injury, and similarly demonstrated good outcomes.<sup>4,15</sup>

Marsalli et al recently published a series of patients seen at their institution with STT in an attempt to characterize injury patterns, describe possible prognostic factors and assess functional status after surgical intervention.<sup>12</sup> While this is the largest series published to date, it again confirms that STT is a broad category that mostly refers to isolated injuries to the axillary nerve (70%) or suprascapular nerve (13%) or the combination of the two (7%). Only 3 of the 30 patients in this series had a nerve injury with deficits distal to the shoulder (10%). Patients identified with a RCT tear were treated promptly and overall demonstrated good outcomes with significant improvements shoulder function scores.<sup>12</sup> The authors were able to confirm that isolated axillary nerve injuries were the most common nerve injuries associated with RCT after anterior dislocation and that surgical treatment of the rotator cuff early led to good outcomes.<sup>12</sup> These studies all identified patients with dislocations who had RCTs, who also have a nerve injury, resulting in mostly assessment of isolated nerve injuries.

Brogan et al looked at the same constellation of injuries but started by identifying patients with more severe BPI. A total of 280 patients seen in a tertiary brachial plexus clinic over a 12-year period who also had a dedicated shoulder MRI were retrospectively reviewed.<sup>3</sup> They identified 23 (8.2%) patients who had a full-thickness RCT. Mechanisms varied, and a majority were high energy trauma, but they did note an association between infraclavicular BPI (injury to the cords or distal nerves) and RCT. While no treatment results were reported, the authors concluded that patients with a brachial plexus injury had nearly a 10% risk of concomitant full thickness RCT and that risk increased with age.<sup>3</sup> They also recommended that patients with BPI receive a dedicated shoulder MRI so that a rotator cuff tear is not missed.<sup>3</sup>

Implicit in this recommendation is the idea that full-thickness RCTs not be missed in the setting of shoulder weakness or upper extremity dysfunction from a BPI. The understanding being that discovering a RCT early would allow for early repair. After recovery of elbow flexion, glenohumeral stability and the recovery of shoulder abduction is paramount in returning UE function to a patient with a BPI.<sup>14</sup> An intact rotator cuff would certainly improve glenohumeral stability as the rotator cuff muscles are a primary stabilizer to the glenohumeral joint.<sup>2</sup> Likewise, an intact rotator cuff is key in obtaining return of abduction. In patients that require nerve transfers, spinal accessory nerve transfer to the suprascapular nerve can be successful at returning good levels of abduction, assuming an intact rotator cuff.<sup>14</sup> In patients who did not require a nerve transfer because the BPI improves with time, an intact rotator cuff would allow for advancing therapy and motion as muscle function returns.

## Conclusion

While there are some studies describing a BPI as well as RCT, there are few that describe a patient in whom the nerve injury was so severe and left the patient with such complete loss of upper extremity function. Many of those case reports had the rotator cuff repair at variable times and fixed with open methods. We believe this case adds to the other more limited BPI reports and confirms early repair of the rotator cuff using arthroscopic techniques and close physical therapy follow-up is safe and did not demonstrate any detrimental effects towards the recovery of the nerve injury. The repair allowed for therapy of the entire UE to be limited only by the extent of the nerve injury and allowed therapy to optimize the functional recovery of the UE based on return of function from the plexus injury.

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