Hydrodilatation for the treatment of frozen shoulder - our early experiences

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Authors: J. Tuckett¹, N. Rose², E. A. Fatone³, G. Hide³, R. Sinha³;
¹Newcastle-upon-Tyne/UK, ²Newcastle-upon-Tyne, England/UK,
³Newcastle Upon Tyne/UK
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Purpose

Frozen shoulder or adhesive capsulitis is a common, painful and disabling condition characterised by spontaneous onset of shoulder pain accompanied by progressive stiffness and disability. It is usually self-limiting but often slow to resolve with a prolonged course over two to three years. It affects approximately 2% of adults, and is commonest in the 5th and 6th decades. A variety of predisposing conditions exist, most commonly diabetes mellitus, where the incidence is between 10 and 20%. A wide range of treatment options are available, including conservative measures such as analgesia, physiotherapy programmes, corticosteroid injections, glenohumeral manipulation under anaesthesia (MUA) and arthroscopic and open surgical release. The NHS Choices website suggests these as the main treatment options available in frozen shoulder, and makes no reference to hydrodilatation as a possible treatment strategy.

Hydrodilatation is a relatively new treatment, which involves inserting a needle into the intraarticular joint under local anaesthesia. Intra-articular position of the needle is confirmed using image guidance before a mix of long acting local anaesthetic, steroid and saline is instilled in a phased manner to distend the contracted joint capsule. The aim is to break down capsular adhesions until capsular rupture occurs, typically requiring between 10 and 80ml of fluid. It has been performed using fluoroscopic, ultrasound and even CT guidance.

A recent Cochrane review has determined that hydrodilatation with saline and steroid provides short-term benefits in pain, range of movement and function in frozen shoulder. Evidence shows that benefits are demonstrable at three weeks post procedure, with numbers needed to treat to benefit (NNTB) of between 2 and 3. The long term success of the treatment is still uncertain. It remains uncertain whether hydrodilatation is better than alternative interventions. However, given that surgical treatments are not without significant risk, in our institution shoulder surgeons are commonly referring cases for hydrodilatation as the next treatment following failure of conservative treatment, physiotherapy and/or injections.

Methods and Materials

All patients were diagnosed with frozen shoulder by a shoulder specialist orthopaedic surgeon or specialist physiotherapist. All patients referred for hydrodilatation were included. There was no limit on the symptom duration.
Shoulder hydrodilatation is performed in our institution under US guidance. We prefer this to fluoroscopic guidance as it allows assessment of the rotator cuff. Whilst most frozen shoulder is idiopathic, it is occasionally secondary to rotator cuff tears or calcific tendinopathy. It is therefore helpful to perform an assessment of the rotator cuff prior to the hydrodilatation. An intact cuff is also necessary for a hydrodilatation to be successful, as without an intact cuff, hydrostatic pressure cannot be built up within the joint.

Glenohumeral joint osteoarthritis can also mimic frozen shoulder, so a plain film of the shoulder is evaluated prior to hydrodilatation.

Following a diagnostic ultrasound scan, the patient is placed on their side with their shoulder on a pillow and the shoulder slightly abducted. Approximately 10ml of 1% lidocaine is used for anaesthesia to the skin and subcutaneous tissues, before a 5cm 21G green needle is placed within the glenohumeral joint passing through the infraspinatus tendon from the posterolateral aspect of the shoulder (figure 1 and 2).

Once needle placement within the joint has been achieved, fluid is instilled into the joint under direct ultrasound visualisation. The instilled fluid includes 80mg (2ml) of Kenalog (Triamcinolone acetonide) and 20ml of 0.5% Bupivaine (2mg/kg is the widely accepted maximum safe dose), with the remaining required volume being normal saline. Intra-articular placement is confirmed by demonstrating anechoic fluid building up adjacent to the articular cartilage of the humeral head, in keeping with an increasing quantity of articular fluid. The glenohumeral joint is distended in a phasic manner (figure 3). The intended end point is rupture of the capsule, confirmed by a sudden reduction in volume of the articular fluid (figure 4). Alternatively, the procedure is stopped if more fluid cannot physically be forced into the shoulder joint due to the pressure within the glenohumeral joint. In our experience, capsular rupture usually occurs after approximately 10-80ml of fluid has been instilled. However capsular rupture, although desirable, is not seen to occur in all patients.

Immediately following the procedure, a series of simple shoulder exercises are demonstrated to the patient. The aim of these is to encourage glenohumeral mobility immediately after the procedure. Five exercises are demonstrated, and the patient is instructed to perform the exercises 25 times each three times a day.

One day following the procedure, the patient has a booked appointment with the hospital physiotherapy department and a programme of physiotherapy sessions begins. Physiotherapy sessions are continued until improvement in symptomatology has occurred and a comprehensive series of appropriate exercises have been taught to the patient.
Shoulder function is assessed by the Oxford Shoulder Score and QuickDASH outcome measures, which are collected before the procedure is performed on the day of the procedure and at one month, three months and six months after the procedure.

The Oxford Shoulder Score (OSS) is a 12-item patient-reported outcome measure specifically designed and developed for assessing outcomes of shoulder surgery and the impact on patients' quality of life. It has undergone rigorous testing for validity, reliability and sensitivity to change and has been shown to be a robust tool for assessing outcomes following intervention. It returns a single score between 0 and 48, with a higher score representing a better functioning shoulder.

The QuickDASH is also a patient-reported outcome measure using 11 items to measure physical function and symptoms in people with musculoskeletal disorders of the upper limb. It returns a single score between 0 and 100, with a lower score representing a better functioning shoulder.

Images for this section:
**Fig. 1:** Video of ultrasound guided needle placement for hydrodilatation. The needle is introduced from the posterolateral aspect of the shoulder, traversing the infraspinatus tendon to enter the glenohumeral joint adjacent to the posterior glenoid labrum. See figure 2 for annotation of anatomy.

**Fig. 2:** Annotated US image from figure 1 demonstrating the correct needle placement, shown in white. The needle traverses the infraspinatus tendon, outlined in red. The needle tip is placed in the glenohumeral joint cavity, on top of the articular surface of the humeral head (yellow). The needle tip is adjacent to the cartilage of the glenoid labrum (black) which is attached to the echogenic bony outline of the glenoid (purple).
Fig. 3: Video of ultrasound guided distension of the glenohumeral joint during hydrodilatation. The anechoic fluid is instilled in a phased manner, and is seen to distend the joint.
Fig. 4: Video of capsular rupture, the intended end point of hydrodilatation. Following continued phased distension of the joint, the volume of fluid within the glenohumeral joint is seen to suddenly reduce, in keeping with rupture of the joint capsule and dispersion of the instilled fluid.
Results

To date, 58 cases have been performed in our institution by a single operator. 32 (55%) of these were female patients and 26 (45%) male. The age at time of procedure ranged from 32 to 73 years, with a median of 52 years. This correlates well with the term used by the Japanese for frozen shoulder, which translates as "the 50 year-old shoulder".

The procedure is well-tolerated by patients. Many describe the sensation of increasing pressure in the glenohumeral joint as an uncomfortable or unusual feeling, while a minority experience moderate levels of pain during the procedure. A minority suffer ongoing pain following the procedure for up to three days, which is well-controlled with simple analgesia.

One patient was abandoned as the capsule was too tight and no fluid could be successfully instilled. The patient was referred back to orthopaedic surgeon and was listed for MUA.

The procedure could not be completed in one patient due to a small full thickness perforation of the supraspinatus tendon. This had not been seen on the initial ultrasound examination. Following intra-articular needle placement, the instilled fluid was seen to pass into the subacromial subdeltoid bursa, superficial to the rotator cuff. The small but full thickness cuff tear, now full of fluid, was more easily appreciated (figure 5).

Two patients continued to have debilitating pain and stiffness during their physiotherapy programme and were referred back to their orthopaedic surgeon. Both went on to have MUA.

One patient had a suprascapular nerve palsy following the procedure. In this patient, air had leaked into the connecting set, allowing air to be injected into the shoulder at the needle tip. This made visualisation of the needle tip difficult and some of the injectate passed into the substance of the infraspinatus tendon (figure 6). This fluid tracked medially along the infraspinatus tendon to the region of the spinoglenoid notch. The injected fluid contained long-acting bupivacaine, which exerted an anaesthetic effect on the suprascapular nerve. The patient had marked rotator cuff weakness, particularly in external rotation and abduction. The patient was reassured and the symptoms resolved approximately 48 hours after the procedure.

Medium and long term results are encouraging (table 1). Follow-up data is still incomplete in our case review, with data available for 18 patients at 3 months and 15 patients at 6
months. All have an improvement in symptom scores at 3 months, with a median 17 point improvement in the OSS and a median 36 point improvement in the QuickDASH.

At six months, one patient had deterioration in score in the OSS, 14 points lower than on the pre-procedure outcome measure. The remainder all showed improvement, with a median improvement of 15 points in the OSS and 26 points in the QuickDASH.

Follow-up data is only available on 4 patients at 1 year post-procedure, but these all show improvement in both outcome measures, with a median 18 point improvement in the OSS, and median 34 point improvement in the QuickDASH.

One patient has returned to have the contra-lateral shoulder treated.

Images for this section:

Fig. 5: Video of attempted glenohumeral distension during a hydrodilatation. Fluid is seen to pass through a small defect in the rotator cuff and into the subacromial subdeltoid
bursa. This small but full thickness cuff tear / perforation had not been appreciated on the initial ultrasound, but is much more conspicuous once filled with injected fluid.

Fig. 6: Video of attempted glenohumeral distension during a hydrodilatation. Air within the injection apparatus is seen to pass into the glenohumeral joint. This causes considerable artefact, making visualisation of the exact position of the needle tip difficult. Some injected fluid is seen around the infraspinatus tendon, due to extra-articular needle placement due to poor visualisation. This fluid, containing bupivacaine, likely tracked along the infraspinatus tendon to anaesthetise the suprascapular nerve, giving symptoms of rotator cuff weakness for approximately 2 days.
Table 1: Oxford Shoulder Scores and QuickDASH scores 3 months, 6 months and 1 year following ultrasound guided hydrodilatation for frozen shoulder, displayed as improvement from pre-procedure scores.
Conclusion

Hydrodilatation is a safe and well-tolerated procedure with only minor adverse effects, mainly pain during and after the procedure. Combined with physiotherapy it can be a safe and effective alternative to manipulation under anaesthesia or arthroscopic release. Our results demonstrate an improvement in shoulder function at 3 months in most patients, which is maintained at up to 1 year. Despite hydrodilatation not being available in our institution two years previously, all three upper limb specialist orthopaedic surgeons now consider hydrodilatation combined with physiotherapy to be the initial treatment of choice for the treatment of frozen shoulder.

References


http://www.nhs.uk/Conditions/Frozen-shoulder/Pages/Treatment.aspx

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