Routine x-rays for suspected Frozen Shoulder offer little over diagnosis based on history and clinical examination alone

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Conflict of Interests

None declared

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Abstract:

Background: Frozen shoulder is a common condition and current guidelines state that it is a diagnosis of exclusion. Along with a history and clinical examination, routine x-ray is mandated to rule out any masquerading pathology such as fracture, dislocation, metastatic lesions or severe osteoarthritis. Despite the certainty of the guidelines there is a lack of evidence to support the use of routine x-rays in this situation.

Design: A retrospective review following SQUIRE Guidelines

Methods: A retrospective review was performed of all x-rays obtained in the diagnosis of frozen shoulder between February 2014 and August 2017 in an integrated musculoskeletal interface service. Results were screened and the prevalence of masquerading pathology was determined.

Results: 350 shoulder x-rays that were performed with a differential diagnosis of frozen shoulder were reviewed. 213 were from female patients (60.9%), mean age was 57.7 years (SD 10.4). 342 (97.7%) did not have any concerning features. Six (1.7%) had severe osteoarthritis, one (0.3%) had a fracture and one (0.3%) had a lucency. All 8 patients with 'masquerading' pathology had findings from the history and clinical examination that would have warranted an x-ray regardless of differential diagnosis of frozen shoulder.

Conclusion: The findings of this retrospective review of a large number of x-rays do not support the requirement of a routine x-ray to rule out masquerading pathology to confirm the diagnosis. The data suggests that it is unnecessary for patients who do not have a relevant clinical history suggesting serious or masquerading pathology to undergo routine imaging.

Key words: adhesive capsulitis; contracted shoulder; frozen shoulder; serious pathology; x-ray

Main Text:

Introduction

Frozen shoulder, also termed adhesive capsulitis or contracted shoulder, is a painful and debilitating condition commonly seen in musculoskeletal (MSK) clinical practice. Primary frozen shoulder has been reported to affect up to 5.3% of the general population, with secondary frozen shoulder affecting up to 38% (Kelley et al, 2013). Codman (1934) described frozen shoulder as a disease of slow onset, resulting in pain near the deltoid insertion, an inability to lie or sleep on the affected side, with pain and restriction on elevation, external rotation with confirmation of the diagnosis by excluding other pathologies using x-ray. The clinical diagnosis of frozen shoulder is based on a history and physical examination indicating shoulder pain with restricted passive external rotation (Hanchard et al, 2011a). Wolf and Cox (2010) further suggested that restricted external rotation should be considered the diagnostic test for frozen shoulder in the absence of arthritis and trauma.

There is a growing consensus that frozen shoulder is a diagnosis of exclusion following a "normal" x-ray for other serious pathologies that might be masquerading as a stiff shoulder (Sano et al, 2010; Lewis 2015; Rangan et al, 2015). According to British Elbow & Shoulder Society (BESS)/ British Orthopaedic Association (BOA) guidance (Rangan et al, 2015), important features of diagnosis include reduced range of movement in a capsular pattern, most notably a disproportionate and severe loss of passive external rotation. It is also stipulated in the BESS/BOA guidelines that normal x-rays are required to rule out mechanical glenohumeral incongruity, which can masquerade as frozen shoulder. Masquerading pathology can include locked dislocation, fracture, arthritis, avascular necrosis and osteosarcoma (Lewis, 2015; Rangan et al, 2015).

There is also evidence to support the use of magnetic resonance imaging (MRI) and ultrasonography (US) in the diagnosis of frozen shoulder (Zappia et al, 2016; Park et al, 2017; Suh et al, 2018) and the exclusion of masquerading pathologies (Roy and Chakrabarti, 2018). Features of rotator interval and axillary joint capsule enhancement and coracohumeral ligament thickening have shown to be sensitive and specific diagnostic indicators on MRI (Suh et al, 2018). Also the coracohumeral ligament thickness ratio (calculated between the affected and non-affected side) on US, was correlated with a diagnosis of frozen shoulder (Park et al, 2017). Roy and Chakrabarti (2018) found that US was useful in the diagnosis of frozen shoulder, and excluded other associated pathologies such as; rotator cuff tears, fractures, labral tears and impingement syndrome.

Serious pathology masquerading as frozen shoulder is rare. Sano et al (2010) found that only 0.8% of the 505 patients initially diagnosed with frozen shoulder were later found to have a tumour. However, the consequences for misdiagnosing such conditions can be significant.

While some have suggested that it is unrealistic to expect all patients with a provisional diagnosis of frozen shoulder to be referred for x-ray (Hanchard et al, 2011a) a questionnaire survey of UK physiotherapists suggested that a majority (54% 152/282) would consider requesting imaging, usually to exclude bony abnormalities (Hanchard et al, 2011b). A recent study into the management of shoulder pain by general practitioners (GPs) identified that 58% of GPs would refer a patient for a plain radiograph of the shoulder if they suspected

frozen shoulder (Artus et al, 2017). The exclusion of other diagnosis (65%) was the most popular reason for requesting further investigation (Artus et al, 2017).

A service evaluation is conducted with the purpose of reviewing the current service and evaluating how well it achieves its intended aims (Twycross and Shorten, 2014). Therefore the aim of this retrospective service evaluation was to analyse all routine x-rays of patients with a provisional clinical diagnosis of frozen shoulder in an Integrated MSK service between February 2014 and August 2017 to identify the prevalence of masquerading pathology that might change the provisional diagnosis and thus confirm or challenge the role of routine x-ray in the diagnostic pathway.

Method

This retrospective service evaluation was approved by Staffordshire and Stoke on Trent Partnership NHS Trust, who determined that ethical approval was not required following completion of the Data Protection Impact Assessment and Caldicott Approval. The work was carried out by physiotherapists in an integrated MSK service.

Data Collection

In 2013 a frozen shoulder service pathway was developed within the lead authors' institute based on the Chartered Society of Physiotherapy guidelines for frozen shoulder (Hanchard et al 2011a). Where there was a suspected diagnosis of frozen shoulder, all patients were referred for an x-ray. Frozen shoulder diagnosis was dependant on a "normal" x-ray as per the guidelines. The standard radiographic views used were anterior posterior (AP) straight, AP angle up and posterior anterior Y view in line with local x-ray protocol for frozen shoulder. All images were reported by a Consultant Radiologist or an Advanced Radiographer Practitioner.

All x-ray requests and results were recorded on a secure confidential database with the initial clinical diagnosis on the x-ray request form being inputted by a medical secretary. The radiologists' reports were screened for red flags by an Extended Scope Physiotherapist (ESP), who then inputted the conclusion onto the database. This database includes all x-ray requests from February 2014 to August 2017. Outcome of x-rays recorded on this database for patients with suspected frozen shoulder form the basis of this retrospective review.

All data collection was undertaken by three of the named authors. An initial review of the database revealed that three common diagnostic terms had been used on the x-ray request form (frozen shoulder, contracted shoulder or adhesive capsulitis). These terms were manually searched in the database. Results were analysed to determine the prevalence of serious pathology in the clinical diagnosis of suspected frozen shoulder.

The NHS number was then searched on our electronic x-ray system to gain further demographic information including patient age and sex which was then used for statistical analysis for this review. Where serious pathologies/masquerades were recorded on the database, these notes where reviewed for further clinical information.

Results

Over the review period, a total of 758 shoulder x-rays were performed; 351 (47%) of which pertained to a potential diagnosis of frozen shoulder. However, one x-ray was excluded due

to frozen shoulder not being the primary diagnosis. The x-ray was performed to check a recent fracture site and frozen shoulder was a differential diagnosis. The x-ray result reported a slight displacement of the humeral shaft due to the fracture and was therefore excluded from our study. The final review population composed of 350 (46%) shoulder x-rays for patients with a provisional diagnosis of frozen shoulder. A total of 213 (60.9%) were females and 137 (39.1%) males with a mean age of 57.7 years (standard deviation 10.4).

Analysis

Of the 350 x-rays that were performed with a potential diagnosis of frozen shoulder, 342 (97.7%) did not have any serious or masquerading pathology, and 8 (2.3%) found positive features. Of the 350 x-rays, 225 (64.3%) showed no abnormalities; 81 (23.1%) had mild-moderate osteoarthritis (OA) of the glenohumeral joint; 30 (8.6%) reported subacromial narrowing and 6 (1.7%) showed calcific tendinopathy. Of the 8 (2.3%) shoulder x-rays that were found to have a serious or masquerading pathology, 6 (1.7%) had severe glenohumeral joint OA. One (0.3%) showed a greater tuberosity fracture, and presented in clinic with a recent trauma following a fall. One (0.3%) identified “a well-defined lucency on the head of humerus”, following a past medical history of lung cancer (Table 1).

Discussion

The aim of this retrospective review was to examine all routine shoulder x-ray results in patients with a clinical suspicion of frozen shoulder over a 42 month period to establish the prevalence of masquerading pathology. The rationale for x-ray in the work up for this diagnosis is to exclude masquerading pathology (Bunker, 2009). However, our findings suggest that only a very small percentage of patients who presented to an Integrated MSK service with a stiff and painful shoulder had serious or masquerading pathology. This finding appears to challenge the requirement for routine x-ray in this diagnostic pathway.

Of the x-rays reviewed, only 2 (0.6%) results out of the total 350 revealed a “red-flag” or sinister pathology. One of these, with a diagnosis of greater tuberosity fracture, reported a traumatic onset whereby the shoulder pain commenced following a fall onto the shoulder with no previous x-ray. The patient presented with constant left shoulder pain, swelling in their upper arm and reduced passive range of motion into rotation and flexion. In the case of the patient whose x-ray showed lucency on the head of humerus, they had a past medical history of lung cancer and lobectomy on the same side as their shoulder pain. They had gross restriction of shoulder movement in multiple planes. In both of the above cases an x-ray would have been requested due to a raised index of suspicion of masquerading pathology based on the clinical history.

The rarity of serious masquerading pathologies in this review are reflective of those of Sano et al (2010) who found in their retrospective review of 505 patients with restricted shoulder range of movement (elevation < 120 degrees) and pain, that only 4 (0.8%) were diagnosed with shoulder tumours. They also reported that in 34 patients with known malignant shoulders seen in their secondary care tumour service, 9 (26%) had been given an initial diagnosis of frozen shoulder prior to the final diagnosis and this initial misdiagnosis caused a significant delay (9 months) in the final diagnosis. It is unclear whether, as in this review, that the index of suspicion of masquerading pathology would have been raised based on clinical history. However, Sano et al (2010) did report that these tumours could not be

identified through physical examination or plain x-rays which thereby challenges the value of routine x-ray in this context.

Robinson et al (2003) also looked at tumours in the shoulder girdle. It was found that all of the 7 cases of tumours in their study had a typical presentation of painful limitation of shoulder movement that was the same as the 50 control subjects who had primary or secondary frozen shoulder. They also reported a “normal” radiograph in 6 of those cases. This further challenges the value of routine x-ray as it is stated that 10% of shoulder girdle tumours present with “normal” radiographs and without a palpable mass (Robinson et al, 2003). It is therefore important to consider each case with the clinical assessment, and any patients that may have an atypical presentation or do not respond to conservative measures in a timely duration, should be considered for further work-up to identify other causes.

Although uncommon, moderate to severe osteoarthritic changes were the most prevalent masquerader found (n=6) in this retrospective review. The majority of these patients were in an age group that may raise a suspicion for moderate to severe OA (72-92), it was found that two patients were younger (56 & 59 years old). There is evidence to suggest osteoarthritis can present at an earlier age following joint trauma (Punzi et al, 2016). Both of the younger patients in this study also had a previous history of trauma to their shoulder, so more severe osteoarthritic changes may be expected. As per the NICE Guidelines (2014) patients can have osteoarthritic changes if they are greater than 45 years old, and this therefore must be considered in the clinical assessment, and may lead to earlier investigation if a past history of trauma is present and early OA is suspected.

The average age of patients diagnosed with frozen shoulder in this review was 57.7 years old. This is in line with the findings of other studies (Robinson et al, 2003) and the “peak age” for frozen shoulder of 56 years old described by Dias et al (2005). Robinson et al (2003) concluded that patients with a tumour were significantly younger than those with frozen shoulder, with an average age of 38 years old. In a study by Moor et al (2013), including 92 patients that had undergone a routine Total Shoulder Replacement (TSR) due to OA, the average age was 68.7 years old. Hence, adding to the findings of this current review, age is an important feature in the differential diagnosis when suspecting primary frozen shoulder. Obvious clinical features of a reduced range of movement in a capsular pattern, most notably a severe loss of passive external rotation, with a younger age should raise the suspicion of a potential tumour, or with an older age raising the suspicion of severe OA. These findings should therefore lead to further investigation to exclude these pathologies

This study has shown that serious pathology is rare. However, the consequences of misdiagnosing frozen shoulder in the initial stages could result in a significant delay in correct diagnosis while conservative pathways are followed. This could potentially cause a progression of severe pathologies, and a significant deterioration in the patient’s prognosis. An important factor to consider when diagnosing and treating what is thought to be frozen shoulder, is to remain alert to any signs that there may be other factors involved with the patient, and to re-question the diagnosis if progression is not being observed or if symptoms deteriorate.

Clinical Impact

Our results show that 342 shoulder x-rays did not have any concerning features and thus conceivably were performed unnecessarily. Considering how common frozen shoulder is, this knowledge could be a stimulus to significantly reduce the number of unnecessary x-rays undertaken per year and also reduce patient exposure to radiation.

The use of MRI and US were not assessed in this review, as they were not routinely performed in the diagnosis of frozen shoulder in this Integrated MSK service. However, despite their reported use in the diagnosis of frozen shoulder (Zappia et al, 2016; Park et al, 2017; Suh et al, 2018; Roy and Chakrabarti, 2018), if they are being performed routinely, purely for the exclusion of other pathologies then the same considerations need to be made. It may be unnecessary to conduct these further investigations without any clinical indication there may be a serious underlying pathology.

Based on the findings of this review, the pathway in the Integrated MSK service in this review has been remodelled and patients with suspected frozen shoulder are no longer routinely x-rayed. However, any patients where there is concern regarding the differential diagnosis of significant OA, unreduced dislocation, fracture, tumour, lytic lesion or unresponsive to previous conservative management, then a shoulder x-ray is requested.

Limitations

This review is based on data from one centre in the UK. Although the number of x-rays reviewed is large, the generalisability of these findings needs to be considered in this context. However, given that national guidance suggests routine use of x-ray in the diagnostic pathway for frozen shoulder it is likely that these findings are transferable but the extent to which they apply to secondary or tertiary care remains unclear and warrants further research.

Within the scope of this study, it is impossible to provide any more information on how many of the 342 routine x-rays that were concluded to have no serious pathology would have raised the index of suspicion during the clinical assessment. However, this data can be traced as a future ongoing study, and it can be identified how many cases show signs that further investigation was warranted based on clinical judgement.

Conclusion

Despite a general consensus that frozen shoulder is a clinical diagnosis of exclusion with pain and restriction on elevation and external rotation and following a “normal” x-ray, the data from this review does not support this rationale in the early stages of the clinical pathway. Our data indicates that it is unnecessary for patients who do not have a clinical history that may suggest serious or masquerading pathology to have a routine x-ray, but rather these resources be used on patients that do, or those that are not improving with ongoing management.

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Table 1: Findings of 350 shoulder x-rays for suspected frozen shoulder

Non-serious pathology/no masquerades	Totals	%
No significant abnormalities	225	64.3
Osteoarthritis (Mild/Moderate)	81	23.1
Subacromial Narrowing	30	8.6
Calcific Tendinopathy	6	1.7
TOTAL	342	97.7

Serious pathology/Masquerades	Totals	%
Osteoarthritis (Severe)	6	1.7
Fracture	1	0.3
Lucency	1	0.3
TOTAL	8	2.3