Suprascapular Nerve Injury Secondary to Cement Extravasation in an Anatomic Total Shoulder Arthroplasty: A Case Report

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Abstract:

We report a case of cement extravasation around the suprascapular nerve during an anatomic total shoulder arthroplasty (TSA) in a 68-year-old male with glenohumeral osteoarthritis. The postoperative course was highlighted by shoulder weakness and lower than expected functionality. A shoulder CT scan demonstrated cement extravasation into the suprascapular notch through the superior hole of the pegged all polyethylene glenoid component. This is the first reported case of suprascapular nerve encasement and injury from cement in the literature and highlights the importance of recognizing glenoid vault perforation prior to placing polymethylmethacrylate cement.

Keywords: shoulder arthroplasty, nerve injury, suprascapular nerve, cement extravasation, anatomic total shoulder complication, arthroplasty revision

Level of evidence: Case Report

Shoulder arthroplasty is a common method of treatment for degenerative shoulder disorders with high rates of successful outcomes. There are various reasons that may affect the outcomes of the replacement, including failure of the glenoid component. Cementless glenoid components in conventional total shoulder arthroplasty have a significantly higher revision rate than cemented glenoid components. The Food and Drug Administration states that all polyethylene glenoid components are intended for cemented use only when used in a total
Nerve Injury Secondary to Cement Extravasation

shoulder application. (Code of Federal Regulations Title 21, Volume 8, 2018; Section 888.3650
shoulder joint metal/polymer non-constrained cemented prosthesis).

It is uncommon for patients to have suprascapular nerve (SSN) impairment, which is
typically a diagnosis of exclusion for anatomic total shoulder arthroplasty. Potential causes of
suprascapular nerve injury include compression from adjacent ganglia, abnormal morphology of
the suprascapular notch, neuritis, direct trauma or traction injury, massive rotator cuff tear, and
iatrogenic injury. Iatrogenic injury to the SSN has been reported in reverse total shoulder
arthroplasty upon drilling or placement of baseplate screws. Iatrogenic cement extravasation
injuries have been reported in other orthopedic surgical procedures including spine procedures
along with hip and knee arthroplasty where the cement was intended to provide structural
support. There have been no reported cases to date regarding suprascapular nerve damage
secondary to cement extravasation in an anatomic total shoulder replacement. We present a case
of cement extravasation through a drill hole in the glenoid during total shoulder arthroplasty
procedure causing neurological deficit to the suprascapular nerve.

Case Report:

A 68-year-old man presented for right shoulder glenohumeral degenerative joint disease.
He had a 4-year history of progressive loss of motion with diminished function in the prior 6
months. Treatment to date had included corticosteroid injections and physical therapy. The
patient reported that injections worked except within the last year and that physical therapy did
not improve his symptoms. Preoperative imaging included x-rays showed mild flattening of his
glenoid consistent with progressive degenerative changes. Following anatomic shoulder
arthroplasty, the patient progressed normally in the early postoperative period. Three months
after surgery, his physical therapist expressed concern with his strength and function. His range of motion on the affected shoulder was 90 degrees forward flexion, 90 degrees abduction and 0 degrees of external rotation with shoulder in 0 degrees of abduction. His strength was 3/5 for external rotation with 0 degrees of shoulder abduction, 3+/5 with pain with forward flexion and 4+/5 for the subscapularis.

An EMG of the affected right upper extremity identified suprascapular nerve injury. A cervical spine MRI did not identify significant pathology corresponding to the suprascapular nerve distribution, C5-6. A CT of the shoulder demonstrated cement extravasation within the suprascapular notch (Figures 1a and 1b), as well as the expansive nature of the cement extravasation (Figure 1c). Upon recognition of the cement mass, the suprascapular nerve was decompressed through an open trapezius splitting approach. Fibrous tissue and a 4 cm maximum length cement fragment was noted in the area surrounding the area of the suprascapular notch surrounding the nerve (Figure 2). It was cleared in a careful fashion and gently elevated with a Freer elevator along its lateral margin near the glenoid surface. The fragment measured 4cm x 1.5cm x 1.0cm (Figure 3a) and contained a clear course of the nerve within the inferior portion of the cement (Figure 3b). The nerve remained intact though there was some stenosis of the nerve through the area of the suprascapular notch. General neurolysis was performed and the suprascapular ligament was released. He was seen approximately two months after his cement removal surgical date and progressed well. His right shoulder range of motion improved to 135 degrees forward flexion, 120 degrees abduction and 20 degrees of external rotation with shoulder in 0 degrees of abduction. His strength at that time was 4/5 for external rotation with 0 degrees of shoulder abduction, 4+/5 with external rotation at 90 degrees of shoulder abduction, 4+/5 with forward flexion and 4+/5 for the subscapularis testing. At his last
Nerve Injury Secondary to Cement Extravasation

Office visit, approximately 8 months from the date of surgery, his range of motion was 130 degrees forward flexion, 120 degrees abduction, 45 degrees of external rotation with shoulder in 0 degrees of abduction, 80 degrees of external rotation with the shoulder abducted to 90 degrees and internal rotation to his back pocket. Strength of the right shoulder was 4+/5 for external rotation with 0 degrees of shoulder abduction, 4+/5 with external rotation at 90 degrees of shoulder abstraction, 5-/5 with forward flexion and 5-/5 for the subscapularis testing. Overall, the patient recovered well with decreased pain and improved functionality compared to preoperative measures. After the patient’s 8 month follow-up, he did not have subsequent follow-up for long period due to geographical remoteness. The patient then followed up with outside institution at 14 years status post-right shoulder arthroplasty with complaints of progressive pain after pushing up from a seated position. CT scan at that time indicated superior anterior migration of humeral head consistent with rotator cuff tear arthropathy and a poorly visualized glenoid component with suggested loosening. Of greater concern at that time, the patient is in diminishing health and has been diagnosed with dementia. These factors ultimately lead to the family pursuing non-operative measures for this patient.

Discussion:

The anatomical course of the suprascapular nerve has been well defined. The SSN ascends from the upper trunk of the brachial plexus involving roots from C5 and C6. The nerve passes downward to the superior border of the scapula and through the suprascapular notch, inferior to the superior transverse scapular ligament, where motor nerves to the supraspinatus muscle branch. From the suprascapular notch the nerve tracks obliquely and laterally along the supraspinatus muscle in the supraspinatus fossa to the base of the scapular spine. The nerve
Nerve Injury Secondary to Cement Extravasation

begins to curve medially once it reaches the base of the scapular spine and passes under the
inferior transverse scapular ligament through the spinoglenoid notch, terminating its course by
giving off glenohumeral posterior capsule articular branches before innervating the infraspinatus
muscle. (Figure 4.) Given that the SSN is essentially in a fixed position throughout its course
along the fossa, it is susceptible to intrinsic and extrinsic damage which could result in neural
pathology.

There are numerous potential etiologies for SSN neuropathy, but to our knowledge, this
is the first case of SSN injury from polymethylmethacrylate cement extravasation during
ATSA. Extruded cement can cause nerve damage via mass effect or via heat generated during
cement polymerization. Nerves can undergo permanent damage when heated to 45°C to 47°C for
one to two minutes. Cement polymerization temperatures are directly correlated with cement
thickness and have been recorded at over 55°C (131°F). We assessed the thermal increase from
two separate cylinders of Simplex (Stryker. Kalamazoo, MI, USA) bone cement measuring 4 x
1.5 x1.0cm with a Raytek Raynger ST infrared thermometer (Raytek Corp. Santa Cruz, CA,
USA) and identified a maximum temperature of greater than 95 °C (>203°F). Thus, prevention or
immediate removal of leaked bone cement is imperative in the prevention of possible nerve
injury from both thermal damage and mass effect. Thermal nerve injury requiring cement
removal appears to not be frequently reported in revision shoulder arthroplasty surgery, but is
noted in other arthroplasty literature. The heat generated by ultrasound devices used during
cement removal may injure surrounding nerves. Measured tissue temperatures during ultrasound
humeral cement removal have raised the adjacent bone to 62.8°C (145°F) and radial nerve to
51.7°C (125°F). Because of this concern, it has been recommended that surgeons employ safe
Nerve Injury Secondary to Cement Extravasation

strategies during cement removal, such as intermittent use of the ultrasound device with the application of cold irrigation during intervals.\textsuperscript{3}

Potential nerve injury related to shoulder surgery has been previously reported. Iatrogenic SSN injuries have been reported during SLAP repairs secondary to an errant drill hole or suture anchor. The available bone stock at the posterior superior glenoid rim is much smaller than that of the anterior superior rim, thus putting the patient at risk of injury if the posterior superior bone is drilled from an anterior approach or anywhere in the upper glenoid if the drill angle does not keep the anchor within the glenoid vault.\textsuperscript{7} Regarding shoulder arthroplasty, reverse total shoulder arthroplasty (RTSA) has been associated with a higher incidence of nerve injury compared to ATSA.\textsuperscript{13} Lüdermann et al in 2011, identified the frequency of acute postoperative nerve injury was 10.9 times higher in RTSA compared to ATSA. This was likely be secondary to the arm lengthening sustained during RTSA and/or external rotation during humeral and glenoid preparation. Avoidance of prolonged periods in these at-risk arm positions, along with intermittent recovery phases in the neutral position, may prove beneficial to decrease the rate of nerve injury. Wang et al in 2010, described an incidence of a malpositioned superior screw entering the suprascapular fossa following RTSA causing SSN entrapment leading to diffuse shoulder pain.\textsuperscript{16} Intraoperatively, 2 cm of the screw tip was observed to be encased with scar tissue and entrapping the SSN from beneath. Six months following the removal of the insulting screw tip and nerve decompression, the patient was reported to have improved pain and regained range of motion. Additionally, a recent cadaveric study established drilling safe zones and concluded that superior/posterior drilling and extraosseous screw employment during baseplate implantation exposes the SSN to possible injury.\textsuperscript{8}
Nerve Injury Secondary to Cement Extravasation

In summary, we report an unusual SSN injury from extravagated cement through a drilled polyethylene glenoid hole in ATSA which required removal and resulted in residual functional deficits. SSN neuropathy secondary to shoulder surgery is infrequent and likely often overlooked as a potential source of lower than anticipated functional outcome. Clinical features of SSN neuropathy may include supraspinatus/infraspinatus atrophy (depending on location of lesion), weakness and posterolateral shoulder pain. SSN neuropathy is typically a diagnosis of exclusion and is usually diagnosed based on clinical features, EMG and imaging. Treatment outcomes vary based on etiology. This case highlights the importance of surgeons to appreciate vault perforation when drilling into the glenoid and inserting polymethylmethacrylate cement in anatomic total shoulder arthroplasty.

References:


Figure 1a. Coronal CT cut demonstrating cement extrusion into suprascapular notch.
Figure 1b. Coronal CT scan revealing suprascapular nerve entrapment within cement extrusion.
Figure 1c. Sagittal CT image demonstrating the expansive nature of the cement along the course of the suprascapular nerve.
Figure 2. Intraoperative image demonstrating the nerve entrapped within the cement.
Figure 3a. Extruded cement viewed from superior viewpoint.
Figure 3b. Inferior view revealing course of suprascapular nerve (dotted white line) through the cement.
Figure 4. Illustration demonstrating course of Suprascapular Nerve
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