Case 4 Ultrasound Glenohumeral Joint Injection Luke Millward

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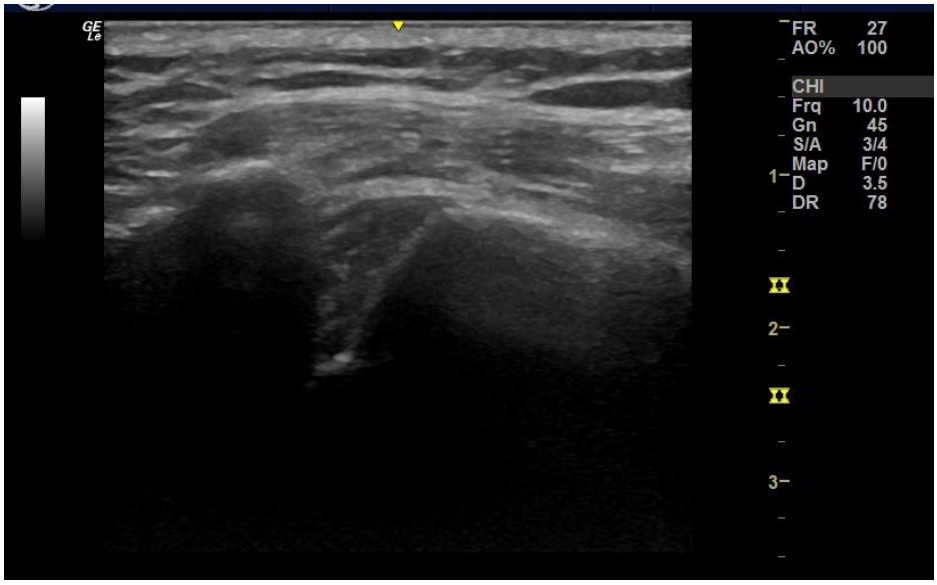
“Throughout this essay the patients name has been changed to maintain confidentiality as requested by the Healthcare Professional Council (HCPC) (2012) and Charted Society Physiotherapy (CSP) (2011) guidelines”

Mrs A was a 45-year-old lady who attended my physiotherapy clinic complaining of 6 months of significant right-sided shoulder pain. She experienced no trauma. Initially her shoulder became painful, however, over the past 2 months her shoulder became progressively stiff. Her pain remained 7/10 on the visual analog scale (VAS). She was unable to sleep on her right side, complete activities of daily living including fastening her bra and drying her hair. She had completed 4 sessions of physiotherapy, which yielded no benefit. Paracetamol gave short-term relief as did the application of heat. Previous medical history revealed type two diabetes for which she is taking Metformin (500mg 3 times a day). She is otherwise fit and well. She took no over-the-counter medication (except for paracetamol as required for her shoulder pain), herbal remedies, supplements or recreational drugs. Red flag questioning ruled out sinister pathology. The reason for Mrs A’s visit was to seek assistance to reduce pain and increase shoulder range of motion.

Objective testing revealed a capsular pattern of tightness. Full rotator cuff strength was maintained, both clinically indicative of adhesive capsulitis (AC) (Vermeulen et al, 2002).

Jacobson (2018) states that the sonographic appearance of AC manifests as limited lateral rotation and abduction, under dynamic testing, this was observed in Mrs A.

The below image was captured during dynamic abduction testing on ultrasound. The acromion is to the left of the image with a humeral head to the right of the image. The patient abducted to 50° which was limited by both pain and stiffness.



Jacobson (2018) further describes both hypo-echogenicity and hyperaemia within the rotator cuff interval and a thickening of the coracohumeral ligament as further sonographic signs. I was unable to quantify these criteria.

The following ultrasonic criteria are used to diagnose tendon pathology. This was utilised to dismiss the differential diagnosis of cuff pathology (Levin, 2005, cited in Resteghini, 2018, p.3).

1. Tendon thickening with heterogeneous echogenicity.

2. Hypoechoic foci representing inter-substance tears.

3. Calcifications and enthesophytes.

4. Neovascularisation on power doppler.

A differential diagnosis of glenohumeral joint osteoarthritis was also rejected by means of plain X-ray. Ultrasound imaging of the humeral head revealed well-defined cortical surfaces with no cartilage thinning or irregularities apparent in the presence of OA (Resteghini, 2018).

After considering the objective testing, completing an ultrasound assessment and reviewing plain X-ray a diagnosis of a right shoulder, stage II AC was made.

Mrs A experienced little relief from previous physiotherapy input, which included manual therapy and a home stretching program, and only short-term relief from over-the-counter medication. With this in mind the clinical rationale for injection therapy was justified.

Consent was gained prior to completing an injection. This was achieved by explaining the diagnosis and discussing the available treatment options, side effects and predicted outcomes. Mrs A was given the opportunity to ask questions and was given an information leaflet allowing her to understand the proposed treatment. She was then able to reach an informed decision prior to consenting. A consent form was completed and signed by the patient.

To ensure effective and safe practice it is imperative that the clinician works within their scope of practice. The CSP (2016) describes the legal framework underpinning injection therapy. Each clinician is responsible for maintaining legal, professional and moral boundaries outlined by the CSP (2016), National Institute for Clinical Excellence (NICE) (2013) and HCPC (2013). The CSP (2016) recommends that physiotherapists who are not independent prescribers or who are independent prescribers but are learning new skills, work within the limits of a Patient Group Directive (PGD). I am an independent prescriber, however, as I am learning a new set of skills, within Ultrasound Guided Injection (USGI) therapy, the medication used within this case study was administered under a PGD. Furthermore, the procedure described in this case was completed during my role as an Extended Scope Practitioner within the NHS. The NHS Trust I currently work within requires all allied health professionals undertaking injection therapy to administer drugs via a PGD.

A PGD is a supply and administration framework for the provision of medication widely used within the NHS. It is described as "a written instruction for the sale, supply and/or administration of medicines to groups of patients who may not be individually identified before presenting for treatment" (NICE, 2017). Only licenced drugs that hold a current marketing authorisation can be used; unlicensed medications are not permitted. The mixing of two drugs produces an unlicensed medication and therefore also cannot be used. A PGD permits the use of a specific medicine, for patients that fall under the inclusion criteria of the PGD (Nuttall and Rutt-Howard, 2017). Mrs A's presentation correlated with the stipulated criteria and therefore was deemed safe by the PGD. NICE (2017) requires that the clinician working under a PGD accept responsibility for patient safety, ensuring all contraindications, inclusion and exclusion criteria are met. Accurate recognition of the indications, precautions and contraindications associated with injection therapy is essential.

Mrs A suffered from type two diabetes. Saunders and Longworth (2012) described diabetes as a precaution to injection therapy.

Younes, et al (2006) reviewed the systemic effects of steroid injections in diabetic patients. 11 patients with AC undertook 3 interarticular injections, at 3-day intervals, of Cortivasol 1.5 ml (equivalent to 50mg of Methylprednisolone). Blood tests were taken at baseline, day 1, 7

and 21. Glucose levels, in patients with diabetes, rose significantly at day 1 and remained so at day 7. All objective markers returned to normal by day 21.

This study found a significant increase in post-prandial glucose levels in diabetic patients. There was no significant increase in fasting blood glucose levels, triglycerides, cholesterol or diastolic blood pressure after intra-articular injection. This study used a small cohort and large volumes of steroid over an unrealistically high injection frequency. This may have implications when transposing results into a clinical scenario. The steroid used within this study has been shown to have a long half-life and is highly biologically active which may again affect validity of results. Authors observed that these frequent injections suppressed the hyperthymic-pituitary adrenal axis (HPAA), however, this also resolved by day 21. HPAA suppression has been linked to Cushing Syndrome and skin depigmentation (Kumar et al. 2004). The risk of these side effects occurring, in this case, was reduced by administering a single injection. Research by Habeb et al. (2007) supports the findings of Younes et al. (2006) who reviewed the effects of one 35mg methylprednisolone intra-articular shoulder injection on blood glucose levels in diabetic patients. This study observed that using a smaller dose of steroid, 35mg rather than 50mg resulted in no detrimental effects to blood glucose levels. Both authors suggest when injecting a diabetic patient that blood sugar levels be well controlled (HbA1c<7%) and that close monitoring should continue for 2 weeks post injection. Mrs A's diabetes was well controlled. Prior to completing the injection Mrs A's blood glucose parameters were reviewed as HbA1c 6.5. Both studies used a steroid dose that reflects those stated within my PGD that requests the administration of 40mg (1 vial) of methylprednisolone for intra-articular shoulder injections. With this in mind, injection therapy was deemed as safe modality for Mrs A.

Gagey et al. (2001) describes AC as shoulder pain with a limitation of passive range of motion of the glenohumeral joint of >25% or 30 degrees in at least two planes of motion, in comparison to the contralateral side. Furthermore Hannafin et al. (2000) describes the underlying pathophysiology of AC as a combination of synovial inflammation and capsular fibrosis.

Prolonged fibroblastic activity within the shoulder capsule has been implicated in this disease process (Hettrich et al. 2016). Myofibroblasts are responsible for promoting wound healing and matrix deposition. These cells undergo apoptosis after wound healing is completed, however, in the presence of AC this does not occur, resulting in continuation of activity, increased capsular stiffness, contracture and scarring. Hettrich et al. (2016) conducted a histological analysis of 34 subjects suffering from AC. All subjects had failed conservative management and were about to undergo surgical capsular release. 20

subjects had previously had one intra-articular steroid injection (80mg of methylprednisolone, 3ml of 0.25% bupivacaine, and 5ml of 1% lidocaine) and 14 who had not. Results were compared to a further 20 control subjects. Histological samples were taken during surgical intervention. Results revealed that subjects who had not had a previous intra-articular injection, had higher levels of fibroblasts, synovial hyperplasia and an increase in smooth muscle actin within the shoulder capsule. The authors' hypothesis is that intra-articular steroid injections have a positive effect on the underlying disease process of AC. This study was limited by only including patients that had failed conservative management. This suggests that the chosen cohort were in the later stages of AC. The addition of a further group of participants in the earlier, more acute stages of the disease would have broadened the scope of results and therefore their validity. Again, this study's findings were plagued by its small sample size. Mrs A had been suffering for 6 months, had failed conservative management and her symptoms mirrored those experienced by participants within this study, therefore, the decision to perform a USGI with the aim of replicating research findings was clinically rationalised.

Lee et al. (2009) conducted a randomised control trial (RCT) assessing the efficacy of landmark guided V's USGI interarticular injections for AC. 43 subjects with a diagnosis of stage II AC were selected. Patients were divided into a landmarked or USGI group. 20 mg of Triamcinolone mixed with 1.5 ml 2% Lidocaine and 4 ml of Saline was injected. This was followed by 5 weekly injections of Sodium Hyaluronate. Outcome measures included range of movement, VAS and shoulder function. Patients were injected, using a posterior approach (sitting with the arm held in horizontal abduction). Both groups showed a significant reduction in all objective markers however the USGI group achieved a more rapid reduction in symptoms peaking at week 2 with a further 2-point reduction in VAS scores in comparison with the landmarked group. By week 6 both group results were comparable. This suggests the efficacy of steroid injection therapy for this population and suggests that the increased accuracy gained under USGI results in more rapid initial reductions in patient's symptoms. This theorising is supported by research from Yi et al. (2006) who observed USGI accuracy rates of 93.3% V's 46.6% for landmarked injections and therefore, USGI was selected in the treatment of Mrs A.

Lee et al. (2009) was limited by small sample sizes ultimately reducing rigour population. It also utilised 5 further weekly injections of sodium hyaluronate. Due to NHS caseloads and clinical constraints this level of intervention would not be achievable, reducing validity further. The question of the benefits of one intra-articular injection needs to be answered.

A systematic review and meta-analysis assessing the effectiveness of injection therapy for the treatment of AC was conducted by Lin et al (2018). Eleven RCT's comprising of 747 patients were reviewed comparing interarticular steroid injection with hydrodilation of the glenohumeral joint for the treatment of AC. A wide variety of volumes were used with hydrodilation, ranging from 20 ml to 90ml. Results were compared with a single cortical steroid injection, using a posterior approach. Steroid volumes ranged from 20 mg to 40 mg. Range of movement, VAS and functional objectives were used to assess the effectiveness of treatment. Lin et al 2018 revealed no significant difference in outcomes between hydrodilation and corticosteroid intra-articular injection. The results of this paper revealed a significant reduction in all outcome measures both cohorts. A wide variety of volumes were used. This would suggest that volume has little effect on outcome. The authors concluded that a single cortisone injection, using a posterior approach under ultrasound guidance, should be adopted when treating AC. This review influenced the adoption of a single corticosteroid injection using a posterior approach in this case study.

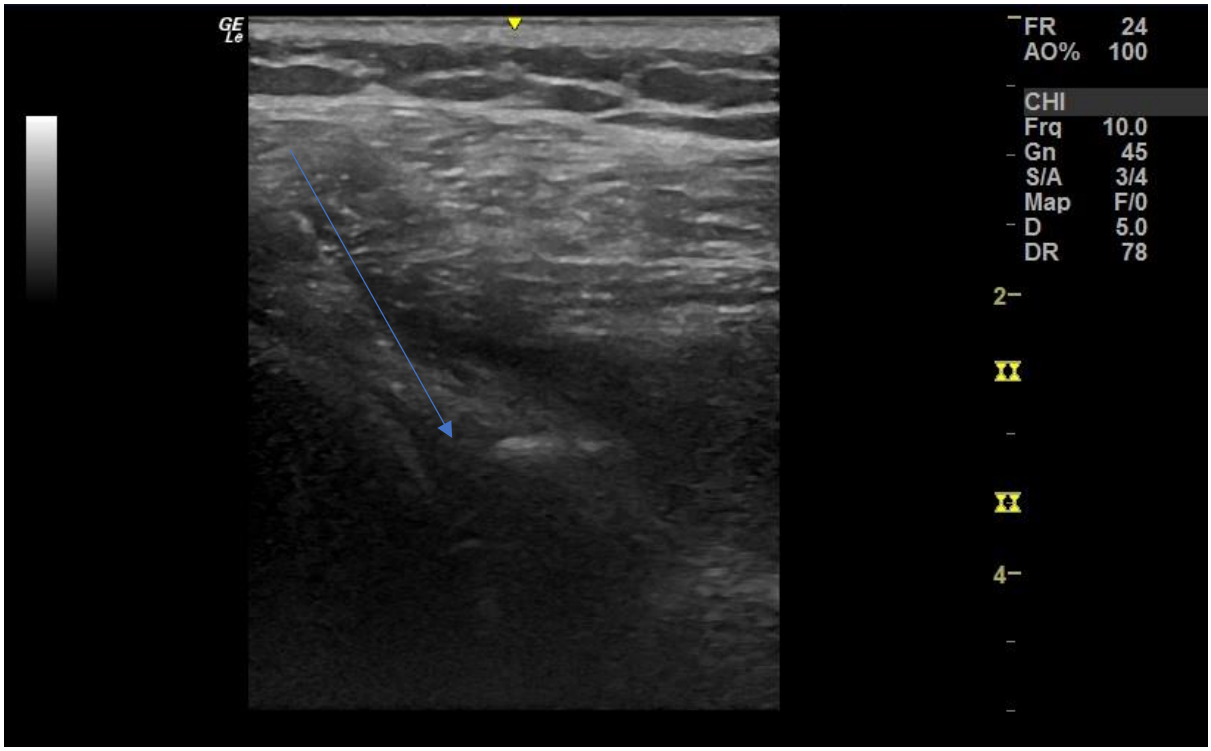
Roh et al. (2012) conducted an RCT to assess the efficacy of inter-articular shoulder injections for AC within diabetic patients. 45 subjects, with stage II AC, who had failed conservative management, were assigned to either an injection group or a non-injection group. Assessors were blinded to group allocation however subjects were not. Rigour could have been increased by the utilisation of a placebo injection in the non-injection group. 40mg Triamcinolone and 3ml Lidocaine was used for all injections. VAS, range of movement and function scores were collected at baseline, week 4,12 and 24. All participants were given NSAIDS and a home exercise plan. Results showed a significant reduction in VAS, an increase in range of movement and function within the injection group at both week 4 and 12. By week 24 no significant difference between groups was observed. Results suggest intra-articular injection is an effective, safe modality for a rapid reduction in pain with increased range of movement and function in the early stages of treatment for diabetic patients with stage II AC. As previously described, the pathophysiology of AC is one of synovial inflammation and capsular fibrosis (Hannafin et al, 2000). Steroid has been shown to reduce Myofibroblast activity and hence inhibit capsular fibrosis. This may part explain the findings of Young et al. (2011). Owing to the chronic nature of the disease process, a longer period of data collection would enlighten the reader into the longer-term benefits of steroid injection in relation to the inhibitory effect on myofibroblastic activity. This study did not complete pre or post injection blood tests to assess blood glucose levels. This is a methodological flaw however the previously discussed research shows that the steroid selected and the dose levels administered by Young et al. (2011) were safe for use with

diabetic patients. The findings of this study can safely be transposed for Mrs A and lend weight to the clinical rationale for providing her with an inter-articular injection. It also reveals the importance of providing patients with further modalities such as a home exercise program and NSAIDS. This was also included in Mrs A's package of care.

After close consideration of the evidence base it was deemed safe and clinically relevant to provide an interarticular injection for this patient.

The literature describes using a posterior injection approach, with the patient in sitting and the ipsilateral hand resting on the contralateral shoulder, in a modified scarf position. This was used in this case, however, to ensure further patient comfort and to reduce the risk of injury from a vasovagal incident Mrs A was laid on her contralateral side with her ipsilateral hand resting on a pillow. This allowed me to achieve the same injection but with increased patient comfort and safety. The ultrasound machine was placed in front of the patient. I was positioned behind her. This gave me a direct line of sight to both patient and machine and allowed me to accurately and safely insert the needle. A long axis view of the humeral head and posterior glenoid was obtained and an in-plane needle approach was used to target the posterior capsule of the glenohumeral joint. A linear probe with a medium to low frequency of 9-12MHz was selected. A green 21G 0.8 x 50mm needle was chosen after reviewing the depth of the target on ultrasound imaging. A no-touch technique was used to reduce the chance of post-injection infection (Saunders and Longworth, 2012). As stipulated within the PGD, and in keeping with the above evidence-base, 40mg of Methylprednisolone in 1m solution and 3ml 1% Lidocaine was administered.

The below image shows the posterior glenohumeral joint capsule. The needle can be observed entering the joint to the LEFT of the picture. Limited needle visualisation was accompanied by tissue movement. This enabled me to locate the joint capsule and administer the injection. The arrow helps the reader to visualise the needle location within the frame.



Immediate after-care included asking the patient to remain in the waiting room for 20 minutes before leaving. This was to monitor for any allergic reaction or a vasovagal event that may occur. The patient was also reminded to monitor blood glucose levels over the next 2 weeks as well as possible complications including post injection infection (Saunders and Longworth, 2012). Mrs A was provided with a set of home exercises designed to increase range of shoulder movement and a follow up appointment was made for 6 weeks post injection.

The current evidence base uses VAS pain score and range of movement as objective markers and therefore these were collected in this case study.

Glenohumeral joint objective markers were as follows;

Plane of motion	**Pre injection range**	**Immediate post injection range**	**6 weeks post injection range**
Flexion	50 degrees	70 degrees	90 degrees
Abduction	45 degrees	50 degrees	80 degrees
Lateral rotation	5 degrees	5 degrees	10 degrees
Medial rotation (hand behind back, 2nd MCPJ height)	L5	L5	L4

VAS pain score objective markers were as follows;

VAS pain score	Pre-injection	Immediate post injection	6 weeks post injection
	7/10	5/10	3/10

The evidence discussed above describes intra-articular steroid injection as an effective modality for diabetic patients with AC. It shows a more rapid reduction in pain, an increase in shoulder range of movement and a quicker return to function when compared with patients who had not had an injection. Results were elevated further when selecting USGI over a landmarked injection, due to the higher rates of accuracy. The steroid used in this case study was deemed safe for a diabetic patient with well controlled diabetes, by both the current evidence base and the PGD described above. The evidence base inclusion criteria accurately resembled Mrs A symptoms. This resulted in the comparable outcomes achieved in this case.

In reflection this was a technically challenging injection. The posterior capsule of the glenohumeral joint is a deep structure. This required me use a low frequency probe which reduced image quality. I had to use an acute needle angle to accurately target the posterior capsule of the glenohumeral joint. This had the negative effect of reducing needle visualisation. I tried to negate these limitations by adjusting the gain and the focus on the ultrasound scanner to achieve the best image possible, prior to commencing the injection. I maintained a firm probe position throughout the procedure by placing the patient in a comfortable and stable position. This allowed good access to the posterior shoulder. During needle advancement I relied on tissue movement as much as needle visualisation. When this happened, I utilised both ‘heal/toe’ and ‘toggling’ probe movements, which helped me to regain visual contact with the needle.

I felt this case study was a success with good patient outcomes, however in future cases I would like to ensure better needle visualisation rather than relying and a combination of needle visuals and tissue movements. I feel my inability to observe both coracohumeral ligament thickening and hyperaemia at the rotator interval was clinically limiting. This is an area of ultrasound diagnostics I need to work on to ensure accurate future diagnostics. AC in the diabetic population is challenging to treat and I now feel more capable of providing these patients with a safe and effective, evidence-based treatment option. The area of interventional ultrasound is very exciting and I am keen to continue to progress my career in this direction.

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