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ICC Wales

Abstract Booklet

Free Paper Session 1
Wednesday 28 June 2023
1:15 PM - 2:35 PM

The Lived Experience of Patients with Lateral Elbow Tendinopathy – a Qualitative Study from the OPTimisE Pilot & Feasibility Trial.

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Background: The aim of this study was to understand and describe the lived experience of individuals suffering from Lateral Elbow Tendinopathy (LET).

Methods: Qualitative semi-structured interviews were conducted as part of a mixed-methods randomised controlled pilot & feasibility trial of patients attending physiotherapy clinics in the UK. Patients with LET were purposively sampled to provide a representative sample based on age, sex, ethnicity, deprivation index and treatment allocation within the OPTimisE Pilot & Feasibility Trial (ISRCTN registration: 64444585, 19/7/2021). Interviews were analysed using thematic analysis.

Results: 17 patients were interviewed. Four themes were identified: (1) the cause of onset - attributed to sudden changes in activity, repetitive work, or compensating for other musculoskeletal conditions; (2) the level of disability - impact on function and quality of life was significant, particularly due to impacts on sleep due to pain, and difficulties performing daily tasks (related to work and hobbies) due to pain, though most were able to persevere with work; (3) self-help and understanding of the condition - limited and confused by the diagnostic term 'Tennis Elbow' that non-sporting individuals struggled to relate to, and uncertainty about the appropriateness and potential harm of online advice; (4) the healthcare experience – the treatment they received was highly variable and often perceived as ineffectual.

Conclusions: This study describes: patients' common perceived causes of LET; its impact on their ability to perform daily tasks, sleep, work and hobbies; the hesitancy of people to rely on online information without formal healthcare advice; the unrelatable nature of the common label of 'Tennis Elbow'; the wide array of treatment options provided with many lacking evidence of effectiveness. This highlights the need for research and guidance for healthcare professionals into the most cost-effective treatment strategy for this common but disabling condition.

Physiotherapist-led exercise versus waiting-list control for patients awaiting rotator cuff repair surgery: a pilot randomised controlled trial (POWER)

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Our aim was to determine the feasibility of a fully powered, randomised controlled trial that would compare physiotherapist-led exercise to waiting-list control in adult patients with tears of the rotator cuff awaiting surgery.

We undertook a pragmatic multi-centre, pilot randomised controlled trial with feasibility objectives.

Adult patients listed for rotator cuff repair surgery were recruited and randomly allocated to a programme of physiotherapist-led exercise or waiting-list control.

Participants were followed-up using electronic questionnaires at 6 weeks, 3- and 6-months, including the Shoulder Pain and Disability Index (SPADI), EQ-5D-5L, days lost from work and driving, and whether surgery has been performed or not.

Pre-defined success criteria were:

- Recruitment rate: percentage of eligible patients recruited
- Treatment fidelity: percentage of participants randomised to physiotherapist-led exercise who received assessment and exercise prescription
- Follow-up rate: percentage of SPADI questionnaires received at 6-months.

Working with six NHS hospitals we recruited 76 participants between September 2021 and August 2022.

Our pre-defined success criteria were categorised as:
- Green – progress to a fully powered trial without changes
- Amber – progress with identified changes
- Red – do not progress

We recruited 76 of 302 (25%) eligible patients (amber).

Final follow-up is due by the end of February 2023. Currently treatment fidelity is 72% (amber) and follow-up rate 72% (amber).

Of 62 participants who are 6-months post-randomisation, 25 have not yet received surgery. Of these 25, 10 who have not received surgery are not intending (7 Physiotherapist-led exercise programme; 3 waiting list control).

Despite challenges during the Covid-19 pandemic, we recruited our target of 76 participants. A fully powered randomised controlled trial appears feasible with minor research design changes. There is potential for significant patient and NHS benefit, including a possible reduction in the need for surgery.

Feasibility of Triaxial Accelerometers in Quantifying Adherence to Shoulder Sling Wear

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Aim: We aim to develop an algorithm quantifying shoulder sling non-wear and assess its accuracy utilizing slings pre-fitted with triaxial accelerometers.

Methods: Triaxial accelerometers detecting both inertial movement and temperature were lodged in sutured inner sling pockets. Recorded data including acceleration in three axes and temperature (as a proxy to identify sling wear times) was collected from 10 normal participants. Participants were asked to wear the pre-fitted slings for 8 hours (480 minutes) with progressive non-wear times embedded into their wear schedule with prior randomization. Sling wear and non-wear were determined from variability in acceleration in three axes and temperature change. Participants were asked to log sling donning, doffing, and wear times in log sheets to accurately cross-reference with motion/temperature recorded by the accelerometers. Data were statistically analyzed using sensitivity analysis.

Results: 10 participants logged 480 minutes/participant of wear. The sensor detected mean duration wear was 479.1 minutes/participant (SD = 2.0). The mean sensitivity for all 10 participant's data was 94.3% (range = 86.3 – 98.3, SD =3.5), and the mean specificity was 99.1% (range = 93.7 – 100, SD = 0.8). Minute-by-minute agreement of sensor-detected wear and non-wear with participant-reported wear (from donning and doffing times) was 97.3% (range = 85.8 – 117.5, SD = 1.5%). Sensor-determined and self-reported total non-wear was compared using paired t-test with no statistical difference found (P=0.14).

Conclusion: An algorithm based on accelerometer-assessed acceleration and temperature can accurately identify shoulder sling wear/non-wear times, thus an accelerometer can be used to define adherence to sling wear. The ramifications of using this high-accuracy method can be extrapolated to assessing whether sling wear adherence after shoulder surgeries has any bearing on patient functional outcomes.

A consultant upper limb physiotherapy clinic to reduce the patient journey and get the right treatment at the point of assessment

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Purpose: Consultant physiotherapy upper limb clinic: reduce patient journey, deliver the right advice/treatment at the point of assessment

Method: Many patients referred into secondary care for 'surgical opinion' do not have a surgical target. A specialist clinic (with longer appointment times) was set up to enable an expert clinical assessment, deliver vital education to the patient regarding their diagnosis, treatment options and likely outcomes, arrange appropriate imaging and deliver care on the day in the form of advice, specialist physiotherapy, injection or splinting. Patients on orthopaedic waiting lists with no surgical target were offered appointments, patients directed in from first contact practitioners and from physiotherapists who felt patients had plateaued, needed investigation/assessment +/- injection. This creates a proactive approach to both waiting list management and ensures early, appropriate treatment and management for patients. A pathway agreed with surgeons was set up to prevent delay/duplication of appointments to list from the clinic if a surgical target found.

Results: Of the first 100 patients seen (62 shoulder, 30 hands and 8 elbow), 100% had treatment delivered on the day, with 91 being their definitive treatment. Waiting times were reduced by a mean of 3 months for appointment, and 27 weeks for physiotherapy input. Imaging/investigations arranged included: 34 x-ray, 6 NCS, 5 bloods, 5 ultrasound scan, 2 CT, 1 MRI. Treatment delivered included 39 injections and 19 splints. All received on the day expert physiotherapy advice, exercise programmes and progression advice. Majority were followed up with a telephone call. Oxford shoulder score improved from 26.3 to 42.4 (mean). DASH scores (for hand and elbow) improved from 47.7 to 12.1 (mean). Patient satisfaction was extremely positive.

Conclusion: The clinic has been very successful at reducing the patient journey, reducing the burden on secondary care clinic appointments and delivering treatment on the day.

Optimising Physiotherapy for People with Lateral Elbow Tendinopathy – Results of a Mixed-methods Pilot and Feasibility Randomised Controlled Trial (OPTimisE).

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Background: The OPTimisE treatment protocol was developed to address uncertainty regarding the most effective physiotherapy treatment strategy for people with Lateral Elbow Tendinopathy. It consists of three elements: condition-specific and general health advice, supported by printed and online resources; a progressive exercise regime working within limits of pain deemed acceptable by individual patients; and the provision of a counter-force orthosis. We aimed to assess the feasibility of conducting a future, fully powered, multi-site randomised controlled trial (RCT) testing whether OPTimisE treatment protocol is superior to usual NHS physiotherapy treatment for adults diagnosed with Tennis Elbow, in terms of clinical and cost-effectiveness.

Method: We conducted a pilot & feasibility RCT across three hospital trusts, allocating patients to receive usual physiotherapy treatment or the OPTimisE treatment protocol. Feasibility was assessed by meeting pre-specified thresholds for: patient consent rate, fidelity to intervention, attendance rate of scheduled sessions, outcome measure completion at six months, as well as acceptability of the OPTimisE intervention from both the perspective of patients and physiotherapists (assessed qualitatively). We

piloted options for patient identification (primary care or physiotherapy referral screening) and outcome measure delivery (postal vs online).

Results: We recruited the target of 50 patients within the allocated 12-month time period. Mean age 48 (SD 8.9), 22 Female, 28 Male. Consent rate was 71%, fidelity to intervention 89%, attendance rate 78%, outcome measure completion >75% at six-month follow-up. Patients and physiotherapists both found the OPTimisE intervention to be acceptable but also suggested improvements to the trial design. Identifying patients directly from physiotherapy referrals was more successful than from primary care records. Outcome measure return rates were higher when completed online compared to by postal questionnaire.

Conclusion: It is feasible to conduct a fully powered RCT to compare the clinical and cost-effectiveness of the OPTimisE treatment protocol against usual physiotherapy treatment.

The Impact of introducing hydrodistension as a treatment for frozen shoulder in a primary care musculoskeletal service: A retrospective audit

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To understand the impact of introducing hydrodistension for frozen shoulder into a physiotherapy led, primary care based, musculoskeletal service on onward referral rates to secondary care orthopaedics.

Methods and Results: A retrospective audit of data from 102 patients who followed our hydrodistension treatment pathway for frozen shoulder since 2017 was conducted. All 102 patients received at least one hydrodistension procedure performed by a physiotherapist. This involved injecting the glenohumeral joint with a combination of local anaesthetic, corticosteroid, and saline under ultrasound guidance with a total volume of 25-35mls. This data was compared to the outcomes of 102 patients who presented with frozen shoulder prior to 2017 who did not receive hydrodistension. Of 102 patients who received hydrodistension within the musculoskeletal service, six patients required onward referral to orthopaedics. Of the 102 patients who did not receive hydrodistension prior to 2017, 58 required onward referral to orthopaedics.

Conclusion: We report a reduction in onward referral to orthopaedics following the introduction of hydrodistension to our physiotherapist-led treatment pathway for patients with frozen shoulder. This preliminary data identifies the need to further evaluate the clinical and cost-effectiveness of hydrodistension performed by physiotherapists for patients with frozen shoulder.

Identification of movement and muscle activity patterns between young people with and without shoulder instability using 3D-movement analysis and surface electromyography.

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Purpose: To identify differences in movement and muscle activity patterns between young people with and without shoulder instability using 3D-movement analysis and surface electromyography (sEMG).

Methods: Participants attended a single measurement session for baseline demographic and clinical assessments. In the same visit, participants movements were assessed during four unweighted (flexion, abduction, abduction with lateral rotation and hand to head, each for six repetitions x two sets) and self-selected weighted tasks of either 0.5kg, 1.0kg or 1.5kg (flexion, abduction, abduction with lateral rotation, each for three repetitions x two sets).

Data was collected using Vicon motion capture and Delsys Trigno sEMG systems. Retroreflective marker clusters were placed on the thorax, acromion, humerus, forearm and hand. sEMG electrodes were placed on middle trapezius, infraspinatus, triceps, latissimus dorsi, deltoid (posterior and anterior) pectoralis major, biceps, wrist flexor and extensor muscles. Statistical parametric mapping was used to identify between-group differences in the upper-limb workspace for all tasks (i.e. glenohumeral, sternoclavicular acromioclavicular and thoracuhumeral angles).

Results: Data was collected for 30 children (15 with shoulder instability (6M:9F) and 15 sex- and age-matched controls (8M:7F)). The shoulder instability cohort had mean (SD) age, height and weight values of 13.9 years (2.8), 163.0 cm (15.2) and 56.6 kg (16.9) respectively. The reference cohort had age, height and weight values of 13.3 years (3.0), 160.6 cm (16.2) and 52.4 kg (14.6) respectively. Statistically significant differences were observed in 49/77 movement planes (65%). Consistent differences between groups were seen across all activities for glenohumeral elevation, sternoclavicular protraction/retraction and elevation/depression angles.

Conclusion: Whilst overall arm position appeared similar, preliminary results suggest that significantly different movement strategies across the shoulder-girdle joints may be used by those with shoulder instability. Further analysis of collected sEMG data is required to explore differences in muscle activity patterns and contribution to the identified movement differences.

Rehabilitation Guidelines Following Arthroscopic Shoulder Stabilisation Surgery for Traumatic Instability - A Delphi Consensus

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Background: There is no consistent approach to rehabilitation following arthroscopic shoulder stabilisation surgery (ASSS) in the UK. The aim of this study was to agree a set of post-operative guidelines for clinical practice.

Method: We identified expert stakeholders including shoulder surgeons, physiotherapists and patients who have undergone ASSS via the BESS membership, PPIE group and professional networks. We conducted a three-stage online Delphi study to present recent UK survey findings and develop consensus on best practice. Consensus was defined by the OMERACT threshold of 70% agreement.

Results: 11 shoulder surgeons, 22 physiotherapists and 4 patients participated. It was agreed patients should be routinely immobilised in a sling for up to 3 weeks but can discard it earlier if able. During the immobilisation period, patients should be able to move only within a defined "safe zone" and this movement could be passive, active assisted or active. During the immobilisation period, within the safe zone, patients could: use cutlery, lift a drink, slice bread, use kitchen utensils, wipe a table, do light dusting, pull up clothing, wash/dry dishes, but need to avoid closing car doors or draining a saucepan. Through range movements can commence after 4 weeks. Resisted movements can start at 6 weeks. Patients can resume light work as soon as they feel able and return to manual work after 12 weeks.
Patients should be able to return to non-contact sports as soon as functional markers for return to play are met. Return to contact sport is based on function & confidence after a minimum of 12 weeks. Additional factors should be taken into account when determining rehabilitation progression: functional/physical milestones, patient's level of confidence and presence of kinesiophobia. The preferred outcome measure is the Oxford Instability Shoulder Score.

Conclusion: This consensus provides expert guidance for rehabilitation following ASSS.

Perceptions of Conservative Management for Medial Epicondylalgia: A Qualitative Study of Physiotherapy Best Practice

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Purpose: The purpose of this study was to explore current physiotherapy management of medial epicondylalgia in adults.

Methods: This study adopted a social constructivist approach. A virtual focus group of musculoskeletal physiotherapists was conducted, recorded, and transcribed verbatim.

Through reflexive thematic analysis, patterned meaning was identified and generated within the data to provide insight into how the physiotherapists clinically reasoned conservative management.

Results: Analysis of the focus group data identified four major themes: (1) tendon pathology understanding, (2) case complexity leading to a need for specialised management, (3) 'patient-centric': return to activity/work, and (4) influencers on evidence-based practice. These themes describe the key elements that are driving conservative management and best practice for medial epicondylalgia.

Findings suggest that contrary to patients with lateral epicondylalgia, for which there is abundant research, therapists describe management of patients with medial epicondylalgia challenging. Therefore, patients would frequently be referred onwards or directly to the hand specialty department due to a lack of evidence-based practice. It appears that in the absence of sufficient evidence, physiotherapists are instead placing a greater emphasis on patient preferences, therapists' clinical experience, and the profession's 'culture'.

Conclusion: Despite clear evidence-based practice guidelines for management of lateral epicondylalgia, management of medial epicondylalgia remains unclear. This is leading to potentially sub optimal management and referral pathways for these patients. The knowledge gained from this study may serve as a starting point to guide the future direction of and foster a consensus on physiotherapy management of adults with medial epicondylalgia.

Free Paper Session 2
Wednesday 28 June 2023
3:45 PM - 5:05 PM

Linking the distal humerus columns in articular fracture fixation

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Introduction: High rates of nonunion in articular distal humerus fractures indicate an unsolved problem. The fixation principles of O'Driscoll describe linking the fractured articular segment to the distal humerus columns with compression screws which creates a stable fixed angle construct. A novel device has been introduced which utilizes an interlocking beam through the articular segment to connect the distal aspect of the medial and lateral plates, creating a linked construct. We sought to evaluate the stability of this linked construct using an articular model of distal humerus fracture.

Methods: Ten matched pair specimens of 65 years of age or older were randomized to the use (LB group) or non-use (NLB group) of an interlocking beam to link the medial and lateral locking plates in fixation of an AO Type C3 fracture model. Outside of the beam, fixation between the matched pairs was consistent using uniform length and fixed trajectory 2.7mm locking screws. Specimens underwent anteroposterior loading.

Results: Mean stiffness was 273 Newtons/mm in the LB group and 225 Newtons/mm in the NLB group ($p=0.001$). Mean maximum displacement was 0.28 in the LB group and 0.93mm in the NLB group ($p=0.006$). Mean load to failure was not significantly different between the groups ($p=0.94$).

Discussion: Success of the distal humerus fixation construct is predicated on 2 conditions - 1) rigid fixation of the articular segment and 2) compression of the articular segments to the humeral shaft. These fixation principles have been applied to a novel fixation construct which links the medial and lateral columns via an interlocking beam. Our results indicate that the construct with an interlocking beam provides greater stability compared to a similar construct without an interlocking beam. We attribute this finding to the beam's double supported design which resists cantilever bending and provides robust compression of the fractured fragments.

Lifting Limitations Following Elbow Arthroplasty: A Survey of British Elbow and Shoulder Society Members

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Introduction: Lifelong lifting limitations are often advised for patients following total elbow arthroplasty (TEA) in an effort to prevent loosening and maximise implant longevity. There is currently no consensus amongst surgeons on the optimal postoperative weight restriction, and this has been highlighted as a research priority by the James Lind Alliance.
The primary aim of this survey was to capture current practice with regard to lifting limitations following elbow arthroplasty, as a first step towards defining optimum rehabilitation strategies.

Methods: An online survey was emailed to all 683 members of the British Elbow and Shoulder Society. Members were asked whether their department had a protocol for post-operative rehabilitation and whether physiotherapists were routinely involved in patient care following elbow arthroplasty. All consultant respondents who reported performing elbow arthroplasty were asked about post-operative physical restrictions.

Results: 115 surveys were completed by 75 consultants, 33 allied health professional and seven registrars/fellows. 55 consultants reported performing linked TEA, 18 reported performing unlinked TEA and 44 reported performing distal humeral hemiarthroplasty. The majority of elbow consultants advise

a lifelong lifting limitation following linked and unlinked TEA (78% and 61% respectively). There was variation in the weight specified for lifelong lifting limitations, the median weight restriction in linked TEA was 5lb (range 1-20lb), and in unlinked TEA was 10lb (range 1-20lb). 13% of consultants performing linked TEA and 33% of consultants performing unlinked TEA do not advise any lifelong lifting limitations post-operatively.

Conclusion: In a perceived attempt to prolong implant longevity most surgeons recommend lifelong lifting limitations following TEA. There is variation in the weight restriction advised by consultant elbow surgeons. Currently the optimal weight restriction to maximise implant longevity is not known and further work needs to be done to understand the true relationship between activity, loading and implant failure.

Similarities and differences in clinical and radiological outcomes of total elbow arthroplasty and elbow hemiarthroplasty done for comminuted distal humerus fractures

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Statement of purpose: The primary aim of the study is to compare early to mid-term clinical and radiologcial outcomes of patients undergoing total elbow arthroplasty (TEA) and hemiarthroplasty for distal humerus fractures.

Methods and Results: Retrospective analysis of data of patients undergoing hemiarthroplasty or TEA for comminuted distal humerus fractures (OTA- C3 Comminuted total articular fractures) was done. This is a single centre consecutive series and the decision to perform either procedure was taken by the operating surgeon. Patients with a minimum follow-up of 12 months were included. Arthroplasty for neglected trauma, failed non-operative management and failed fixations was excluded.

A total of 25 patients (13 TEAs and 12 hemiarthroplasties) were operated in the period between 2015-2021. One patient was excluded due loss of follow-up. The mean age of the patients undergoing TEA was 81.3 years against 68.4 years for hemiarthroplasty ($p<0.05$). The mean follow-up was 36.2 months and 35.4 months respectively. The mean arc of flexion-extension was 13-111 degrees and 22-124.5 degrees in the TEA and hemiarthroplasty group respectively ($p>0.05$). The mean range of supination was 84 and 74 degrees ($p>0.05$) while pronation was 84 and 86 degrees($p>0.05$) in the TEA and hemiarthroplasty groups respectively. QuickDASH score was 7.8 and 8.9($p>0.05$) in the TEA and Hemiarthroplasty groups. There were no cases of infection, dislocations, intra-operative fractures or revision surgery

Radiological evidence of heterotrophic ossification was seen in 5 patients with TEA and 7 patients with hemiarthroplasty. Osteolysis was seen around the ulnar component in 3 patients with TEA without any migration while none of the patients with hemiarthroplasty showed signs of loosening.

Conclusions: Total elbow arthroplasty and hemiarthroplasty provide predictably comparative clinical outcomes when performed for trauma. Osteolysis around the ulnar component appears to be an issue that could lead to loosening in the long-term for TEA.

Discovery total elbow replacement polyethylene bearing exchange: outcomes and experience

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Purpose: Discovery total elbow replacement (TER) utilises a polyethylene bearing within the ulnar component. Polyethylene bearing exchange may be indicated in bearing wear with well-fixed stems or infection, thereby avoiding ulnar component revision. The bearing requires preoperative freezing and

implantation within two-minutes of freezer removal to allow insertion into the ulnar component. We report outcomes and experience in this technique.

Method: Prospective analysis of a two-surgeon consecutive series of Discovery TER bearing exchange. Inclusion criteria includes patients in which exchange was attempted with minimum 1-year follow-up. Outcome measures include range of movement, Oxford Elbow Score (OES), Mayo Elbow Performance Score (MEPS) and complications.

Results: 11 TER in 10 patients fulfilled inclusion criteria. Indications were bearing wear encountered during humeral component revision (n=5), bearing failure (n=4) and acute deep infection treated with DAIR (n=2). Mean time from primary TER to bearing exchange was 5 years, 9 years and 1 month respectively.

Bearing exchange was performed first attempt in 10 cases. 1 case required a second attempt due to a delay in bearing transfer from freezer to surgeon. No ulnar ring damage was encountered that may have precluded exchange. 1 patient developed infection postoperatively managed with 2-stage revision.

Mean follow-up of bearing exchange TER is 3 years (range 1-7). 1 patient died 3 years following exchange. No patients required further surgery with no infection recurrence in DAIR cases.

Mean elbow flexion-extension and pronosupination arcs were 107^0 and 140^0 respectively. Mean OES was 24/48 and MEPS 83/100.

Conclusion: This is the first series reporting outcomes and experience in Discovery TER bearing exchange. Our results support this technique in bearing wear with well-fixed stems or acute infection. Our experience suggests requirements include a suitable freezer location, two ulnar bearing kits and the capability to perform an ulnar component revision were the ulnar ring damaged.

Elbow dislocations- what are we doing? – A Trainee Led Nationwide Collaborative Epidemiological Study

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Aims: The elbow represents the second most commonly dislocated joint in adults. Management is often guided by the degree of stability. At present, optimal management of elbow dislocations is debateable and it is unknown what the practice is nationally. The primary aim of this study was to determine the current epidemiological trends in traumatic elbow dislocations(TED) and their management within the UK.

Methods: A multicentre retrospective cohort collaborative study was conducted. All patients over the age of 18 with a TED in 2019 were included. Demographic variables were recorded: age; sex; side of injury; mechanism of injury; Wrightington classification grading; operative technique used; complications; and subsequent procedures. Baseline characteristics were described for demographic variables. Categorical variables were expressed as frequencies and percentages.

Results: 97 patients were identified across 6 trusts. 52% female and 53% left sided. The mean age was 47 years old. 47(48%) were simple dislocations(SD), while 49(51%) were complex(CD). Posterior dislocations were the most frequent(47%) SD. CD classification yielded 9 type A, 10 type B, 7 type B+, 14 type C, 1 type D and 4 type D+. 99% required manual reduction and overall, 59(61%) of patients received conservative management while 38(39%) received surgical management. Conservative management involved immobilisation(64%) in either a plaster or brace, while the remainder were treated purely with a sling. Of the patients who received surgical management: 13- ORIF, 7- soft tissue reconstruction and 13- combination of both. The complication rate was 14% which included ongoing pain, stiffness, re-dislocation, metalwork problems and ulnar nerve injury.

Conclusions: We provide the first epidemiological review of TED management in the UK, with similar distributions of complex vs simple dislocations. Our data suggests marked heterogeneity and no clear consensus on the management of these patients. A pragmatic RCT would be useful to determine the optimal management.

Hemiarthroplasty Or Total elbow arthroplasty for unreconstructible distal humeral fractures in the elderly (HoT Elbow): a feasibility study

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Objective: This BESS funded feasibility trial aims to assess the practicality of, and obtain preliminary data to inform, a definitive randomised control trial (RCT) of total elbow arthroplasty (TEA) versus distal humeral hemiarthroplasty (DHH) in patients over the age of 65 with un-reconstructible distal humeral fractures (DHF).

Methods: Eligible patients presenting to our orthopaedic department with acute unreconstructible DHF were approached for consent to be randomised to receive TEA or DHH. Recruitment took place over an 18 month period from December 2020 until July 2022. Pre-intervention data on patient demographics and pre-injury Oxford elbow score (OES), Disability of the Arm, Shoulder and Hand (DASH) score and an EQ-5D-5L were collected. Data on complications, OES, DASH and EQ-5D-5L were collected at six weeks, three months and twelve months postoperatively. Range of motion assessment and standard radiographs were undertaken at 12 months.

Results: 16 patients met the inclusion criteria during the recruitment period and 14 (88%) consented to be randomised (recruitment rate: 0.8/month). One patient withdrew from the study leaving 13 patients, 12 female and one male, for analysis (recruitment retention: 93%). Seven patients with a mean age of 74+/-5.7 were randomised to TEA and six patients with a mean age of 75+/-6 to DHH. 92% of patients were available for 6 week follow-up and 100% of patients were available for 3 month follow-up. A 10 point difference in favour of DHH in DASH (44.5+/-9.9 vs 54.2+/-11) and OES (31.6+/-7.7 vs 21.3+/-7.7) was seen at 6 week follow-up, while no difference in PROMs was seen at three or twelve month follow-up.

Conclusion: This study has demonstrated feasibility of undertaking an RCT of TEA versus DHH in patients over the age of 65 with unreconstructable distal humeral fractures, and preliminary data suggests ongoing equipoise and requirement for a large multi-centre RCT.

Coronoid Coverage Height and Coronoid Height Index are Effective at Quantifying Anteromedial and Apical Bone Loss In Coronoid Fractures of The Elbow

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Purpose: To determine the efficacy of a novel technique for measuring apical and anteromedial facet coronoid bone loss that is independent of proximal ulna morphology.

Methods: Two observers conducted measurements on 108 elbow CT scans with an intact coronoid. Multiplanar reconstruction was used to ensure measurements were consistently performed in the same orientation.
A best-fit circle was placed in the greater sigmoid notch and Coronoid Coverage Height (CCH) and Coronoid Coverage Index (CCI) were measured on sagittal slices at the apex and anteromedial facet.
Measurements were repeated on 55 CT scans with a coronoid fracture to assess the sensitivity of the CCH and CCI at quantifying bone loss across a range of fracture subtypes.

Results: There was no significant difference in the CCH or CHI between male and female subjects. Inter-observer reliability was good or excellent for all parameters.
Coronoid Coverage Height
Mean apical and anteromedial CCH in intact coronoids was 11.4mm +/- 1.3mm and 11.6mm +/- 1.3mm. Mean CCH was significantly lower in fractured coronoids at both apical and anteromedial positions (9.7mm +/- 1.4mm, and 9.8mm +/- 1.6mm, p=<0.001)
Coronoid Height Index
Mean apical and anteromedial CHI in intact coronoids was 56.7% ± 4.9% and 41.1% ± 3.6%. Mean CHI was significantly lower in fractured coronoids at both apical and anteromedial positions (45.8% ± 6.5%, and 33.9% ± 6.5%, p=<0.001).
In fractured coronoids, the CCH (p=0.04) and CCI (p=0.005) measured at the anteromedial positions were sensitive at quantifying bone loss in different regions of the coronoid.

Conclusion: The CCH and CHI are reproducible measurements of coronoid bone loss. This is the first such study to use CT to perform measurements in different regions of the coronoid in both intact and fractured coronoids. The technique is recommended to aid decision-making in the wider context of an osseo-ligamentous elbow instability.

Minimal Access Olecranon Osteotomy – A New and Validated Technique

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A Statement of Purpose

We report the results of an anatomical study conducted to develop a new technique for olecranon osteotomy, with an aim to accurately identify the location of the ulnar bare area (UBA), with minimal soft tissue disruption, to assist in the management of intra-articular distal humeral fractures.

Summary of Methods and Results: Twenty-four elbows in 12 formaldehyde embalmed cadavers were utilized. The elbows were prepared via a posterior approach and, after placement of two mini-Hohmann retractors, the medial and the lateral points where the retractors touch the articular surface were marked. The retractors were then removed, the capsule excised, and the elbow disarticulated. The medial and lateral points where the mini-Hohmann retractors touched the olecranon were connected using a straight line along the articular surface. The point where this line crosses the midline of the olecranon articular surface was found to be the "crown" of the UBA (C). The distal extent of the UBA was also marked (D). A statistical analysis was performed of these markers in relation to surrounding anatomical landmarks. From the statistical analysis of the data collected, we could determine that an osteotomy made 4mm distal to the "crown" would reliably exit within the ulnar bare area; identifiable on the dorsal ulnar surface by placement of the mini-Hohmann retractors, when utilising a posterior approach to the elbow (f:CD=4.8$\pm$0.4 mm and m:CD=5.4$\pm$0.8 mm).

A Statement of Conclusion: This study has confirmed that a minimally invasive technique, using readily available mini-Hohmann retractors, reliably and accurately identifies the UBA whilst avoiding extensive stripping of the triceps insertion, disruption of the blood supply, or wide dissection of elbow joint. In addition to assisting with union rates post-operatively, it helps to identify the ulnar bare area reproducibly for the safe performance of a cartilage-sparing olecranon osteotomy.

Outcome Validation of the CURL Classification Following Surgery for Proximal Ulna Fracture Dislocation of the Elbow

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Purpose: The Coronoid, proximal Ulna, Radius and Ligaments (CURL) system is a framework designed to focus attention on the key injury components of a proximal ulna fracture dislocation that influence outcome and has been demonstrated to have high inter and intra-observer reliability. The aim of this study was to analyse the CURL classification's prognostic value with respect to patient outcome.

Methods: 182 surgically treated patients with an unstable proximal ulna fracture dislocation were identified for inclusion. Minimum follow up was 12 months. Eligible patients were assigned a CURL score after review of imaging and operative notes. Patient reported outcome measures collected were Oxford Elbow Score (OES) and Visual Analogue Score (VAS). Complications and re-operations were recorded for all patients. Statistical analysis was performed to understand the effect of overall CURL score and the individual components of the CURL score on patient reported outcome and complication rates.

Results: 69/182 (37.7%) patients had at least one major or minor complication. A higher overall CURL score correlated with increased major and minor complication rate ($r=0.85$, $p<0.03$) and the presence of a coronoid ($r=0.26$, $p<0.01$), radial head ($r=0.36$, $p<0.01$) or ligament ($r=0.38$, $p<0.01$) injury was independently associated with a higher rate of complications.
The median OES and VAS were 43 (range: 2-48) and 1 (range: 0-10) respectively. A higher overall CURL score was correlated with inferior OES ($r=-0.89$, $p=0.01$) and the presence of a coronoid ($r=-0.43$, $p<0.01$), radial head ($r=-0.38$, $p<0.01$) or ligament injury ($r=-0.42$, $p<0.01$) was independently associated with inferior OES.

Conclusion: In this series, surgically treated proximal ulna fracture dislocations had good patient reported outcomes despite a relatively high complication rate. The CURL classification system was demonstrated to be of prognostic value and is recommended as a framework for planning and executing surgical treatment of these complex injuries.

Total elbow replacement versus hemiarthroplasty in the treatment of distal humerus fractures: a comparative study of functional outcomes

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Purpose: To compare the functional outcomes and re-operation rates of total elbow replacement (TER) and hemiarthroplasty (HA) in the management of distal humerus fractures.

Methods: We retrospectively reviewed 17 patients (16 female and 1 male) with a distal humerus fracture who had been treated with either TER (11 patients) or HA (6 patients) between 2016 and 2022. The mean patient age was 73 years and mean follow-up was 28 months. Patient-reported outcome measures (PROMS) were used to assess functional outcomes and quality of life, namely: (1) Mayo Elbow Performance Score (MEPS), (2) Oxford Elbow Score (OES), (3) Quick-DASH (Q-DASH), (4) SF-12 Physical Component Score (PCS), and (5) EQ-5D. Complications requiring re-operation were recorded for all patients.

Results: Better functional outcomes, physical health status and quality of life were reported following HA compared to TER. The mean differences were clinically important with all PROMS but only met statistical significance with the MEPS and OES (MEPS: HA 90.8 ± 6.1 vs TER 71.4 ± 19.9, $p=0.0363$; OES: HA 41.8 ± 7.1 vs TER 32.8 ± 8.7, $p=0.047$; Q-DASH: HA 23.9 ± 14.3 vs TER 42.1 ± 21.4, $p=0.083$; SF-12 PCS: HA 48.3 ± 10.9 vs TER 37.1 ± 10.7, $p=0.058$; EQ-5D: HA 75 ± 13.8 vs TER 64.5 ± 15.2, $p=0.18$). In the HA group 2 patients required re-operation for heterotopic ossification. In the TER group, 1 patient

required re-operation on 3 occasions for periprosthetic ulna fracture treated with plate fixation complicated by subsequent infection necessitating staged plate removal and revision of the ulna component.

Conclusion: In the treatment of complex intra-articular distal humerus fractures in the elderly, HA provides better functional outcomes compared to TER. This data is limited by low patient numbers given the rarity of this injury. A multicentre randomised controlled trial is warranted to definitively establish best practice.

Free Paper Session 3
Thursday 29 June 2023
8:00 AM - 9:15 AM

The association between surgeon volume and patient outcomes after elective shoulder replacement surgery

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Purpose: To improve patient outcomes and inform future resource planning for joint replacement surgery by investigating the effect of surgeon volume on patient outcomes following shoulder replacement surgery.

Methods: All shoulder replacements carried out at public and private hospitals in the United Kingdom from 2012 to 2021 were identified using data from the National Joint Registry linked to NHS Hospital Episode Statistics data. Multilevel survival and logistic mixed-effects models were developed to investigate the effect of surgeon volume on patient outcomes including revision surgery, reoperations, serious adverse events and prolonged hospital stay. Selection criteria included consenting patients aged 18 years or more having an elective shoulder replacement for indications other than acute trauma or malignancy.

Results: A total of 39,281 shoulder replacement procedures undertaken by 638 consultant surgeons at 416 surgical units met the selection criteria and were available for analysis. Centring restricted cubic splines of the volume variable at the local minimum inflection point identified a minimum volume threshold of 10.4 procedures per year, below which there was a significantly increased risk of revision surgery which was up to double that of the lowest risk operators (HR 1.94, 95% CI 1.27 to 2.97). A greater mean annual surgical volume was also associated with a significantly lower risk of reoperations, fewer serious adverse events and shorter hospital stay with no thresholds identified. Annual deviations in a surgeon volume did not affect patient outcomes.

Conclusions: In the healthcare system represented by this registry data, surgeons averaging more than 10.4 shoulder replacements per year obtained lower rates of revision surgery and re-operation, lower risk of serious adverse events, and shorter hospital stays. This study will inform resource planning for surgical services and joint replacement surgery waiting lists while further improving patient outcomes after shoulder replacement surgery.

Utilisation of a quantitative load-balancing sensor in reverse total shoulder arthroplasty – 1-year outcomes

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Purpose: To investigate the association between intraoperative surgeon subjective assessment of joint tension and objective measurement by a quantitative load-balancing sensor in reverse total shoulder arthroplasty (rTSA); and report 1-year outcomes.

Method: Prospective analysis of a single-surgeon series of primary rTSA. A wireless load-sensing humeral liner trial (VERASENSE for Equinoxe, OrthoSensor) was implanted and the joint reduced. Surgeon structured subjective assessment of reduction tension was performed including: tension on reduction; gapping from impingement; shuck test. The maximum sensor measured load in pound-force (lbf) was recorded with: internal and external rotation at 0^0, 45^0 and 90^0 abduction; maximal flexion and extension; cross arm adduction and hand overhead.

Routine follow-up occurred at 6 and 12 weeks and 1-year postoperatively. Outcome measures included objective ROM, visual analogue scale (VAS) and Oxford Shoulder Score (OSS). Radiographs were performed at 6-weeks and 1-year.

Results: 10 patients had 1 year follow up after rTSA with the sensor trial implant. Subjective assessments of reduction tension revealed 5 'normal' and 5 'tight'. The load sensor detected higher maximum loads in 'tight' reductions in all measured internal and external rotation positions but not overhead or flexion/extension. No significant differences were seen in VAS, OSS and measured shoulder rotation/abduction. However, significantly greater flexion was measured in 'tight' versus 'normal' shoulders at 1-year (150^0 vs 128^0, $p<0.02$). No complications (including scapular stress fractures or dislocations) occurred.

Conclusion: This is the first series reporting clinical outcomes following use of a quantitative load-balancing sensor in rTSA. An association is evident between surgeon subjective assessment of reduction tension and objective measurement utilising a load-balancing sensor. Our results validate a structured surgeon assessment of tension intraoperatively. They also reveal superior flexion at 1-year in rTSA with a tight trial reduction and higher maximum objective loads during rotation. Long-term follow-up is required.

Stemless Metaphyseal Reverse shoulder arthroplasty - Long Term clinical and radiologic outcome in prospective 10 to 17 years follow-up study

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The aim of this study is to evaluate long-term clinical and radiologic outcomes (10 to 17 years follow-up) using a stemless metaphyseal reverse total shoulder arthroplasty (rTSA).

Between 2005 - 2012, 207 consecutive patients underwent rTSA with stemless metaphyseal rTSA (51M/156F). 121 cuff arthropathy, 19 fracture sequelae, 26 rheumatoid arthritis, 16 massive rotator cuff tear & failed repair, 7 anatomic prosthesis with cuff deficiency, 7 osteoarthritis and 11 acute trauma. 49 of these were revision TSA. 95 patients died before 10y from surgery but were pleased with their shoulder at their last FU, 9 patients were lost to FU. 103 patients were available for long term FU of more than 10 years (10 -17 years; 120 - 193 months).

Mean age at surgery was 74.8 years (range, 38-93 years). Subjective Shoulder Value (SSV) improved from 14/100 to 89/100. Mean Constant score (CS) improved from 17.5 to 66 points, age/sex adjusted CS improved to 107 ($P < .0001$). Range of motion improved from 58° to 145° elevation, 22° to 38° external rotation, and 32° to 83° internal rotation. 98/103 patients felt much better or better since the operation, 4 same and 1 worse. Radiographic analysis showed no lucencies, subsidence, or stress shielding. Glenoid notching was found in 21% of the patients (mainly grade 1-2). 18 cases had to be re-operated: 3 for dislocation, 4 plating of scapular spine fracture, 7 revised due to traumatic periprosthetic fracture (3 humeral, 3 glenoid and one both) and 2 revised for infection.

The stemless metaphyseal rTSA design shows good long-term results in 10 to 17 years FU. The design of this implant seems to result in improved rotational movements, low incidence of glenoid notching and no implant loosening, subsidence, or stress shielding. The good outcome was maintained throughout the long-term follow-up with no deterioration.

Does long-term follow-up and monitoring of primary shoulder arthroplasty identify failing implants requiring revision?

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Purpose: Published scoping review has identified evidence paucity related to long-term follow-up of shoulder arthroplasty (SA). We aim to report effectiveness of elective primary SA surveillance in identifying failing implants requiring revision.

Method: Analysis of a prospective database recording SA and subsequent follow-up surveillance in a shoulder unit. SA were performed by 4 fellowship-trained shoulder surgeons for accepted elective indications (glenohumeral arthrosis with reverse prosthesis in cuff deficiency) utilising ODEP 10A reverse total (rTSA), 7A anatomic total (aTSA) and 7A hemiarthroplasty (HA) prostheses. Included SA were performed 01/05/2004-31/12/2021 with minimum 1-year follow-up.

Surveillance programme involves specialist physiotherapist review at 1, 2, 3, 5, 8, 10, and 15-years postoperatively including clinical examination, outcome scoring and radiographs. Patient-initiated review occurred between timepoints if a patient requested assessment due to symptoms.

Outcome measures include ratio of failing implants identified by surveillance and patient-initiated review, with number of surveillance reviews offered and proportion that identified a failing implant requiring revision calculated.

Results: 1002 elective primary SA with minimum 1-year follow-up were performed (547 rTSA, 234 aTSA, 221 HA). 238 patients died prior to 31/12/2022 resulting in 4019 surveillance appointments offered.

38 prostheses required revision $\geq$ 1-year postoperatively (6 rTSA, 9 aTSA, 23 HA) with surveillance identifying requirement in 53% (33% rTSA, 56% aTSA, 57% HA) and patient-initiated review in 47%. Mean years from implantation to revision was 5.2 (2.7 rTSA, 3.6 aTSA, 6.6 HA). Revision indications included rotator cuff failure (56% aTSR, 43% HA) and glenoid erosion (57% HA).

Conclusion: This is the first series reporting effectiveness of SA surveillance in identifying implants requiring revision. Surveillance identified over half of implants requiring revision though only ~1% of appointments identified revision requirement. A cost-effectiveness analysis is planned. Surveillance enrolment may influence patient-initiated review utilisation therefore similar studies utilising only patient-initiated follow-up would help inform recommendations.

Adverse outcomes following total shoulder arthroplasty and hemiarthroplasty: A cohort study using data from the National Joint Registry

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Statement of purpose

Compare the risk of adverse outcomes following hemiarthroplasty and total shoulder arthroplasty (TSA) in patients with osteoarthritis.

Method: Data from the National Joint Registry of England Wales and Northern Ireland were linked to Hospital Episode Statistics. Anatomical shoulder arthroplasties performed for osteoarthritis in patients with an intact rotator cuff between April 2012 and July 2021 were included. Propensity score matching was used to reduce the risk of selection bias in this observational study. A cohort of 11,156 TSAs and hemiarthroplasties were matched on multiple variables related to the patient, surgeon and procedure. The risk of revision, reoperation, complications within 30-days, 1-year mortality and length of stay were compared. Sensitivity analyses were performed to ensure the conclusions were robust to model assumptions.

Results: At eight years 94.6% (95% CI; 93.5 – 95.5) of TSAs and 90.5% (95% CI; 89.3 – 91.6) of hemiarthroplasties remained unrevised (HR 1.9, 95% CI 1.6 – 2.3). Rotator cuff insufficiency was the most common reason for revision in both groups. Non-revision reoperations were performed in 2.4% (2.0 – 2.8) of TSAs and 5.3% (6.1 – 4.6) of hemiarthroplasties at 8 years (HR 2.3, 1.9 – 2.9). The incidence of acute kidney injury was higher following TSA (1.1% vs 0.6%, p=0.007). The mean length of stay was 2.3 days in both groups. There was no difference in 1-year mortality (HR 1.2, 95% CI 0.7-1.9). On subgroup analysis of patients 60 years and younger the risk of revision was higher following hemiarthroplasty (HR 2.1, 95% CI 1.5 – 2.9).

Conclusion: In patients with osteoarthritis and an intact rotator cuff the risk of revision and non-revision reoperation was greater following a hemiarthroplasty compared to a total shoulder arthroplasty at 8 years. This finding was replicated on subgroup analysis in patients 60 years and younger.

Outcomes of Reverse Total Shoulder Arthroplasty in Young Patients (≤ 65 years): Age, Gender, and Follow-up Matched Cohort Study

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Study purpose: To assess clinical outcomes, complication rates, and revision rates of primary rTSA in patients 65 years or younger and compare with a matched control of patients who had an anatomic total shoulder arthroplasty (aTSA)

Methods: Patients </=65 years of age who underwent primary rTSA and aTSA with the Equinoxe shoulder system with a minimum 2-year follow-up were identified from an international shoulder registry and divided into age, gender, and follow-up matched groups. There were 541 patients in each cohort (293 female and 248 male), a mean age of 60 years at the time of surgery, and a mean follow-up of 48 months. Numerous outcome measures were compared using a 2 tailed paired T-Test, including active shoulder range of motion, complications, revision surgery rates, and patient reported outcome scores (PROMs)

Results: rTSA patients were generally worse prior to surgery in terms of ROM and PROMs. Although not statistically significant, the revision rate was higher in the aTSA group (5.9% compared to 3.5% in rTSA; p=0.062). No significant difference was noted in PROMs in four out of six scores measured. Gender sub-analysis demonstrated that females </=65 years had a significantly higher (p=0.0066) revision rate with aTSA (7.2%) than rTSA (2.4%). Males and combined cohorts did not show any difference in revision or complication rates.

Conclusions: This study demonstrates excellent results following rTSA with a medial glenoid/ lateral humeral implant design in young patients < 65 years of age with greater improvement in ROM and lesser risk of revision in females.

The effect of Glenosphere diameter in patients of short, average and tall height undergoing Lateralized Humeral Prosthesis Reverse Total Shoulder Arthroplasty

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Study Purpose: To evaluate the hypothesis that, for reverse total shoulder arthroplasty (rTSA), higher range of motion and patient reported outcome scores (PROMS) are achieved if patients are matched with smaller or larger diameter glenospheres based on their height.

Methods: An international database of a single shoulder prosthesis was analysed and primary rTSA patients were classified as short (<158cm), average (158-173cm), or tall (>173cm). Patients with revisions, fractures, rheumatoid arthritis, or previous infections were excluded. Constant shoulder scores and

range of movement was analysed and stratified by two glenosphere diameter cohorts. These are referred to as "small": 38mm or less and "large": 40mm or more.

Results: 3,318 (787 short, 1,614 average, 917 tall) primary rTSA patients were analysed pre-operatively and at longest clinical follow up.
Short patients with small glenospheres had significantly more forward elevation (139.9 vs 132.6,p=0.0477) than short patients with large glenospheres at latest follow up. There was no significant change in Constant score.
Average height patients with small glenospheres had significantly more internal rotation (4.5 vs 3.9,p=0.0001) and external rotation (39.6 vs 37.1,p=0.0172) at latest follow up. They also had significantly more overall improvement in internal rotation (1.3 vs. 10,p=0.0118). However, they showed significantly less improvement in their Constant score (31.7 vs. 35.3,p=0.0092).
Tall patients with small glenospheres had significantly more internal rotation (4.6 vs. 3.9,p<0.0001) and external rotation (43.0 vs. 38.9,p=0.0061) at latest follow up. They also had significant improvements in external rotation (21.2 vs 16.4,p=0.0161) but significantly lower constant scores (68.7 vs. 72.2,p=0.0370).

Conclusion: Rather than the anticipated benefits of matching short patients with small glenospheres and tall patients with large glenosopheres, across the height cohorts, smaller glenospheres were associated with significantly higher internal and external rotation scores. However, smaller glenospheres in the average and tall patient cohorts were associated with lower Constant scores.

Shoulder arthroplasty is a viable option in the management of native shoulder joint infections – a systematic review

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Purpose: The purpose of this review was to systematically review and analyse the outcome of shoulder arthroplasty in patients with native shoulder infections.

Methods: A systematic review of the literature was conducted in accordance with the PRISMA guidelines using the Pubmed and the Cochrane database. The review was registered on the PROSPERO database prospectively. Studies reporting on adults with either primary or secondary infections of their native shoulder joints treated with a spacer, hemiarthroplasty (HA), total shoulder arthroplasty (TSA) or reverse shoulder arthroplasty (RSA) were included. Clinical studies were appraised using the MINORS tool.

Results: 14 studies were deemed eligible for inclusion (n=136). Mean age of patients ranged from 56 to 72 years and the mean follow up from 20.5 months to 8.2 years. Primary shoulder infections were present in 50 patients and secondary infections in 86: previous rotator cuff repair (n=49), previous fracture fixation (n=27) and other arthroscopy surgery (n=10). The commonest causative micro-organisms were Methicillin sensitive staphylococcus aureus 12-91%, coagulase negative staphylococcus 7-38%, Cutibacterium acnes 9-40% and Staphylococcus epidermidis 18-57%. 76 patients underwent a 2 stage, 46 patients a single stage procedure whilst 14 refused second stage surgery. Mean post-operative Constant score ranged from 38 to 56.2 and mean ASES scores from 57.6 to 78.4. The overall reported re-infection rate was 2.3% and complication rate was 26% with loosening, instability and fractures the most frequent complications encountered.

Conclusion: Shoulder arthroplasty appears to be a viable option in the management of patients with either primary or secondary native shoulder infections with re-infection rates low at short term follow up. However, longer term studies are required to ensure these re-infection rates remain low and functional outcomes are maintained.

Cementless reverse total shoulder replacement for acute proximal humerus fractures: Results of 2-8 years Follow up

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[1]Reading Shoulder Unit,[2]East Kent Hospitals University NHS Ft, [3]Orthopaedic Department, Barzilai Medical Centre, Ashkelon, Israel

The purpose of this study was to prospectively evaluate the clinical and radiographic outcomes of a cementless rTSA in acute proximal humerus fractures.

Materials and methods: Between 2007 to 2019, 50 patients underwent a cementless rTSA for acute proximal humerus fractures. All operations performed within 4 weeks from fracture with mean time to surgery of 2 weeks.
Procedures were performed using the Neviaser - MacKenzie approach with a cementless rTSA, designed for fractures, incorporating bone graft impaction technique. Mean age 80.2 years (range 40-94). Thirty-five patients were available for long follow-up. Fifteen patients could not be evaluated: 8 died along the years (delighted with the shoulder in their last follow up) and 7 lost to follow up. Mean follow-up 44.4 months (range 24-106 months).

Results: The patients showed good outcome with 31/35 patients very satisfied with the results at the last follow-up. The mean Constant Score was 59.5 points (Age/Sex adjusted, 91.0) at the last follow up. Mean forward elevation was 125.4, abduction 120°, active internal rotation 70.2° and active external rotation 27.7°. Tuberosity healing was achieved in 82.9% of the cases (n=29). There were no complications in the study group. Radiographically, good fixation of the implants was observed with no signs of lucencies, loosening or implant subsidence.

Conclusion: Cementless rTSA for acute proximal humerus fractures demonstrates excellent clinical and radiographic results with high patient satisfaction. The use of a cementless rTSA with suitable stem design and incorporation bone graft impaction technique, provides good immediate and long-term implant fixation. The specific implant design with only proximal HA-Porous coating and a smooth distal stem, support metaphyseal fixation and reduce the risk of stress shielding. Use of cementless rTSA for acute proximal humerus fractures seems promising in the medium to long term (2-8y).

Free Paper Session 4
Thursday 29 June 2023
2:00 PM - 3:20 PM

Conservative Treatment of 3- and 4-Part Proximal Humeral Fractures: Can Poor Outcomes Be Predicted?

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Statement of Purpose: This study aims to assess radiographic and PROMS data to identify factors leading to poor outcomes following non-operative treatment.

Methods & Results: Retrospective local database analysis identified patients sustaining 3 or 4-part proximal humeral fractures. Radiographic and functional outcome measures were collected including Oxford Shoulder Score (OSS), Subjective Shoulder Score (SSV) and VAS pain scores.

We included 104 patients (84F:20M) at mean follow-up of 55 months, with a mean age of 69 at time of injury. Analysis highlighted significant OSS differences in 3 vs 4-part fractures (p=0.027), dominant vs non-dominant side injured (p=0.046), age at injury >65 vs younger (p=0.006), varus coronal neck shaft angle <115 vs 115-155 degree (p=0.002), apex anterior sagittal neck shaft angle >155 vs 115-155 degree (p=0.024), GT displacement >5mm vs less (p=0.001), GT comminution (p=0.02) and medial hinge displacement >3mm or less (p=0.002). Each variable achieved a minimally important clinical difference (MCID) of 5 points.

VAS pain was significant in varus neck shaft angle (p=0.011), GT displacement >5mm (p=0.027), medial hinge displacement >3mm (p=0.045).

SSV varied significantly with 3 vs 4-part fractures (p=0.005), age >65 (p=0.04), varus angulation (p=0.001), apex anterior angulation (p=0.001), GT displacement >5mm (p=0.001), GT comminution (p=0.008), medial hinge displacement >3mm (p<0.001). Each variable showed a MCID of 12.

Conclusion: Patients with a 4-part fracture showed poorer functional outcome on both OSS and SVV. Injury to the dominant side showed poorer clinical outcome than to the non-dominant side. Over age 65 reported poorer clinical outcomes than younger. Varus type fractures, posterior head angulation, GT displacement >5mm, GT comminution and medical hinge >3mm displacement are further predictors of poorer clinical outcomes. These results allow for improved shared decision-making regarding treatment options and patient expectation management.

Is Reverse Total Shoulder Arthroplasty for Fracture replacing Open Reduction Internal Fixation in the elderly?

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Introduction: Proximal humerus fractures are becoming more common with an aging, increasingly fragile population. Patient age, functional status, bone quality and fracture pattern all influence decision making. When they meet operative indications, surgical options including open reduction internal fixation (ORIF), hemiarthroplasty (HA) and reverse total shoulder arthroplasty (RTSA). However, recent modifications in indications and knowledge of the complication profile may have changed implant selection trends. This study aimed to report U.S. national volume and incidence estimates and to analyse differences in volume and incidence among age groups, and gender.

Methods: Using IBM Marketscan national database, all patients that underwent ORIF, HA, or RTSA between 2010-2019 were identified using CPT codes. The dataset was further stratified to identify patients with a diagnosis code for proximal humerus fractures. Volume and incidence were adjusted per

1,000,000 persons and calculated for subgroups according to age group and sex. The U.S. Census Bureau annual population data was used for all incidence calculations.

Results: During the study period, 136,093 surgically treated proximal humerus fractures were identified. The total procedure volume and incidence increased by 29% and 20%, respectively. Total volume and incidence of RTSA increased by over 300% and increased across all age groups. Although the overall incidence of ORIF decreased, it remained the most common surgical treatment. The greatest decrease in volume and incidence of ORIF occurred in patients ≥75. Total volume and incidence of HA decreased between 2010-2019.

Discussion and conclusion: Surgical management trends of proximal humerus fractures have changed greatly over the past decade. RTSA is likely growing in popularity over ORIF due to the benefits of immediate motion, tolerance of poor bone quality and lower reoperation rate. ORIF remains the mainstay in patients with good bone quality and a viable humeral head, but hemiarthroplasty has fallen out of favour.

MR imaging in the management of significantly displaced adolescent posterior sternoclavicular joint injuries

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Background: Diagnosis and treatment of adolescent posterior sternoclavicular joint (SCJ) injuries is typically guided by CT scans. However, the medial clavicular physis is not visualised so there is no differentiation between a true SCJ dislocation and a physeal injury (PI). MRI scans allow visualisation of the bone and physis. This study presents use of MRI to guide management of significantly displaced posterior SCJ injuries in adolescents.

Methods: Patients with a significantly displaced posterior SCJ injury between 2016-2020 were included. Patients underwent MRI scans to differentiate between true SCJ dislocation and PI, and to further differentiate between a PI with or without residual medial clavicular bone contact. Patients with a true SCJ dislocation or a PI without bone contact underwent an open reduction and fixation. Patients with a PI with bone contact were treated non-operatively with repeat CT scans at 1 and 3 months. SCJ clinical function was assessed at final follow-up using Quick-DASH, Rockwood, Modified Constant and SANE scores.

Results: 13 patients (11 male and 2 female) with an average age of 14.9 years (12–17) were included. 4 patients underwent open reduction internal fixation (1 true SCJ dislocation and 3 PI without bone contact). 8 patients with a PI and residual bone contact were treated non-operatively. Serial CT scans demonstrated maintained position with callus formation and bone remodelling. Average follow-up was 42.9 months (24-62). At final follow-up, the mean Quick-DASH was 0.4, Rockwood was 15, Modified Constant was 98.8 and SANE was 99.5%.

Conclusion: In this case series of significantly displaced adolescent posterior SCJ injuries, MRI identified true SCJ dislocations and PI without residual bone contact which were successfully treated with open reduction internal fixation. Further, MRI allowed differentiation of PI with residual bone contact which were successfully treated non-operatively.

A 10 year consecutive case series of acquired thoracic outlet syndrome (TOS) following clavicular fractures

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Background: Clavicular fractures are common. Inferiorly displaced butterfly fragments, significant angulation or excessive callus formation may encroach on the costoclavicular space compressing the brachial plexus and presenting as acquired-Thoracic Outlet Syndrome.

Objective: We present a consecutive case series of acquired-TOS following clavicle fractures, updating the previous experience from our unit published in 2002.

Methods: A retrospective review of patients undergoing claviculoplasty for acquired-TOS between 2004 and 2019 at a peripheral nerve injuries unit was performed. Patient records, imaging, and PROMs, including DASH, neuropathic pain inventory score and patient satisfaction score, were assessed.

Results: Ten patients underwent claviculoplasty, with a mean time between injury and operation of 10 months (Range: 2-26 months). Mean age was 46 years (Range: 21-59 years). Preoperatively, 8 had motor weakness, 9 had sensory disturbances, and 6 reported neuropathic pain. Two patients had undergone clavicular ORIF prior to referral, one acutely, and one for delayed union. All patients had pre-operative imaging demonstrating clavicular shortening, displaced butterfly fragments or reduced costoclavicular space. In three cases, intraoperatively the brachial plexus was tethered or compressed by a bony fragment, callus or scar tissue formation. Mean follow up was 6 years. Post-operatively, 3 patients had no residual symptoms, 2 continued to have pain, 6 had sensory disturbances with 4 having ongoing weakness. Median DASH scores were 28 and median neuropathic pain scores were 21. There was 80% patient satisfaction.

Discussion: Acquired-TOS secondary to displaced clavicle fractures can cause significant morbidity and functional deficit. Claviculoplasty can decompress the costoclavicular space without disturbing shoulder stability. In conjunction with neurolysis of the brachial plexus satisfactory functional outcomes can be achieved. However, a degree of residual symptoms is recognised in the majority of patients. This study raises awareness of this uncommon complication and provides a detailed description of the operative technique of claviculoplasty.

Correlations of the ADLER Score with the Outcomes of Reverse Shoulder Arthroplasty for Trauma

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Statement of intent: To correlate and quantify patients ability to regain active elevation and external rotation using the ADLER (Activities of Daily Living [ADL] which require active External Rotation [ER]) scoring system in patients sustaining proximal humerus fractures treated with Reverse Total Shoulder Arthroplasty (RSA).

Methods: This study prospectively followed 40 consecutive elderly patients with complete clinical and radiological data and minimum 2 years follow up, who underwent RSA for complex shoulder fractures. All patients were evaluated to identify correlations between the ADLER score and all recorded outcomes included range of motion (ROM), Visual Analogue Score (VAS) for pain, Oxford Shoulder Score (OSS), Subjective Shoulder Value (SSV), QuickDash (QD), radiological union of greater tuberosity (GT) and lesser tuberosity (LT).

Results: The injury to surgery time was 3.4 weeks with a median age at surgery of 72 (62-83) years and median follow-up of 27 (24-44) months. Most patients regained the ability to perform ADLs, particularly those that require a coordination of elevation and external rotation: eating, drinking, shaving, dressing, combing hair, and holding a phone. The median ADLER score was 28 (23-30) with no improvement after

1 year. There was a significant correlation between ADLER and active elevation (Spearman's rho: p=0.011) but not with external rotation. ADLER was also correlated to OSS (Spearman's rho: p=0.011) but not with other scores.
There was no influence of GT and LT union on ADLER based on univariate analysis.

Conclusions: RSA is a reliable treatment option with good function and most patients regained adequate active elevation and active external rotation with satisfactory ADLER scores.

Artificial intelligence automated analysis of scapula dynamics using dynamic digital radiography: A validation and reliability study

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Introduction: Dynamic Digital Radiography (DDR) is a novel technique using pulsed low-dose radiographs during joint motion. In the shoulder, it allows dynamic non-invasive examination of glenohumeral and scapula kinematics with shoulder abduction and can diagnose shoulder pathology by discerning changes in the interplay between scapulothoracic and glenohumeral joint motion. Manual radiographic measurement is the current gold standard to calculate the scapulohumeral rhythm (SHR), however this process is time consuming. The purpose of this study was to assess the reliability of an artificial intelligence (AI) image analysis software by comparing it to manual measurements across various shoulder pathologies, potentially facilitating automated image analysis and diagnostics.

Methods: Using standardised acquisition protocols, dynamic digital radiography (15 frames/second) was prospectively performed on 73 shoulders (40 right sided, mean age 57.9, 47% female) including normal controls (23 shoulders) and those diagnosed with rotator cuff tears (41 shoulders) and adhesive capsulitis (9 shoulders) based on clinical examination and MRI. Manual measurements of the angle between the humerus and the midline and the medial border of the scapula and midline were taken by two trained readers at 30, 60, and 90 degrees of shoulder abduction to calculate the SHR between 30-60, 60-90 and 30-90. An algorithm using computer vision and supervised machine learning was developed and trained on 447 images. Corresponding software measurements were compared using intra-class correlations (ICC).

Results: The total number of paired measurements was 219. Excellent inter-rater reliability (ICC 0.87 (95% confidence interval 0.75 – 0.93)) was found in the manual measurements. Moderate reliability (ICC 0.58 (95% confidence interval 0.4-0.71)) was found between the manual and AI measurements of SHR.

Discussion and conclusion: The automated image analysis algorithm shows proof of concept, and early promise but requires further training before it can reliably replace manual measurement of SHR and scapular kinematic analysis.

Correlations of the ADLIR Score with the Outcomes of Reverse Shoulder Arthroplasty for Trauma

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Introduction: The importance of internal rotation in activities of daily living (ability to perform perineal care, getting dressed) has been very seldom described. Loss of internal rotation remains a challenging issue after reverse shoulder arthroplasty (RSA).

Aim: Our goal was to define the expected functional internal rotation after RSA using the Activities of Daily Living which require Internal Rotation (ADLIR) 100 points scoring system in a homogenous elderly population treated for complex shoulder fractures.

Methods: This study prospectively followed 40 consecutive elderly patients with complete clinical and radiological data and minimum 2 years follow up, who underwent RSA for complex shoulder fractures. Active internal rotation was measured as the most superior vertebral segment reached by the thumb and in points as per Constant-Murley score. All patients were evaluated by independent clinicians to identify correlations between the ADLIR score and all recorded outcomes included range of motion, Visual Analogue Score (VAS) for pain, Oxford Shoulder Score (OSS), Subjective Shoulder Value (SSV), QuickDash (QD), radiological union of greater tuberosity (GT) and lesser tuberosity (LT).

Results: The injury to surgery time was 3.4 weeks with a median age at surgery of 72 (62-83) years and median follow-up of 27 (24-44) months. Most patients regained satisfactory internal rotation with median ADLIR score of 85 (39-100) with no improvement after 1 year. ADLIR was correlated to active internal rotation (Spearman's rho: p=0.04). There ADLIR was not correlated to any outcome scores. There was no influence of GT and LT union on ADLIR based on univariate analysis.

Conclusions: RSA is a reliable treatment option with good function. The ADLIR score showed reliability for post-operative evaluation of patients treated with RSA, but further studies are needed to investigate the evolution of the ADLIR score.

The treatment of acromioclavicular joint (ACJ) pain, an 11 year longitudinal study

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Purpose: This study reviews the treatment of ACJ pain due to arthritis in a single practice, exploring factors which determined whether the patient could successfully be treated by injections alone, or would require surgical intervention.

Methods: We included 154 consecutive shoulders from a single clinic over an 11 year period. The pathway involved initial consultation, radiological investigation, initial treatment with x-ray guided Kenalog injection, and further treatment as required with further injection or surgery. Post-treatment questionnaires were sent to all patients assessing current Oxford Shoulder Score (OSS) and 12 item short form survey score (SF-12) at a mean of 5 years follow-up, providing 80 responses.

Results: 73 patients had abnormal radiology before intervention, with 38 normal x-ray but abnormal MRI. 23 patients reported no ongoing pain since first injection, with no further intervention. 27 went on to have a repeat injection, with 9 reporting no symptoms on follow-up. 26 underwent Subacromial Decompression and Excision of the Distal Clavicle, of which 17 report no ongoing symptoms. The average follow-up OSS was 44 and SF-12 was 51.4 (physical) and 55.1 (mental), with 64 OSS>42. 85% of OSS at mean 5 years post-treatment indicated minimal ongoing limitations.

Conclusion: Through evaluating OSS, SF-12 and reported post-intervention symptoms, we have not been able to identify a correlation between radiologic findings, relief from injection, or progression to surgery.

Diagnosis with MRI proved important in detecting ACJ OA, with 48% having only MRI findings. Overall OSS improved at the time of follow-up from 31 to 44 demonstrating improvement following the various interventions.

Scapulohumeral rhythm changes in serratus palsy and scapular dyskinesis: A matched, controlled dynamic radiography study

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Introduction: Serratus anterior palsy and scapular dyskinesis cause abnormal scapula motion and shoulder complex kinematics, due to a reduced abduction contribution from the scapulothoracic (ST) joint and a compensatory increase from the glenohumeral (GH) joint. Scapulohumeral rhythm (SHR), defined as the ratio of the change in humeral abduction over the change in scapula upward rotation during humeral abduction, is an important parameter in assessing shoulder complex kinematics. Dynamic Digital Radiography (DDR) is a novel technique which takes a series of pulsed low radiation radiographs during active range of motion and may enable quantitative SHR analysis and assist diagnosis of scapular pathology. The purpose of this study was to compare SHR in patients with serratus anterior palsy and scapular dyskinesis to normal controls, using DDR.

Methods: Shoulders were included if they had a diagnosis of serratus anterior palsy and scapular dyskinesis based on examination and DDR. These patients were matched based and age and sex to a group of normal controls. All included patients were prospectively analysed using DDR under a standardised protocol, obtaining a series of pulsed radiographs during arm abduction. GH and ST motion were quantified based on DDR images taken in 0-30°, 30-60°, 60-90° of arm abduction, and SHR calculated. An ANOVA was performed.

Results: Forty patients were included – 11 patients with serratus anterior palsy, 8 with scapular dyskinesis, and these were matched with 21 normal controls with 1:1 matching. Patients with serratus anterior palsy had significantly higher SHR (12.6 $\pm$ 16.4) than scapular dyskinesis (3.67 $\pm$ 1.45), and normal controls (2.18 $\pm$ 0.67), $p<0.001$. The difference was most apparent in the 0-30 range of humeral abduction.

Discussion and conclusion: Our study uses dynamic radiography and offers a novel, cost-effective and rapid diagnostic method, and demonstrates consistently higher SHR values in patients with serratus anterior palsy.

Free Paper Session 5
Friday 30 June 2023
8:20 AM - 9:40 AM

Arthroscopic capsular shift surgery in atraumatic shoulder instability - a randomised double blinded controlled trial

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Purpose: To determine the effects on pain and functional impairment of arthroscopic capsular shift for people with atraumatic shoulder instability.

Methods: Patients aged 18 years and over, who reported feelings of insecurity at their shoulder and had evidence of capsulolabral damage on arthroscopic examination were included. Patients were excluded if their shoulder apprehension symptoms were precipitated by a high collision shoulder injury, they had bony or neural damage, a rotator cuff or labral tear or had previous shoulder surgery on the symptomatic shoulder. All participants underwent a diagnostic arthroscopy followed by arthroscopic capsular shift or diagnostic arthroscopy alone. All participants received the same post-operative clinical care from the surgical and physiotherapy teams.

The primary outcome was pain and functional impairment measured by the Western Ontario Shoulder Instability Index (minimum clinically important effect = a reduction in pain and disability of 10.4 points). 68 participants were recruited (mean age 25.6 years $\pm$6.4 SD; 77.0% female; mean symptom duration 7.1 years $\pm$7.3 SD). Complete primary outcome data were available for 61 participants at 6 months, 59 at 12 months and 56 at 24 months.

Results: Mean reductions in pain and disability for both trial groups were similar. Compared to diagnostic arthroscopy, arthroscopic capsular shift increased pain and functional impairment by means of 5 points (95% CI: -6 to 16 points) at 6 months, 1 point (95% CI: -11 to 13 points) at 12 months, and 2 points (95% CI: -12 to 17 points) at 24 months.

Conclusions: Arthroscopic capsular shift does not confer clinically relevant short or medium term reductions in signs and symptoms of atraumatic shoulder instability compared with diagnostic arthroscopy.

The suprascapular nerve block (sscnb) is easily administered using a landmark based technique: a cadaveric study to assess nerve staining post-injection

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The suprascapular nerve is an ideal target for nerve blockade to alleviate shoulder pain given its widespread innervation to the shoulder girdle. Many techniques have been described, some including the use of ultrasound.

To widen the availability of this treatment we investigate whether an anatomical landmark technique can be easily learned by novice injectors to provide efficacious blockade.

Five injectors were recruited with varying experience; from the novice medical student to an orthopaedic consultant. Five torsos (10 shoulders) were used. A single page of written instruction and illustration of the Dangoisse landmark technique was provided prior to injection of a Thiel embalmed cadaver bilaterally. A pre-mixed injectate with blue dye was used. Cadavers were dissected and the presence or absence of dye staining reported by 3 observers and a consensus agreement reached.

Dissection demonstrated diffuse staining in the suprascapular fossa. 90% of shoulders were found to have adequate staining of the suprascapular nerve directly, or its distal branches, in a manner which would provide adequate anaesthesia. The inter-observer agreement was good (k = 0.73) for staining at the supraspinous fossa and excellent (k=0.87) for staining distally. The technique was easily performed by novice injectors with a 100% success rate.

We demonstrate that this technique is reproducible by a range of clinicians to effectively provide anaesthesia of the SScN. The main risks are ineffective block (10% in this series) and of intravascular injection. In our clinical practice the procedure is well tolerated by patients. Within a resource strained healthcare environment greater uptake of this technique is likely to be of benefit to a wider array of patients.

The scapula spine is not a reliable source of bone graft for glenoid reconstruction in critical bone loss

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Introduction: Restoration of anterior glenoid bone is fundamental to correcting anterior glenohumeral instability associated with "critical" bone loss (>15%). The coracoid is most commonly used in the Latarjet procedure but despite literature showing favourable outcomes, the complication rate is significant. Iliac crest autograft has equivalent outcomes but can be unacceptable. The scapular spine has been proposed as an alternative but there is little current literature regarding its anatomy or efficacy.

It has been suggested that a 2 x 0.8 x 0.8cm graft could reliably be harvested 49.6mm from the medial border of the scapula spine and the only clinical paper showed no failures at a minimum follow-up of 25 months.

This study aims to determine the possibility of reliably harvesting either a 2x1x1cm or a 2x0.8x0.8cm graft from the scapula spine.

Methods: The dimensions of the scapular spine were measured in 50 preoperative CT scans of patients with surgically treated instability. Measurements were made at 10mm intervals starting 10mm medial to the spinoscapular notch.

The maximal height and width was measured for the 2x1x1cm and the 2x0.8x0.8cm graft options.

Results: Only 36% of the samples had at least one location in which a 2x1x1cm graft could be obtained. This rose to 72% with the smaller graft.

At the 49.6mm landmark described previously a 2x1x1cm graft could be harvested in only 14% of the samples and this rose to only 34% with the smaller graft size.

Conclusion: The scapula spine can be used as a source of autograft for reconstruction of glenoid bone loss. Grafts up to 2x1x1cm can be harvested in a limited number of individuals however the anatomy is very variable, prescribed landmarks should not be trusted and pre-operative CT planning of graft source location is essential.

Does the implementation of national BESS guidance on first time traumatic shoulder instability lead to improved outcomes?

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Background: In order to improve our treatment of patients with 1st time traumatic instability BESS introduced national guidance in 2015, but it is unclear if the new guidance has led to an improvement in outcomes. The aim of this study was to investigate outcomes following the implementation of national BESS guidance at Royal Derby Hospital in 2016.

Method: Patients >16 years of age presenting with a 1st time traumatic shoulder dislocation between Jan 2013 and Dec 2013 (pre-guidance) and between Oct 2016 and Dec 2019 (post-guidance) were included. Patients with associated fractures were excluded. Clinic letters and imaging were used to compare rate of, and lag time to imaging and surgery, as well as re-dislocation rates.

Results: There were 99 patients treated for a first-time dislocation pre-guidance and 342 patients post-guidance. Mean age was 48.4 years with a 2:1 male:female ratio. Percentage of patients aged <25 that had an MRI arthrogram increased from 20.7% to 68.2% with mean lag time reducing from 119 to 62 days. Percentage of patients >40 years that had an USS increased from 42% to 60% with mean lag time reducing from 74 to 36 days. Rate of surgery for instability in the under 25s and cuff tear in the >40s remained the same, but lag time did improve. Rate of dislocations only improved marginally in the <25s from 1.48 per person to 1.32 per person, but the number of patients suffering 3 or more dislocations reduced from 13.8% to 6.1%.

Conclusions: Implementation of national guidance on 1st time traumatic shoulder instability has led to an increased rate of imaging and decreased time to imaging and surgery. This has not led to a significant increase in rate of surgery or a significant reduction in the rate of re-dislocation.

The Effect of NSAIDs and COX-2 Inhibitors on Structural and Clinical Outcomes Following Rotator Cuff Repair - A Systematic Review and Meta Analysis

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Purpose: The aim of this systematic review and meta-analysis is to evaluate the structural and clinical impact of non-steroidal anti-inflammatory drugs (NSAIDs) and cyclooxygenase-2 (COX-2) inhibitors on primary arthroscopic rotator cuff repair outcomes.

Methods: The study was registered with PROSPERO (CRD42023385611). EMBASE, Medline, PsychINFO and the Cochrane Library were searched for randomised controlled trials investigating the use of NSAIDs or COX-2 inhibitors in rotator cuff repair. Primary outcomes included healing / retear rate determined by radiological imaging. Secondary outcomes included shoulder-specific outcome measures and VAS pain scale. Risk of bias was graded using the Cochrane risk-of-bias v2.0 tool.

Results: The systematic search returned 7 unique eligible studies. NSAIDs use did not yield a difference in retear rate (n =4 studies; 129 NSAIDs vs 97 control; OR: 0.99, 95% CI 0.31 to 3.11, p = 0.98). NSAIDs were shown to significantly reduce pain at a minimum of 6 hours post-operatively (n =7 studies; 278 NSAIDs vs 209 control; standardised mean difference (SMD): -0.27, 95% CI -0.51 to -0.04, p = 0.02). COX-2 inhibitors did not significantly reduce pain (n = 3 studies; 170 COX-2 vs 95 control; SMD: -0.03, 95% CI -0.24 to 0.18, p = 0.77). Quantitative analysis of ASES and UCLA scores showed NSAIDs significantly improved functional outcomes vs control (n = 5 studies; 239 NSAIDs vs 163 control; SMD:

0.33, 95% CI 0.15 to 0.51, p = 0.0006). COX-2 inhibitors did not significantly improve functional outcomes (n = 3 studies; 94 COX-2 inhibitors vs 95 control; SMD: 0.19, 95% CI -0.09 to 0.48, p = 0.18).

Conclusion: NSAIDs do not affect rotator cuff healing rate, however, reduced post-operative pain and improved patient reported outcomes. Larger randomised controlled trials with low risk of bias and more comprehensive imaging follow up for structural healing data are needed.

Profiles of the postoperative management of arthroscopic rotator cuff repairs - Analysis as part of a multicentric cohort study

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Background: This study aims to describe the postoperative management after ARCR in Switzerland and identify groups of patients following specific rehabilitation paths.

Methods: As part of a large multicentre Swiss cohort study (ARCR_Pred), patient characteristics, rehabilitation and outcome data were collected at baseline, six weeks, six months, one and two years after first time ARCR from 19 clinics through patient examinations and interviews. Data were categorized and described across clinics. A polytomous latent class analysis (poLCA) with clinic as a covariate was applied to the medication-, immobilization- and rehabilitation management parameters to identify patient rehabilitation groups. The associations between identified groups and the functional Constant Score (CS) and Oxford Shoulder Score (OSS) were investigated at baseline, six months and one year.

Results: Data from 973 patients were used. The LCA revealed a three-class model for medication management with a `NSAID Group` (48%), `Non-NSAID & Weak Opioid Group` (42%) and a `Non-NSAID & Potent Opioid Group` (10%). The immobilisation management comprised three classes a `Standard Group` (53%), `Conservative Group` (24%) and an `Progressive Group` (23%). The rehabilitation management had three classes with a `Less Therapy Group` (49%), `Intense Therapy Group` (27%) and a `Standard Therapy Group` (24%). The `Non-NSAID & Potent Opioid Group` had lower OSS at baseline and six months but not one year. The `Progressive Group` had higher CS at baseline and six months but not one year. There were no differences between the rehabilitation groups.

Conclusions: The medication-, immobilization and rehabilitation management could best be explained by three groups each. Functional outcome scores of the `Non-NSAID & Potent Opioid Group` and the `Progressive Group` differed from the other groups at baseline and after six months, but not after one year. No differences were found between the rehabilitation groups.

CT methods for measuring glenoid bone loss are inaccurate, not interchangeable and not reproducible.

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CT scanning is commonly used to image glenoid bone loss but there is no consensus on which measurement technique is the best.

The aim of this investigation was to evaluate the accuracy and reproducibility of the most commonly described techniques and analyse whether the circle of best fit (COBF) is better derived from an intact glenoid than a deficient glenoid.

Method: 3D models of the glenoid were sequentially cut and CT scanned. Using a PACS system 6 radiology and shoulder surgery consultants calculated the bone loss using the 6 most common techniques. These were compared with the physical measurements.

Results: A threshold of 15% was set as the limit for bone augmentation.
When the bone loss was less than this the linear and COBF fit techniques overestimated the bone loss with a likelihood of recommending augmentation. The area techniques (Sugaya/Pico) tended to underestimate.
At 17.6% bone loss the linear, COBF and Sugaya overestimated and at bone loss >20% the Pico technique underestimated the amount, not reaching the grafting threshold.

Methods that had high sensitivity lacked specificity and those that had high specificity lacked sensitivity. Overall, the most accurate technique (statistically and mathematically) was the Pico technique with 97.1% accuracy.

The COBF derived from the intact glenoid was 7% smaller than one derived from the deficient glenoid. This difference was significant when being used to calculate the bone loss.

Conclusion: There is no single technique which stands out as being the most accurate and reliable and caution should be applied when using any of them. Area techniques were more accurate below 15% bone loss but underestimated at greater amounts.

This study highlights that measurement techniques are not interchangeable and that, until there is an accepted gold standard, recommended bone loss thresholds presented in the literature should be considered with caution.

Relationship of suprascapular nerve & suture-button fixation during "Bone Block" surgical reconstruction for recurrent glenohumeral joint instability.

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Purpose: Suprascapular nerve injury has been reported with the traditional Latarjet procedure performed utilising screw fixation - we wished to evaluate the relative risk to the last branch of the suprascapular nerve whilst utilising the suture button fixation technique to perform a coracoid or bone block transfer.

Method: Ten fresh frozen cadavers were dissected after having undergone anterior bone block procedures. The posterior arthroscopic guide to perform the suture button technique of fixation during coracoid or bone block transfer was utilised as per the published technique. The specimens were then examined to evaluate the relationship of the drilled pins posteriorly on the glenoid to the suprascapular nerve whilst using the guided instrumentation.

Results: The mean distance from the drill pins and the suprascapular nerve was 6.45mm (SD 0.83mm). There was no nerve contact in any of the cases with the smallest distance to the nerve being 3.25mm and the furthest being 8.75mm.

Conclusion: This study serves to highlight the close relationship between the drill pins and the suprascapular nerve. The utilisation of a posterior drill guide optimises the peri-articular pin position, making positioning of the guidewires for button position reproducible, which may avoid injury to the nerve. The proximity of the suprascapular nerve to the posterior buttons whilst utilising this technique should be considered to avoid injury.

Capsule preservation versus rupture techniques in hydrodilatation for adhesive capsulitis

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Intra-articular hydrodilatation with corticosteroid improves short-term pain and function in adhesive capsulitis (AC) compared to corticosteroid injection alone. However, the historically used endpoint of capsular rupture (CR) remains controversial with wide variability in injectate volume and approach.

Capsular preservation (CP) techniques theoretically achieve sustained stretching of the capsule and contained corticosteroid delivery, maximising anti-inflammatory effects. Previous studies aiming for CP showed less clinical improvement but delivered small volumes (2-10mL) probably insufficient for hydrodilatation. As MRI studies demonstrate synovial inflammation and fibrosis is most severe at the rotator interval with CHL thickening, an anterior approach could achieve more localised and effective dilatation.

We compared an anterior approach, using a surrogate endpoint of patient discomfort to achieve maximal distension whilst preserving the capsule, to conventional posterior CR technique.

Methods: Retrospective analysis of two protocols from 2018-2022 was undertaken. A mixture of corticosteroid, bupivacaine and saline was either injected via a posterior approach with endpoint of CR, or injected anteriorly until patients reported discomfort with intent of CP. Patients who underwent both protocols were excluded. Passive range of movement (ROM) pre- and post-procedure was compared.

Results: 103 patients were included [CR(n=50);CP(n=53)]. In each group, 15 underwent a repeat procedure and 2 proceeded to surgery. An average of 16ml (CP) versus 26ml (CR) injectate was used. Post-first hydrodilatation, CP demonstrated greater average improvement in ROM in all directions (abduction 41^0 versus 35^0, flexion 40^0 versus 33^0, external rotation 16^0 versus 12^0), although only improvement in external rotation was statistically significant (p=0.047). No significant difference in ROM gains were found post-second hydrodilatation.

Conclusion: CP technique achieves at least equivalent ROM improvement to CR, without risk of long-term sequelae from deliberate capsule injury. It is anecdotally better tolerated, uses a shorter needle approach, generally faster to perform, and allows targeting of particularly inflamed anterior capsular structures.

Quantitative changes in Scapulohumeral rhythm in adhesive capsulitis – A matched, controlled study using Dynamic Digital Radiography

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Introduction: Adhesive capsulitis (AC) is largely a clinical diagnosis of exclusion, often with an unnecessarily expensive work-up, delay in diagnosis and subsequent intervention. AC is characterised by a reduction in shoulder abduction range of motion, specifically a reduced contribution from the glenohumeral joint and frequently a compensatory increase from the scapulothoracic joint. Scapulohumeral rhythm (SHR), defined as the ratio of the change in humeral abduction over the change in scapula upward rotation during humeral abduction, is an important parameter in assessing shoulder complex kinematics. Dynamic Digital Radiography (DDR) takes a series of pulsed low radiation radiographs during active range of motion, and may enable quantitative SHR analysis and assist diagnosis of AC. The purpose of this study was to compare SHR in patients with AC to normal controls throughout active ROM, using DDR.

Methods: Shoulders were prospectively analysed using DDR under a standardised protocol, obtaining a series of pulsed radiographs during arm abduction. GH and ST motion were quantified based on DDR images taken in 0-30°, 30-60°, 60-90° of arm abduction. SHR was calculated by dividing the change in humeral abduction by the change in scapular upward rotation in each abduction interval.

Results: Forty-eight patients were included - 16 patients with AC and 32 normal controls, 2:1 matched for age and BMI. Patients with AC had significantly lower SHR (1.55 $\pm$ 0.37) compared to controls (3.47 $\pm$ 0.80, $p<0.001$). When analysed across 30° intervals of humeral abduction, a statistically significant lower SHR was found at 0-30° (1.67 vs 3.97, $p<0.001$), 30-60° (1.64 vs 3.17, $p<0.001$) and 60-90° (1.45 vs 3.43, $p<0.001$) in AC patients compared to controls.

Discussion and conclusion: Our study uses novel dynamic radiography to demonstrate consistently lower SHR in patients with AC compared to normal controls. Dynamic SHR quantification can provide a well-defined, objective diagnosis.

Shoulder MR arthrography: a novel ultrasound-guided injection technique

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Purpose: Various glenohumeral joint injection techniques for MR arthrography (MRA) have been described. As the anterior approach traverses the subscapularis tendon, and the coracoid process can obscure the needle tip in the rotator interval approach, the posterior approach is commonly performed. It has a technical success rate of 96.7-100% and extravasation rate of 52-60%, but requires a more vertical needle tract due to the deep position of the glenohumeral joint.

We propose a new ultrasound-guided injection technique for MRA targeting the lateral capsule, immediately adjacent to the infraspinatus tendon footplate, and assess its technical feasibility and patient tolerance.

Methods: Retrospective analysis of 26 patients referred for MRA over an 18-month period undergoing ultrasound-guided injection of dilute gadolinium by the same radiologist either via a conventional posterior (PA) (n=13) or novel superolateral approach (SLA) (n=13) under local anaesthetic. Technical ease, MRA diagnostic quality and complication rate were evaluated.

Results: SLA required a shorter distance from skin to target (average of 31.7cm versus 46.4cm), and smaller median needle size (23-gauge versus 22-gauge). All SLA injections were successful on first attempt; 11 achieved good and 2 adequate capsular distension. One PA injection required repositioning and 1 was inadequate (patient refused second attempt), with 7 achieving good and 5 adequate capsular

distension. Capsular extravasation rate was significantly reduced with SLA (38%) compared to PA (77%) (p=0.47), although no cases significantly affected diagnostic quality.

SLA could be performed with a more horizontal needle tract, enabling superior visualisation of the needle and intra-articular distension. Both approaches were well-tolerated with no procedural complications recorded.

Conclusion: A technique targeting the lateral capsule can be performed more easily, traverses less overlying soft tissue, with significantly lower extravasation rate compared to posterior injections. It is well tolerated, with high technical success, adequate joint distension, and consequently good diagnostic MRA quality.

Partial correction of glenoid retroversion gives satisfactory outcome with stemless TSA

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Introduction: Significant glenoid retroversion, posterior bone loss and subluxation of the humeral head have historically been associated with an increased failure rate of Anatomic Total Shoulder Replacement (ATSR). Eccentric reaming with partial correction of retroversion is one option to address the retroverted glenoid.

Purpose of study: To assess clinical outcomes and survivorship of ATSR using a stemless humeral component with cemented pegged polyethylene glenoid. Eccentric glenoid reaming to partially correct retroversion was compared with concentric reaming in non-retroverted glenoids.

Methods: A retrospective case series and Xray review was performed. Glenoid retroversion was measured on pre-operative and post-operative axillary view x-rays as per Service et.al. 2 groups were identified (1) Retroverted glenoid and (2) Non-Retroverted glenoid. The Lazarus score was used to identify glenoid loosening. Clinical outcomes were assessed using the Oxford Shoulder Score.

Results: 102 ATSA were evaluated, with 49 in Group 1 and 53 in Group 2. Patient demographics and mean follow up (3.5 years vs 3.9 years) was similar in both groups. The mean pre -operative retroversion in Group 1 (Retroverted) was 20.18 degrees. Post-operative retroversion was 15.87 with a correction of 4.31. In Group 2 (Non-Retroverted) the pre-op version was 4.42degrees and post-operative version was 9.56 degrees.
There was no significant difference in Lazarus score, Oxford shoulder score or revision rate between the 2 groups.

Conclusion: Partial correct of glenoid retroversion results in similar outcomes to concentric reaming in non-retroverted glenoids. Mid term results are reassuring but ongoing long term follow up is required.

The Growth of Total Shoulder Arthroplasty in the United States 2010-2019: Past Trends and Future Directions

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Introduction: Utilisation of total shoulder arthroplasty (TSA) is expected to increase as a result of an aging population, expanding indications and increasing implant longevity. Outpatient arthroplasty has the potential to increase patient satisfaction, decrease costs, and free up valuable resources within our medical system. Shoulder arthroplasty has not been as quickly adopted in the outpatient setting. The purpose of this study is to report the nationwide volume and incidence of outpatient TSA over the past decade and describe projections for the coming decade to allow a better understanding for healthcare policy and anticipate the future needs of our population.

Methods: The IBM MarketScan database was searched for patients undergoing primary TSA between 2010 and 2019. Patients were stratified by procedure setting (inpatient vs outpatient), age group, gender, and geographic region. Complex sampling and sample weights were utilised to create volume estimates with 95% confidence intervals representative of the entire US population.

Results: 1,006,954 primary TSA procedures were identified. Annual case volumes increased from 60,000 to 150,000 procedures annually between 2010 and 2019. Outpatient TSA increased from 8,000 (13.3%) to 26,500 (17.7%) procedures annually throughout the decade. Inpatient and outpatient volumes rose by 135% and 230%, respectively. There has been a 120% and 209% increase in the per capita incidence

of inpatient and outpatient TSA, respectively. Most TSA procedures were performed in patients aged 65-74. Overall, the annual volume of TSA increased across all age groups, <55 (+74%), 55-64 (+146%), 65-74 (+174%), >75 (+143%).

Discussion and conclusion: TSA in the outpatient environment will likely increase in the coming years and surgeons, hospitals, and healthcare legislators must understand the increasing demand to prepare for the changing practice of TSA. The most substantial increases in outpatient TSA were seen in patients younger than 65 years and male gender.

A logical protocol for the use of 3-D planning software – reliable and reproducible results

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Purpose: To compare Intra and inter-observer reproducibility of 3D planning software for shoulder replacement

Methods and Results: The Signature One planning system from Zimmer Biomet does not have any specific protocol accompanying it, allowing surgeons wide freedom to place the glenoid baseplate. We have developed a method for use of the software which we believe gives consistent placement of the glenoid components. We tested this protocol for Intra and inter-user variability.

Methods: 20 patients were added to this prospective study. All were listed for a reverse Shoulder arthroplasty by their surgeon. A CT scan was done according to Zimmer-Biomet Protocol.

Three orthopaedic surgeons performed 3D templating twice over a 4-week interval with a different order of the patients. 3D positioning with 6 degrees of freedom (A-P and superior-inferior positioning on the glenoid face, version and inclination, rotation and reaming depth) along with central screw length was measured and the agreement and Intra Class Correlation were evaluated.
For inter-observer trials, the agreement rate and ICC were calculated for each unique pair of the three observers, the average of these values was recorded as the overall value and compared with intraobserver trials.

Results: The Protocol gave excellent reproducibility with ICC between 0.81 and 0.96 for inferior tilt, rotation and screw length. There was a substantial agreement for reaming depth (ICC 0.79). The original placement of the baseplate (Superior/inferior placement and version) showed moderate agreement (ICC 0.66)
These results were similar for an intra-observer agreement after a four-week gap (ICC 0.97-0.64)
The mean implant-to-bone contact was found to be 91.38% after the use of augments.

Conclusion: A protocol for use of CT-based 3D templating showed excellent reliability for component size and alignment in RSA. This is beneficial to all users of the software in planning shoulders in a consistent and reproducible way.

Topical Preparations for Reducing Cutibacterium Acnes Infection in Shoulder Surgery: a systematic review and network meta-analysis

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Purpose: The aim of this study was to evaluate the relative effects of topical preparations in reducing C. Acnes in shoulder surgery.

Methods: The study protocol was registered with PROSPERO (CRD42022310312). We searched the MEDLINE, Embase, PsycINFO, and Cochrane Library databases in March 2022. Randomised controlled trials (RCTs) comparing any form of skin preparation in arthroscopic or open shoulder surgery were included. The primary outcome was reduction in the number of positive C. Acnes cultures. Secondary outcomes were adverse events related to application of topical preparations. We performed a network meta-analysis (NMA) to facilitate simultaneous comparison between multiple preparations across studies. We calculated differences between preparations using odds ratios (ORs) and their 95% confidence intervals (CIs). Risk of bias was assessed using the Cochrane risk-of-bias v2.0 tool.

Results: We found 16 RCTs (1,062 patients), of which 13 were suitable for NMA (927 patients). 4 RCTs were deemed as "low" risk-of-bias and 12 raised "some concerns". Preparations included benzoyl peroxide (BPO), BPO combined with clindamycin, chlorhexidine gluconate (CHG), hydrogen peroxide (H2O2), povidone-iodine, and water with soap. Only BPO resulted in a significantly lower odds of a positive C. Acnes culture compared to placebo or soap and water (OR 0.14 95% CI 0.05-0.36). There was no statistically significant difference with all other skin preparations (BPO with clindamycin: OR 0.64 95% CI 0.07-5.50; CHG: OR 0.46 95% CI 0.09-2.53; H2O2: OR 0.52 95% CI 0.18-1.54). The only adverse events were skin irritation from BPO and CHG in a small number of reported cases.

Conclusions: BPO is the most effective topical agent in reducing prevalence of C. Acnes in shoulder surgery. These results are limited by the combination of indirect and direct data. Future studies should focus on establishing optimal frequency and duration of pre-operative BPO to further reduce the burden of C. Acnes.

Learning Curve of Bony Increased-Offset Reverse Shoulder Arthroplasty

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Introduction: Angled bony-increased offset-reverse shoulder arthroplasty (BIO-RSA) can correct severe retroversion and bone loss, decrease scapular notching, and improve functionality. However, the learning curve associated with this technically challenging procedure has not yet been described. Understanding changes in proficiency can inform preparedness and help predict complication rates. The purpose of this study was to report the learning curve of angled BIO-RSA and its implications.

Methods: All patients who underwent primary reverse shoulder arthroplasty using an angled BIO-RSA were included between November 2018 and February of 2022. The surgeon has already completed his learning curve for anatomic total shoulder arthroplasty (aTSA) and traditional reverse shoulder arthroplasty (RSA). Operative time (incision to closure), and intraoperative complications were all included. Patients were excluded if they underwent a planned two-stage arthroplasty. Linear regression analysis was used to test the relationship between surgical time and time elapsed since the first BIO-RSA.

Results: Thirty-four angled BIO-RSAs were identified. Two patients were excluded as they did not undergo primary arthroplasty. Mean total operative time was 127 minutes. Average operative time for the first five BIO-RSAs was 158 minutes, while the average operative time for the last five BIO-RSAs was 92 minutes. There was a significant decrease in operative time and no intraoperative complications for all 32 procedures.

Discussion and conclusion: Our study demonstrates operative times reduced during subsequent angled BIO-RSA procedures. Operative times had not reached a nadir at the last included procedure, demonstrating that the learning curve has still not been completed after 34 procedures. Surgeons taking on these complex procedures should be aware of the long learning curve and seek ways to expedite efficiency.

Stress shielding of the proximal humerus in stemless anatomic total shoulder arthroplasty

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Background: Finite element analysis has suggested that stemless implants may decrease stress shielding. Recent case series have shown higher-than-expected rates of stress shielding to occur following stemless total shoulder arthroplasty (TSA). This study aimed to assess the radiographic proximal humerus bony adaptations to stress shielding and associated clinical outcomes following stemless TSA.

Methods: A retrospective review of all patients who underwent stemless TSA surgery at our centre from 2010 to 2020 was performed. Demographic, operative, and clinical data were obtained from medical records. Serial post-operative radiographs were reviewed to assess for evidence of stress shielding and lucency.

Results: 115 stemless TSA utilising a single implant design with a minimum one-year follow-up were identified over a 10-year period. The median follow-up was 3.5 years (range 1 – 8.9 years). Evidence of stress shielding was observed in 20 cases (17%), (9 mild (8%), 0 moderate (0%), 11 severe (9%). No significant differences were seen between stress shielding and gender, BMI, post-operative range-of-motion, patient satisfaction, or Oxford shoulder score. No significant differences were seen between operative technique and stress shielding (subscapularis tenotomy vs. lesser tuberosity osteotomy). No cases had evidence of humeral lucency. 24 cases (21%) had evidence of glenoid lucency of Lazarus grade 0 – 3. No cases had Lazarus grades 4 or 5. There was no association between stress shielding and humeral lucency, glenoid lucency, or revision procedure.

Discussion: Stress shielding in this study occurred at lower rates than anticipated following stemless TSA and was not associated with radiographic evidence of lucency, revision procedures, or adverse effect on clinical outcome measures.

Is Virtual Reality 'Head and shoulders' above Cognitive Simulation in Orthopaedic Reverse Shoulder Arthroplasty Training?

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Statement of Purpose: With Virtual Reality (VR) and Cognitive Simulation (CS) becoming increasingly recognised for their value as educational tools for learning orthopaedic procedures, we conducted a study to test whether one of these approaches is more effective than the other and determine which method would merit greater investment within orthopaedic education.

Methods: In this small-sample pilot quasi-randomised study comparing VR and CS as tools in reverse shoulder arthroplasty (RSA) training, we divided 16 orthopaedic registrars into a VR group and CS group. The VR group undertook a 30-minute VR experience using PrecisionOS VR headsets, while the CS group underwent a 30-minute CS exercise. Both groups were subsequently assessed using the Objective Structured Assessment of Technical Skills (OSATS) score on their RSA performance on Sawbone models.

Results: Overall, no significant difference was found in the average OSATS scores achieved between the VR group and CS group (VR=15.0$\pm$1.29; 95% CI: $\pm$2.92, CS=12.2$\pm$0.167; 95% CI: $\pm$0.429, p=0.125). Participant ratings of the two tools in terms of usefulness, instilling procedural confidence and likelihood of future use also found no significant differences (instillation of confidence: p=0.180; usefulness: p=0.655; future utility: p=1.000).

Conclusion: While VR technology feels more futuristic as a training tool, considering the expense of equipment, there may be value in further developing CS techniques, especially for use in resource-deplete environments. However, both VR and CS are incredibly valuable learning assets and may have their own unique and non-mutually exclusive places within the armamentarium of orthopaedic training tools.

Are outcomes in reverse shoulder arthroplasty for cuff tear arthropathy affected by preop hamada grade?

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Aim: The indications for rTSA have gradually expanded and the procedure is now used for both cuff tear arthropathy (CTA) and for massive or irreparable cuff tears without arthritis. The aim of the study is to establish if the outcomes following RTSA are affected by severity of cuff damage.

Methods: This was retrospective review of prospectively collected data. One Hundred and Twelve patients who underwent rTSA for CTA between Aug 2004-July 2021 were identified. Patients were classified in to 2 groups: Early Hamada (Grade 1/2/3) and Advanced Hamada (Grade 4a/4b/5) based on radiographic evaluation using Hamada grading for CTA. Patients records were reviewed to assess shoulder range of movement including forward elevation and abduction and patient satisfaction.

Results: A total of 112 patients were evaluated and had a mean follow up of 2.4 years (range 1-6 year). Early Hamada group(n=24) had a mean age of 75.4(44-81 years) with a satisfaction rate of 95.8%. Advanced grade Hamada (n=88) had a mean age of 75.4(44-81 years) with a satisfaction rate of 96.6%. Early Hamada group had overall 60% gain in the forward elevation movements while gain in abduction ROM was 58.5%. Similarly, Advanced Hamada group had overall 67.8% gain in the forward elevation movements while gain in abduction ROM was 62.2%.

Conclusion: rTSA yields satisfactory outcome and predictable results irrespective of disease severity in all stages of cuff arthropathy. Satisfaction rates were high (>95%) in both groups.

Methylprednisolone Taper is an Effective Addition to Multimodal Pain Regimens after Total Shoulder Arthroplasty: Results of a Randomised Controlled Trial

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Introduction: Perioperative corticosteroids are promising as a non-opioid analgesic adjunct for various orthopaedic pathologies, but have not been well investigated after total shoulder arthroplasty (TSA). Thus, the purpose was to assess the impact of a methylprednisolone taper on a multimodal pain regimen after TSA.

Methods: This study is a randomised control trial, of a group of opioid naïve patients undergoing TSA. Patients were randomly assigned at the time of surgery to receive intraoperative dexamethasone only (control group) or intraoperative dexamethasone followed by a 6-day oral methylprednisolone taper course (treatment group). Visual analog pain scores (VAS-pain), VAS-nausea, and number of opioid tablets consumed during the first 7 post-operative days were recorded.

Results: Overall, there were 67 patients enrolled in the study, including 32 in the control group and 35 in the treatment group. There was a reduction in the mean VAS pain scores and in cumulative oxycodone tablet consumption (control group = mean of 18 pills vs. treatment group = 4.2 pills) in the first postoperative week. Patients also had less opioid-related side effects, including nausea, within this first

postoperative week. Although there was an improvement in VAS pain score in the treatment group at 2 weeks postoperatively, there were no differences at 6 weeks, 12 weeks, or at final follow-up. There were no differences in EQOL, shoulder SANE, or ASES scores at 2 weeks, 6 weeks, or 12 weeks postoperatively, or at final follow-up, between the groups. At a follow-up of 23.4 (12-39) months in the control group and 19.4 (12-37) months in the treatment group, there was 1 infection in the control group and 1 postoperative cubital tunnel in the treatment group.

Discussion and conclusion: A methylprednisolone taper course shows promise in reducing acute pain and opioid consumption as part of a multimodal regimen following TSA.

Lateral collateral ligament tear and common extensor tendinopathy - a specific subgroup?

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MRI scan of 53 patients with complaint of lateral epicondylitis for more than 1-year were reviewed. The average age is 50 years old (range 36-67) and male to female ratio is 3:2. Of these, lateral epicondylitis was all confirmed with MRI changes of common extensor origin oedema or tear. All patients with history of elbow dislocation, significant trauma or fracture to the elbow were excluded. Of these 19 (36%) patients had evidence of concomitant lateral collateral ligament complex sprain or partial tear. 9 (17%) patients had never had prior steroid injection. Age, gender, presence of inflammatory disease, occupation and shape of radial head (elliptical/circular) and neck shaft angle had no correlation to the presence of the collateral ligament tear. There was no macroscopic radiological evidence of radial head subluxation in the group with tear. Collateral ligament changes were often presence in patients with high grade partial tear. We conclude that collateral ligament tear often co-exists with common extensor tendinopathy, even in the absence of steroid injection. Collateral ligament tear and micro-instability may be associated with the pathogenesis of tennis elbow.

The current scope of practice of First Contact Practitioners and the management of Rotator Cuff Related Shoulder Pain

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Background: Rotator cuff related shoulder pain (RCRSP) is considered the most common of all shoulder presentations. Persistent RCRSP is defined as pain or dysfunction lasting beyond six months. This study aims to identify the current scope of practice of First Contact Practitioners (FCPs) and the current management of persistent RCRSP in primary care.

Methods: A cross-sectional online survey was developed and adapted by the author and two experienced researchers. Clinical vignettes were used to evaluate clinical practice of FCPs. Ethical approval was obtained from University of Hertfordshire Health, Science, Engineering and Technology Ethics Committee. The survey was hosted online between the 26th May and 30th June 2022 and distributed via social media and relevant professional networks using non-probability purposive sampling. Percentages and frequencies were calculated to summarise descriptive data; free-text survey items were analysed using quantitative content analysis to identify codes and categories.

Results / Findings: 94 respondents completed the survey. Differences were observed between rates of pay, post-graduate training and additional skills between respondents.

'RCRSP' and 'degenerative RC tear' (dRCT) were the preferred terminology. In the RCRSP scenario, the majority of respondents would not request further imaging, and provide 'advice, education and reassurance', 'give simple, appropriate exercises' and 'advice regarding medication optimisation' as initial management. In contrast, fewer respondents would not request imaging for dRCT, and the majority would refer to physiotherapy, consider a steroid injection or secondary care referral. Expected recovery times for RCRSP and dRCT differed considerably.

Conclusion: Variation in FCP scope of practice was observed, with unnecessary referrals leading to poorer resource allocation. The present study provides evidence that FCPs management for persistent RCRSP is consistent with guidelines in some aspects, however the use of imaging and injection therapy demonstrates disparity between guidelines and clinical practice. Better publicity of existing guidance and education may be required.

The First-Ever Measurement of Elbow Joint Forces in Man

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Purpose: To generate real-time in vivo force and moment data during activities of daily living (ADL) for the first time by internally instrumenting a custom humeral component of an unconstrained total elbow replacement to measure the 6 degrees of freedom (d.o.f) acting at the hinge axle.

Methods: A customised 3D model of a humeral component was developed with three cavities to house electronics and strain gauges. The mechanical loading of the model was evaluated in an FEA study replicating the 6 d.o.f loads experienced by the joint in vivo. A total of 10 titanium (Ti-6Al-4V) humeral implant prototypes were fabricated via CNC machining. Four welded prototypes are being fatigue tested for durability at a frequency of 5 Hz and a maximum joint reaction force of 700N for 5 million cycles. Axle loads are sensed by strain rosettes mounted in each fork cavity and in the main cavity. Stem tip loads are sensed by gauges enclosed in an annular cavity near the tip. Implants will be calibrated using custom fixtures and a loading machine. The implantation of pre-calibrated internally strain-gauged humeral implants in the humerus sawbone will validate the load measuring ability of the implant and enable stem loosening to be modelled.

Results: The FEA study identified the optimum locations for the strain gauges for sensitivity to all d.o.f and for selectivity. The first cyclically loaded humeral component has successfully completed 5 million cycles at a peak load of 700N without failure.

Conclusion: Adding internal cavities to the humeral implant did not negatively impact its performance, as it was found to withstand the same loading conditions as previously tested humeral components. The overall research project proposes to develop an instrumented humeral implant for TER to measure hinge forces and moments.

Clinical and functional results of Lateral Ulnar Collateral Ligament repair for posterolateral rotatory instability of elbow.

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Lateral Ulnar Collateral Ligament (LUCL) injury can result in posterolateral rotatory instability requiring surgical fixation. Ligament reconstruction is widely used but here we evaluate the surgical outcome direct repair of Lateral Ulnar Collateral Ligament.

Methods: In this retrospective observational study, we included all cases of direct repair of LUCL that were performed in the last five years. Patients were identified from theatre coding and confirmed with operation notes. Electronic Patient Records were reviewed for demographics, diagnosis, intraoperative findings and complications. Patient reported outcome scores, using Mayo Elbow Performance Score (MEPS) was used as the primary outcome.

Results: 15 patients with avulsion and/or attenuation of the LUCL underwent direct repair between 2018 and 2022. Two were lost to follow up and 13 included. Eight were on the dominant arm side. The mean age of patients at the time of injury was 38.8 (range 18-61 years). 6 patients were operated on for acute trauma (mean days to operation = 20), 6 for trauma sequelae (mean days to operation = 299) and 3 for chronic instability (mean days to operation = 715). In all cases pathology was at the humeral attachment and the quality of the ligament assessed to be good for repair. LUCL was fixed with a 3.5mm anchor in all cases. At a mean follow up of 26 months, the mean MEPS score was 99. According to Nestor grading, 12 patients had excellent and 1 had good result. One patient underwent cubital tunnel decompression three months post LUCL repair.

Conclusion: In the management of both acute and chronic elbow posterolateral rotary instability, a direct repair of the LUCL when possible, achieved excellent to good clinical outcomes and eliminated the need for ligament reconstruction.

Outcome of a Metaphyseal Stemless Reverse Total Shoulder Replacement in Rheumatoid Arthritis

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Use of reverse total shoulder arthroplasty (rTSA) in rheumatoid arthritis (RA) has been questioned in the literature due to the poor bone quality and high complication risk. Anatomic shoulder replacements have been used over the years leading to moderate functional outcome.

Aim: To assess the clinical and radiological results of a metaphyseal rTSA without a stem in patients with RA.

Methods: Between 2005 - 2015, 45 shoulders in 36 consecutive RA patients underwent cementless rTSA with a bone impaction technique. 9 had staged bilateral rTSA. 11 were revisions. Patients assessed clinically and radiographically preoperatively, at 3 weeks, 3 months, 6 months, 1-year postop and yearly thereafter, using the Constant Score (CS), pain score, Subjective Shoulder Value (SSV) and patient satisfaction score.

Results: 44 shoulders, 27 females (32 shoulders) and 9 males (13 shoulders) were available for follow-up (FU). Mean FU 67 months (range 24m – 146m (12y)). Mean age at surgery 68.7 years (range 39-86). CS improved from 17.5 preoperatively to 60.9 (Age/Sex adjusted 86.5) at last follow-up, results maintained over time.
Pain score improved significantly from 3.2/15 to 12.1/15. SSV improved from 1.2/10 to 8.9/10.

Mean ROM improved to 140° active flexion, 134° active abduction, 47° active external rotation (AER) and 70° active internal rotations (AIR). The mean AIR with the hand behind the back was thoracolumbar spine.
No lucencies around the implants, loosening, subsidence or stress shielding was evident radiographically. 38 implants showed no glenoid notching. There were two grade-I, two grade-II and two grade-III Sirveaux-Nerot glenoid notching.

Conclusions: Short metaphyseal rTSA without stem shows to be successful and safe in RA patients. Impaction grafting technique improves humeral component stability. Patients restore good function, resume daily activities and have high satisfaction rates. Improvement is maintained over time. No signs of implant loosening, subsidence or stress shielding were observed.

Patient reported outcomes following total shoulder arthroplasty and hemiarthroplasty: An analysis of data from the National Joint Registry of England, Wales and Northern Ireland

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Statement of purpose: The aim of this study was to investigate the pattern of post-operative improvement in the Oxford Shoulder Score (OSS) following total shoulder arthroplasty (TSA) and hemiarthroplasty and determine which implant resulted in superior scores.

Method: National Joint Registry records were linked to the patient reported outcome measures dataset. Anatomical shoulder replacements performed for osteoarthritis in patients with an intact rotator cuff were included. The distribution of the OSS and improvement at 6 months and 5 years were analysed across each implant. To reduce the risk of selection bias, propensity scores were used to generate a matched cohort of 2002 patients. Propensity scores represented the probability a patient received a hemiarthroplasty, based on 10 variables, and was calculated using a logistic regression model where the dependent binary variable defined treatment group allocation. OSSs were compared at 6 months in the matched sample.

Results: There was significant improvement in the OSS in both groups ($p<0.001$). At 6 months the OSSs were superior following TSA compared to hemiarthroplasty (median 42 vs 36, $p<0.001$). The median score at 5 years was 44 after TSA and 35 following hemiarthroplasty.

Score distributions were skewed towards the maximum score. The highest possible score (48) was achieved following 15% of total shoulder arthroplasties at 6 months, and 28% of TSAs at 5 years. After hemiarthroplasty 5% of patients achieved the highest score at 6 months, 9% at 5 years. A minimum improvement of 5 points on the OSS was shown at 6 months following 82% of hemiarthroplasties and 94% of TSAs. At 5 years 78% of hemiarthroplasties and 93% of TSAs achieved a minimum improvement of 5 points.

Conclusion: TSA led to superior OSSs at 6 months in patients with osteoarthritis. A ceiling effect was shown in the OSS following TSA at 5 years.

A Virtual Clinic Model for Long-Term Follow-Up of Shoulder Arthroplasty

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Aim: We aim to demonstrate the clinical and financial effectiveness of virtual clinic (VC) for long-term follow-up of shoulder arthroplasty patients.

Method: We performed a retrospective analysis of a prospectively developed database containing trauma and elective shoulder arthroplasty patients reviewed post-operatively in VC from January 2021 to December 2022 at a busy NHS teaching hospital. All patients included underwent routine surgeon-led face-to-face clinic (FTFC) review during the first post-operative year and subsequent specialist-nurse-led VC follow-up after that. VC assessment took place at 2, 5 and 10 years post-operatively with formal evaluation performed using Oxford Shoulder Scores (OSS) and standardised shoulder radiographs, all these being reviewed at consultant-led MDTs. Patients with an OSS of <30 were recalled to FTFC for further assessment.

Results: We reviewed 228 patients with a mean age of 72(26-92) years and follow-up from 2-10 years. They included 47 trauma (2 hemiarthroplasties, 45 reverse total shoulder arthroplasties (TSA)) and 181 elective cases (13 hemiarthroplasties, 36 anatomic & 132 reverse TSAs), of which 9 were revisions. 69% of VC patients were compliant with assessment by OSS and radiographs. Seven patients were recalled to FTFC for further evaluation, with one subsequent revision.

Discussion: A routine NHS orthopaedic appointment tariff is approximately £80. As a FTFC cost approximates to £160 per appointment, these run at a loss. VC is quoted as saving £110 per appointment so seeing 100 patients per year in VC costs an estimated £5000 versus £16000 for FTFC. Our review suggests the use of VC in reviewing shoulder arthroplasty patients over long-term follow-up can provide safe and effective clinical assessment and a financially beneficial model for NHS practice. As indications for recall and revision in our cohort stemmed primarily from patients' OSS, we also question the need for radiographs at every appointment, permitting further reduction of costs.

A self-adhesive mesh and topical sealed adhesive skin closure system reduces wound complication and primary care burden after primary shoulder arthroplasty

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Study purpose: To compare the efficacy of a self-adherent mesh and sealed glue skin closure dressing system (Dermabond Prineo, Ethicon) with conventional dressings (Mepilex) in healing surgical sites after primary total shoulder arthroplasty.

Methods: A prospective case-control study with 59 patients overall (32 cases and 27 control patients). Patient's follow up assessed their experience of dressing satisfaction, wound satisfaction, wound problems within two weeks of surgery, problems with dressings after showering, dressing changes at home or local GP practice, and any problems reported by the GP practice.

Results: Patients in the mesh and sealed adhesive case group had 100% wound and dressing satisfaction ratings. None of these patients had an issue with the dressing after a shower compared to 7.4% in the control group who had to change the dressing due to soakage. 11.11% (n=3/27) of patients in control group reported issues with the dressing to their GP (two patients with stitch complications and one with soaked dressings), whereas none of the case patients reported any problems. All the patients in the control group visited their GP for wound checks after 2 weeks; however, 71.8% (n=23/32) of the case patients visited their GP for a wound check and dressing removal due to miscommunication or misunderstanding of the discharge advice.

Conclusions: A self-adherent mesh and sealed glue skin closure dressing system dressing allows for a more comfortable recovery (bathing allowed) and reduces wound concerns and complications. It also allows for patient managed post-operative dressing care thereby potentially reducing primary care burden. Although the dressing system is more expensive, the reduction in wound complications and post-operative appointments offsets this cost.
Our series also revealed some challenges in changing discharge protocols long embedded in the system, where patients are routinely directed to clinical review for dressing management and wound checks.

The Scapula Spine is a Useful Palpable Intra-Operative Landmark for Guiding Glenoid Component Version in Total Shoulder Arthroplasty

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Purpose: To assess the radiographic relationship of the scapula spine to Friedman's line and its usefulness as a palpable intra-operative landmark for glenoid component positioning.

Methods: 3D CT scans of 50 patients (21 male and 29 female) undergoing shoulder arthroplasty were assessed using Blueprint (Stryker, Kalamazoo, Michigan) planning software. Each scapula was orientated in the same plane to ensure consistency of measurement by using Friedman's line and a virtually implanted reverse geometry base plate placed in the vertical axis of the glenoid face. A best fit line was drawn along the surface of the acromion and scapular spine and the angle between this line and the Friedman's line was recorded.
Measurements were performed by three observers and repeated after a two-week interval.
Inter and intraobserver reliability was calculated using the Cronbach's Alpha test.

Results: In round one of measurements the mean scapula spine Friedman line angle (SSFA) was 17.7° +/- 3.9°. The median SSFA was 17.1°. The mean difference in recorded SSFA between observers was 1.7° (range 0.2° - 9.5°). Inter-observer reliability was excellent (Cronbach's alpha 0.96).
In round two of measurements the mean SSFA was 17.6° +/- 3.9°. The median SSFA was 16.9°. The mean difference in recorded SSFA between observers was 1.7° (range 0° - 8.4°). Inter-observer reliability was excellent (Cronbach's alpha 0.96).

Intra-observer reliability was also excellent (Cronbach's alpha of 0.98, 0.99 and 0.99).
There was no significant difference in SSFA between male and female scapulae.

Conclusion: The SSFA angle is a simple intra-operative adjunct to more complex techniques used to optimise guide wire placement in shoulder arthroplasty. It is independent of patient positioning, body habitus and glenoid deformity. This study is the first to measure the SSFA and demonstrated a narrow range between the patients assessed confirming its applicability in clinical practice.

The internal joint stabilizer of the elbow: a review of the clinical and biomechanical evidence

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Background: The goal of surgical management for unstable elbow injury is restoration of joint concentricity and stability. Following internal fixation, instability may persist, or there may be concern for the durability of the fixation construct. Historically, these scenarios were treated with options such as transarticular pinning or external fixation. Recently, there is momentum for internal joint stabilization that allows postoperative mobilization. Our objective was to review the literature for the clinical and biomechanical evidence on the internal joint stabilizer (IJS) of the elbow.

Methods: A systematic review was performed within the PRISMA guidelines. Article groups were the following: retrospective clinical reports on the IJS, case reports on the IJS, and biomechanical reports on the IJS.

Results: There were 7 retrospective clinical reports totaling130 cases at a mean term of follow up of 12.1 months. Across 6 articles, the mean DASH score was 24.2. All 7 articles reported the complication of implant failure with a pooled rate of 4%. Recurrent instability was reported by 6 articles with a pooled rate of 4%. Four of the 6 articles reported a 0% rate of recurrent instability.

Discussion: The IJS is a temporary internal device to stabilize the elbow and allow early motion. Following surgical fixation, the elbow may remain unstable. Application of adjuvant devices, whether internal or external, can provide the requisite stability to reduce the risk of postoperative complication. Recurrent instability has been reported in up to 19% of elbow trauma cases. This complication is challenging and portends chronic dysfunction. Across 6 of the 7 retrospective reports, the pooled rate of recurrent instability with the internal joint stabilizer was 4%. In aggregate, the literature describes satisfactory clinical outcomes and biomechanical efficacy for the IJS. Additionally, case reports have expanded the understanding of clinical application, device position, and surgical approach for the IJS.

Objective Fat quantification in Rotator Cuff Muscles using 2DmDixon techniques of MRI scanning

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Purpose: This study examined the ability of a new technique of MRI scanning to determine fatty infiltration versus wasting of rotator cuff muscles in normal and rotator cuff deficient patients.

Methods and Results: 120 patients presenting for shoulder MRI with normal rotator cuffs (e.g. instability, arthritis etc) were assessed using 2D Fat quantification techniques and a colourized area for surface area measurement. Fatty infiltration is known to increase with age and BMI (Kuzel et al) and we were able to confirm this on statistical grounds using the fat quantification technique to assess increases in supraspinatus from an mean average of 6% under 20 years old to 10% at 80 years old in patients with no rotator cuff tear. Infraspinatus demonstrated increases from 7.5% under 20 years old to 9% at 80 years of age.

120 patients with rotator cuff tears were assessed for level of fat quantification, demonstrating various levels of severity to over 25% in severe cases. We were able to measure rapid deterioration in fatty levels in patients with rotator cuff tears left untreated in as little as 8 months. Rotator cuffs repaired showed maintenance of fat quantification over time after surgery with intact repairs.

Conclusion: There is significant potential in this MRI technique to demonstrate possible prognostic factors in patients presenting with rotator cuff disease and to monitor functional outcomes after surgery.

A comparison between Arthroscopic Capsular Release and Hydrodilatation in the treatment of Frozen Shoulder

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Background: Adhesive capsulitis, or frozen shoulder, is a common but poorly understood condition. Multiple treatment options are available but no superior first line treatment has been identified. Two commonly used treatment options are arthroscopic capsular release (ACR) and hydrodilatation (HD). In recent years, the use of HD has become increasingly common. The aim of this retrospective single-centre study was to compare the outcomes of patients undergoing HD for frozen shoulder versus ACR.

Methods: All patients undergoing HD or ACR for frozen shoulder over a 5 year period (April 2014 to March 2019) were screened for eligibility in the study. The primary outcome measure was whether the patient required further treatment for frozen shoulder or was discharged from care after a single intervention. The secondary outcome measure was improvement in range of motion. Sub-group analyses were also performed on diabetic and post-traumatic groups with frozen shoulder.

Results: A total of 71 patients who underwent ACR and 100 patients who underwent HD were included in the study, with 73.2% and 70% of patients being discharged after a single intervention respectively. There were no statistical differences between patient demographics in either cohort, including the rate of post-traumatic and diabetic frozen shoulder. In both cohorts there was a significant improvement in range of motion and no difference in the efficacy of the treatments was identified, including post-traumatic and diabetic cases. However, diabetic patients were 2.41 times (95% CI, 1.05-5.51; P=0.0376) more likely to require further treatment compared to a non-diabetic.

Conclusion: ACR and HD are both effective treatments for frozen shoulder, however, no significant difference in outcomes between the two interventions was found. HD has less healthcare-associated costs and has fewer potential complications associated with it than ACR, making it a preferable first choice of intervention for frozen shoulder.

Massive rotator cuff tears demonstrate significantly altered scapulohumeral rhythm when compared to small tears using dynamic radiography: a matched, controlled study

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Introduction: Rotator cuff tears (RCTs) alter force couples and glenohumeral kinematics and are known to alter the scapulohumeral rhythm - the ratio of glenohumeral (GH) to scapulothoracic (ST) motion. Quantifying SHR with Dynamic Digital Radiography (DDR), by taking a series of pulsed low radiation radiographs during active range of motion, may enable clinicians to understand the pattern, extent of motion impairment and clinical relevance of RCTs. This could overcome the limitation of conventional MRI only evaluating static morphologic changes. The purpose of this study was to evaluate patients with massive and small rotator cuff tears using DDR, assessing for differences in SHR and range of motion between the two groups.

Methods: Using standardised acquisition protocols, DDR (15 frames/second) was prospectively performed on shoulders, that had MRI-confirmed massive and small RCTs. Glenohumeral and scapulothoracic joint angles were measured at 0-30°, 30-60°, 60-90°, and maximal coronal plane humeral abduction. SHR was defined as the ratio of the change in humeral abduction over the change in scapula upward rotation during humeral abduction and was calculated within the above angle intervals.

Results: Forty-two patients, 29 with massive RCTs (MRCTs) and 13 small RCTs (SRCTs) were included and matched for age and BMI and underwent DDR. SRCTs had a significantly higher average overall SHR (3.04 $\pm$ 1.16) compared to the MRCT (1.91 $\pm$ 0.51) (p=0.003). Scapular range of motion during humeral abduction was lower in SRCT (29.71 $\pm$ 12.91) compared to MRCT (41.57 $\pm$ 10.41).

Discussion and conclusion: Novel dynamic radiography demonstrates consistently lower SHR in MRCTs compared to SRCTs. MRCTs had an increased reliance on scapular contributions to overall humeral elevation. While RCTs continue to be diagnosed on static MRI, dynamic SHR quantification can also inform the extent of motion impairment, clinical relevance and compensatory kinematic changes.

Have Indications for Total Shoulder Arthroplasty expanded?

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Introduction: Shoulder arthroplasty has transformed the shoulder surgery landscape in the last 10 years. Both anatomic and reverse total shoulder arthroplasty (TSA) have broad surgical indications, most notably primary osteoarthritis (OA), rheumatoid arthritis (RA), cuff tear arthropathy (CTA), proximal humerus fracture, and avascular necrosis. However, recent modifications in indications, knowledge of the complication profile and revision rates may have changed implant selection trends. This study aimed to report how TSA for each surgical indication had changed during this period.

Methods: Using IBM Marketscan® database, all patients who underwent a TSA, including anatomic and reverse, from 2010 to 2018 were identified using common Current Procedural Terminology (CPT) codes. Using International Classification of Diseases (ICD) codes, patients who underwent TSAs specifically for OA, RA, proximal humerus fracture, avascular necrosis, and CTA were included in the study. Population estimates were used to estimate the annual incidence of patients with TSA for the above diagnoses. Case volume and incidence were estimated for gender, and age subgroups were determined with 95% confidence intervals.

Results: From 2010 to 2018, 311,153 TSAs were performed. Indications for surgery were: OA (56%), CTA (34%), proximal humerus fracture (5%), RA (2%), proximal humerus necrosis (2%), and combined RA + OA (1%). During this period, annual case volumes of TSAs significantly increased for patients diagnosed with OA by 120%. Across the reportable age cohorts, most of the TSA incidences of patients diagnosed with OA, CTA, and proximal humerus fracture significantly increased.

Discussion and conclusion: TSA for all major indications has become more popular in the past decade. Expanding indications, stronger evidence and superior implants may all be responsible for the increase in TSAs being performed. Osteoarthritis continues to be the major indication. These results suggest that orthopedic training should prepare trainees by incorporating sufficient exposure to total shoulder arthroplasty.

Clinical effectiveness of various surgical reconstruction modalities for acute ACJ separation: a systematic review and meta-analysis

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Purpose: The aim of this systematic review and meta-analysis was to assess the clinical effectiveness of the surgical reconstruction methods utilised for acute ACJ separation.

Methods: The study protocol was designed and registered prospectively on PROSPERO (Ref: CRD42021291349). MEDLINE, EMBASE, PsycINFO, and The Cochrane Library electronic databases were searched in November 2021. Randomised control trials (RCTs) evaluating surgical procedures for ACJ reconstruction were included, without limitation of publication date or language. The primary outcome measure was function as measured by shoulder-specific patient reported outcome measures (PROMs). Risk of bias within each RCT was assessed using the Cochrane Risk of Bias Tool v2.0.

Results: 2714 participants from 44 RCTs were included. 32 of 44 RCTs were deemed "high risk" of bias and the remaining 8 RCTs were deemed to have "some concerns" for risk of bias. Due to the heterogeneity of the outcome measures, quantitative analysis was only performed for Constant Murley Shoulder Score (CMS) in tightrope/endobutton versus hook plate and in hook plate versus ligament reconstruction (long head of biceps or semitendinosus autograft). The tightrope/endobutton demonstrated better CMS compared to hook plate (5 RCTs, n=128 tightrope, n=144 hook plate, mean difference 5.93, 95% CI 2.51 to 9.35). Ligament reconstruction demonstrated better CMS compared to hook plate reconstruction (2 RCTs, n= 49 hook plate, n=48 ligament reconstruction, mean difference -10.2, 95% CI -12.22 to -8.17).

Conclusion: Despite numerous RCTs evaluating different surgical techniques for reconstructing acute ACJ separations, most are heterogenous in their reporting and prone to high risk of bias. Tightrope/endobutton and ligament reconstruction techniques demonstrated superior functional outcomes compared to hook plate reconstruction as per CMS.

Awake shoulder surgery under regional anaesthesia prevents cancellations and the need for HDU/ITU postoperatively.

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Purpose: To demonstrate that awake regional anaesthesia (RA) is a useful tool for shoulder surgery, reducing the need for a HDU/ITU bed postoperatively, and may prevent cancellations on the day of surgery.

Methods: Patients undergoing elective shoulder surgery (n=93) were randomly selected to have a RA rather than a general anaesthetic (GA). Electronic patient records and theatre logs were retrospectively reviewed to investigate the cause for any cancellations of surgery and any postoperative complications.

Results: Procedures carried out were 19% TSR, 76% arthroscopic and 3% open. All patients were pre-assessed, with 5.4% recommended to have HDU/ITU beds available perioperatively. No patients were cancelled and none required an HDU/ITU bed. 72% of patients required light sedation at the time of positioning, and 17% required a longer sedation period. 11% required no sedation at all. None required a PCA post operatively and 14% required local anaesthetic to be delivered by the surgeon.

There were no recorded postoperative complications related to the anaesthetic, including brachial plexus injuries or diaphragmatic paralysis. Mean surgical duration was unchanged as compared to

departmental norms for arthroscopic (128 mins), arthroplasty (167 mins) and open (103 mins) procedures.

Conclusion: Regional anaesthesia provides a safe method of anaesthesia for patients undergoing shoulder surgery and is particularly useful in avoiding cancellations/delays of surgery for high risk patients. This technique provides effective RA for patients undergoing procedures in the shoulder and may be repeated in other centres.

Tranexamic acid administration significantly improves visual clarity for arthroscopic shoulder surgery, but adrenaline offers significantly better clarity than tranexamic acid: A meta-analysis of randomised controlled trials

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Purpose: The purpose of this study was to determine the effect of tranexamic acid (TXA) and/or adrenaline on visual clarity in arthroscopic shoulder surgery. Secondary objectives were to evaluate its effect on total operating time, pain, mean arterial pressure (MAP), and volume of irrigation fluid used.

Methods: A review of the online databases MEDLINE and Embase was conducted according to PRISMA guidelines. Clinical studies evaluating the effect of TXA in arthroscopic surgery were screened. Data aggregation was performed for studies reporting two or more secondary objectives using a random effects model [Review Manager (RevMan) software, V.5.4]. The review was registered in the PROSPERO database. Included studies were appraised using the CONSORT tool.

Results: Seven studies met eligible criteria, all of which were double blinded RCTs. Five studies reported no difference in visual clarity between TXA vs saline, while two reported a significant improvement with TXA. Pooling of data showed that visual clarity was significantly better in the TXA group vs saline, on a standardised 10-point Likert scale (mean difference 0.73 points, p= 0.03). However, adrenaline administration offered significantly better visual clarity than TXA (mean difference 0.9 points, p=0.02). There was no significant difference with TXA use in MAP (mean difference 1.2mmHg, p= 0.14), operative time (mean difference 6.8 minutes, p= 0.11), irrigation volume used (mean difference 0.2L, p=0.88), or post-operative pain (mean difference 3.89 on a 0-100 VAS, p= 0.34).

Conclusion: TXA use in arthroscopic surgery significantly improves visual clarity when compared with saline irrigation alone. This, however, does not translate to significantly less operative time or post-operative pain score. Furthermore, adrenaline use alone offers significantly better clarity than TXA. There may not be an added benefit to give both, but this area requires further research.

Management of Traumatic Brachial Plexus Injuries Pre- and Post-Major Trauma Centre Introduction in the United Kingdom

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This study aims to determine if the management of traumatic brachial plexus injuries (TBPIs) has altered following the introduction of MTCs.

The Trauma Audit and Research Network database was reviewed to identify eligible patients admitted between 1990 and 2022. These patients were subcategorised into those admitted prior to and those

following MTC introduction. Specific measures of utilisation of plexus magnetic resonance imaging and frequency of operative repair of plexus were analysed for differences pre- and post-April 2012. In addition, time to hospital arrival and length of stay data were assessed.

A total of 1276 eligible patients were identified with 388 identified prior and 888 following the nationwide introduction of MTCs. The advent of MTCs was associated with a longer time from incident to arrival in hospital, adding a median of 33 minutes to transfer time ($p<0.001$). The number of patients undergoing brachial plexus MRI more than doubled after the introduction of MTCs (51 vs 12%, $p<0.001$). This improved the access to early surgical repair (during the initial admission) from 5% to 8% ($p<0.05$). Length of stay was reduced by a median of two days (95% CI: 0-3) following MTC establishment ($p=0.012$). This corresponded with a significant increase in the proportion of patients discharged to their own or a relative's home (40% to 78%, $p<0.001$) and decreased likelihood of discharge to a further acute hospital or institution ($p<0.001$).

This study suggests that the introduction of MTCs has improved the utilisation of diagnostic imaging and early surgical repair for patients with TBPI. This is suggestive of an improvement in the specialist care of TBPI during initial admission as a result. An increase in time from incident to hospital arrival post-MTC introduction was identified, which may be explained by increased transit times and redirection to more specialist centres.

Acute rehabilitation following traumatic anterior shoulder dislocation (ARTISAN): A Multi Centre Randomised Controlled Trial

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Background: First time traumatic anterior shoulder dislocation has an incidence of 23.9 per 100,000 annually. Rehabilitation has a key role in restoring a functional, painless shoulder. However there is limited evidence comparing different rehabilitation methods after the initial support in a sling.

Rehabilitation is commonly delivered through a combination of early advice and a programme of physiotherapy, advocated in current UK BESS guidelines. However this is in contrast to some international guidelines that explicitly do not recommend referral to physiotherapy, instead advocating advice alone.

Purpose: We aimed to compare the clinical and cost effectiveness of a single session of advice with a single session of advice and a programme of physiotherapy.

Methods: We completed a pragmatic, superiority, multi-centre randomised controlled trial, funded by NIHR (NIHR; 16/167/56). Four hundred and eighty two participants were recruited from 39 NHS sites between 14th November 2018 and 14th March 2022. To be eligible all participants had to be non-operatively managed with a first time shoulder dislocation (confirmed radiologically), receiving advice and/or rehabilitation within six weeks of injury.

All eligible and consenting participants received a single session of advice to aid self-management. This lasted for up to one hour and included education on the injury, common complications and how to prevent them, pain relief and suggested exercises. Following this session of advice they were randomly allocated (stratified by participant age, hand dominance and recruiting site) to this advice session alone or additional physiotherapy over a four month period. The primary outcome was the Oxford Shoulder Instability Score at six months.

Results and conclusion: The results are currently embargoed whilst under review, but are completed and will be presented on the day.

Shoulder Injury Related to Vaccine Administration (SIRVA) after COVID-19 vaccination: A Case Series

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Background: SIRVA, defined by the Health Resources and Services Administration (HRSA), is ipsilateral shoulder pain and reduced range of motion within 48 hours of vaccination, with no prior shoulder dysfunction or current abnormality that could explain the symptoms. SIRVA is a diagnosis with medicolegal implications and is being increasingly reported in the literature after COVID-19 vaccination. The purpose of this study is to report outcomes in a series of patients presenting with SIRVA after COVID-19 vaccination.

Methods: A retrospective study was performed from January 2021 to March 2022. All patients presenting to the musculoskeletal interface service with atypical shoulder pain after vaccination were reviewed against the HRSA criteria. Data was extracted from the hospital electronic medical records. Patients without a minimum 6-month follow-up and incomplete medical records were excluded.

Results: 31 patients presented to hospital attributing their symptoms to the COVID-19 vaccine. 36% patients (n=11) met the HRSA diagnostic criteria for SIRVA. The mean age was 56 years (31 to 71). Male: female ratio was 5:6. Mean follow-up was 74 weeks. Two patients were concerned about vaccination technique.
55% patients improved after physiotherapy: discharged with near complete symptom resolution (n=3 at 10 weeks) and DNA (n=3 at 11 weeks). 27% patients (n=3) remain under conservative management. Further intervention planned in 18% patients: hydrodilatation (n=1), arthroscopy (n=1).

Discussion: This is the largest series of SIRVA patients after COVID-19 vaccination. Two-thirds of patients may be incorrectly diagnosed with SIRVA. SIRVA after COVID-19 vaccination can be treated conservatively with good outcomes, comparable to SIRVA after non-COVID vaccination (70% patients treated conservatively improved by 30 weeks - Cagle). Prolonged symptoms may require intervention. Poor vaccination technique may be a contributor and national vaccination guidelines exist to minimise risk.

Conclusion: SIRVA has a low incidence rate and responds well to non-operative management.

Does it work and is it cost-effective? - Hydrodilatation for Adhesive Capsulitis

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Purpose: Is Hydrodilatation an effective and economical treatment for patients with Adhesive Capsulitis symptoms uncontrolled by primary care management?

Background: Adhesive Capsulitis symptoms are often self-limiting, however for some patients pain and stiffness can be debilitating and persistent. For severe cases, or when physiotherapy and local steroid injection(s) have not managed symptoms, our local practice is to offer Hydrodilatation treatment. Failing this, patients are often offered a second trial of Hydrodilatation, or more invasive options. Several small studies have reported success with Hydrodilatation, but lack of high level evidence prevented its recommendation by BESS/BOA in the 2015 patient care pathway. Success rates and cost effectiveness of hydrodilatation in our treatment algorithm warranted review.

Methods: Shoulder Hydrodilatation procedures were identified January 2018 - September 2021 from our Radiology booking system electronic report and Practitioner log-book records. Retrospective

electronic notes review was conducted and costing information sought from our local Finance Department.

Results: 451 procedures were identified. After inclusion and exclusion criteria were applied 365 shoulders in 353 patients were analysed. 307/365 (84%) were successfully treated with one hydrodilatation procedure. Complication rates were low. Treatment failure requiring further procedures were second hydrodilatation 22/58 (38%), steroid injection 12/58 (21%), MUA 7/58 (12%), Arthroscopic Capsulotomy 3/58 (5%) and multiple procedures in 10/58 (17%). A rudimentary cost analysis found Hydrodilatation was significantly less expensive compared to MUA or Arthroscopic Capsulotomy when used in this treatment algorithim, even when including costs of further procedures when treatment failed.

Conclusion: The data have demonstrated Hydrodilatation is an effective and safe treatment for patients suffering severe symptoms of Adhesive Capsulitis. When used in a step-wise treatment approach, Hydrodilatation avoids the expense and complications associated with surgical management.

Arthroscopic Bone Block Stabilisation Using Lateral End Clavicle Autograft

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Aim: To report the outcomes of arthroscopic anterior bone block glenohumeral stabilisation with lateral end clavicle autograft.

Methods: This is a retrospective review of all cases of anterior bone block stabilisation with lateral clavicle bone graft done by two surgeons in their respective centres. Data was collected on patient demographics, post-operative outcomes (Oxford Instability Score OIS) and complications. Post-operative CT scans were analysed to assess position of bone graft and union.

Results: Twenty-two patients with mean age of 30 years (±8) underwent stabilisation with this technique and had a minimum follow-up of 6 months. Most of these patients (72%) were involved in moderate to high demand work or sports. 15 (68%) patients had medium to large Hill-Sachs defect.The average glenoid bone loss was 15%. 9 patients had previous failed soft tissue stabilisation. The average pre-operative OIS was 19 (±7). Capsulolabral repair over the graft was possible in 18 patients. The mean follow up period was 10 (±3) months. The average post-operative OIS at last follow-up was 38 (±7). Proper graft positioning in the antero-inferior quadrant was seen in all cases. 20 patients had union of the graft confirmed by post-operative CT. Two patient had non-union of graft although had remained stable thus far. One patient had a traumatic dislocation 5 months post-surgery. No cases of infection, nerve injuries or adhesive capsulitis have been reported. No cases experienced donor site morbidity (ACJ pain or instability).

Conclusion: Lateral clavicle provides an excellent alternative bone graft to previous established options with no donor site morbidity and no extra costs. Healing is equivalent to other techniques and early clinical results are reassuring. Further follow up is required to assess that, longer term, these results are maintained.

Arm lengthening with or without preoperative superior migration in Reverse Total Shoulder Arthroplasty (RTSA): Is there a correlation with postoperative active range of movement (AROM)?

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Purpose: To investigate whether arm lengthening after RTSA is correlated with shoulder AROM.

Methods: Patients underwent arm length measurement pre and post RTSA using a manual calliper. Arm length was measured from the lateral acromion to the distal olecranon, with 90 degrees of elbow flexion, arm by the side. Reliability of method was established in a previous pilot study. Outcomes were AROM of flexion and abduction at 3, 6, 12, 24 and 36 months. A specialist physiotherapist undertook all measurements. A subgroup analysis comparing those with and without preoperative superior migration was undertaken.

Results: 54 patients were included, with median age 75 years. 35 females and 19 males.
Mean arm lengthening was 25mm (SD=11.59). Weak, but significant correlations between arm lengthening and flexion AROM (r=0.37, p=0.018) and abduction (r=0.30, p=0.032) at 3 months were found (n=40). A weak correlation (r=0.44, p=0.018) with abduction was also apparent at 3 years (n=28). No other significant correlations were found. Median arm lengthening of the superiorly migrated group was 30mm, compared to 25mm in the non-migrated group, but the difference was not statistically significant. There were no significant correlations with AROM in either subgroup. One brachial neuropraxia was observed in a patient with 25mm of arm lengthening and there were no acromial stress fractures.

Conclusion: There is a weak correlation between arm lengthening and post-operative AROM in RTSA at 3 months, and in abduction at 3 years. We acknowledge the lower numbers at 3 years. All patients achieved functional ROM regardless of degree of arm lengthening. Arm lengthening does not appear to be a critical factor in recovery of AROM post RTSA, and is not associated with complications.

Systematic review of Parsonage Turner syndrome following Covid 19 pandemic

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Background: Shoulder girdle syndrome or Parsonage Turner syndrome (PTS) is a debilitating condition, with acute onset excruciating pain around the shoulder girdle and arm leading to weakness and atrophy of muscles. Numerous reports have been published following COVID-19 infection and vaccination leading to PTS. The current review aims at collating the data and analysing them to identify the course of the disease and management strategy.

Methods: A comprehensive search was performed using OVID, EBSCO hosted Medline, CINAHL, PEDro, Cochrane and PubMed databases between Jan 2020 and October 2022. The search strategy identified 173 papers, of which 94 were relevant, after applying strict inclusion criteria, 33 articles were included in the study.

Results: The review identified 62 cases, of which 37 patients (60%) are post vaccination. 43 patients (69%) are males with a mean age of 51 years (range 17-84). Majority of these patients had mRNA vaccination (26/37). The mean incubation period for development of the symptoms were 14 days from vaccination or infection. The average time between onset of pain and neurology is 17 days. 77% of patients developed symptoms on the arm they had vaccination. Axillary nerve (21) was commonly involved followed by suprascapular nerve (15). 13 patients had sensory involvement, two patients have complete plexus involvement and one had bilateral upper-limb weakness. 81% of patients who had steroid therapy had complete or near complete recovery when compared to 55% in the supportive therapy group.

Conclusions: PTS affects middle aged males following covid vaccination or infection. Majority of the patients who had PTS had mRNA vaccines. Rotator cuff and deltoid are commonly affected. The outcome following use of steroid therapy in these patients are promising when compared to supportive therapy.

Bilateral Shoulder Fracture Dislocations - Long term outcome and management algorithm

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Introduction: Bilateral shoulder fracture dislocations are uncommon and pose a challenge for treating surgeons. There is significant gap in the English literature as there is limited evidence in management of these injuries. We present our experience from our centre, the biggest series reported in the English literature. Based on our experience and literature review, treatment algorithms were devised.

Methods: Seven cases that presented to our institute between 2012 and 2022 were included in the study. Four patients had bilateral anterior dislocation, one had bilateral posterior dislocation and two had anterior and posterior dislocations. All were males, and the average age was 42yrs (26-63). Two part fracture pattern was the commonest 64%, followed by 4 part fractures 29% and 3 part fracture 7%. Four shoulders were treated with closed reduction alone and remaining treated with ORIF. All the patients were assessed with DASH, ASES and EQ5D score. Literature review revealed 37 reports with 41 patients, based on the review and our experience, management algorithm is formulated.

Results: At an average follow-up of 57 months the mean DASH score was 26 (range 0 to 80), the mean ASES score was 75 (range 27 to 100). The average EQ5D-5L score was 2 (range 1-4). There is significant difference in the outcome between post seizure (10 shoulders) and post traumatic shoulder dislocations with the outcome worse in patients with post trauma. One patient developed AVN, and eight patients developed heterotopic ossification (HO).

Conclusion: The long-term outcome following appropriate management of these complex injuries is reassuring and the algorithm will assist the surgeons plan the management protocol, based on the injury pattern. The risk of HO is high and could be minimised with stable fixation and early mobilisation. The outcome in post-traumatic fracture dislocations is poor when compared to the post seizure ones.

Validating the Glenoid Track Concept for Recurrent Traumatic Anterior Glenohumeral Joint Instability Using Arthroscopic Assessment

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Purpose: The purpose of this study was to determine the accuracy and reliability of utilising the glenoid track concept against dynamic arthroscopic assessment of Hill Sachs lesion engagement.

Methods: After ethical approval (ref: REB#17-0575), patients listed for anterior labral stabilisation surgery were invited to participate. 49 patients undergoing arthroscopic Bankart repair surgery for recurrent traumatic anterior shoulder instability, performed by three fellowship-training shoulder surgeons, were enrolled in this diagnostic validation study. All shoulders were classified as 'on track' or 'off track' using 3DCT and static arthroscopic measurements using a calibrated measurement probe (as described by Di Giacoma et al). These classifications were compared to dynamic arthroscopic assessment (engagement of the Hill Sachs lesion on the anterior glenoid rim in the athletic position) to determine their accuracy and reliability.

Results: 3DCT based measurements to determine glenoid track status had a higher positive predictive value (66% vs 42%), higher specificity (47% vs 42%), and higher accuracy (65% vs 59%) compared to static arthroscopic measurements. Static arthroscopic measurements to determine glenoid track status had a higher negative predictive value (96% vs 64%) and higher sensitivity (96% vs 81%) compared to 3DCT based measurements. Inter-rater reliability (Krippendorff's α) was fair for determining the glenoid track status using 3DCT (0.368; 95% CI 0.217-0.519) and moderate for static arthroscopic measurements (0.523, 95% CI 0.364-0.666). Intra-rater reliability (ICC 3,k) was moderate for 3DCT measurements (0.660, 95% CI 0.444-0.798) and good for static arthroscopic measurements (0.769, 95% CI 0.629-0.862).

Conclusions: Determining glenoid track status using either 3DCT or static arthroscopic measurements yielded moderate accuracy and reliability. Surgeons using the glenoid track concept to aid surgical decision-making in traumatic recurrent anterior shoulder instability should utilise 3DCT or static arthroscopic measurements with caution, and not in isolation to other factors.

The Impact of an Upper Limb Orthopaedic Network: supporting regional shoulder and elbow arthroplasty

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Introduction: The management of complex upper limb arthroplasty has received increasing scrutiny over the last few years with national guidelines supporting the use of a regional network. An upper limb network was established to share experience and best practice between 5 units for both elbow replacement and complex or revision shoulder replacement. This study evaluates the impact of establishing this network over a four-year period.

Methods: Clinical data and case outcomes were collected prospectively from network meetings from June 2017 to December 2020. Hospital level NJR data was obtain for the same time period to analysis of case volume.
Results: 191 cases were discussed. There was a year-on-year increase in cases discussed until 2020 during the COVID pandemic. 77% of cases originated from the hub centre. Network discussion changed the management plan in 53% of cases. Only 8% of cases required transfer to the tertiary centre.

Discussion: A specialist regional network adds value to surgical decision making for complex cases, with further management options realised in over half of cases presented. Whilst the network led to changes in management plans for many patients, the support allowed the majority to remain in their original unit for surgery. Discussion allowed every patient to gain the advantage of shared experience while retaining the ability to have their surgery conveniently at a local hospital.

Outcomes of managing severe glenoid bone loss using custom 3D printed glenoid components in primary and revision reverse polarity total shoulder arthroplasty: a minimum 2-year follow-up.

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Purpose: The aim was to report the outcomes of custom 3D-printed glenoid components for managing severe glenoid bone loss in primary or revision reverse shoulder arthroplasty with a minimum 2-year follow-up.

Methods: Following ethical approval (ref:17/YH/0318), patients were invited to participate. Inclusion criteria were: 1) severe glenoid bone loss necessitating the need for custom implants; and 2) patients with definitive glenoid and humeral components implanted more than 2 years prior. Patients underwent clinical assessment utilising the Oxford Shoulder Score (OSS), Constant Murley score (CMS), American Shoulder and Elbow Society Score (ASES), and Quick Disabilities of the Arm, Shoulder, and Hand Score (QuickDASH). Radiological assessment included AP and axial radiographs and a CT scan to confirm osseointegration. Statistical analysis included descriptive statistics and paired t test for parametric data.

Results: Of 58 eligible patients, 11 declined to participate. Five were deceased prior to study commencement, leaving 42 patients for analysis. Mean age was 74-years-old (range 53-92). Mean follow-up was 32months (range 24-52months). Fourteen patients were primary cases; 28 had a prior shoulder arthroplasty. OSS improved from a mean 15 (SD8.4) to 36 (SD12, $p < 0.001$). CMS improved from mean 15 (SD11.2) to 52 (SD20.1, $p<0.001$). QuickDASH improved from mean 70 (SD21) to 31 (SD24.8, $p=0.004$). ASES improved from mean 22 (SD17.8) to 71 (SD23.3, $p=0.007$). Mean abduction was 99° (SD40°); mean flexion 105° (SD37°); mode internal rotation was to the buttock level. Mean abduction

strength was 7lb (SD5.9). Radiological evaluation demonstrated good osseointegration in all but one patient. Three patients underwent revision surgery; 2 of 3 retained their custom glenoid components. One patient developed deep infection requiring excision arthroplasty; 2 had humeral-sided asceptic loosening requiring revision humeral prostheses.

Conclusion: The utility of custom 3D-printed components for managing severe glenoid bone loss yielded significant yet modest clinical improvements in this complex cohort.

Impact of Accumulating Risk Factors on Instability after Reverse Total Shoulder Arthroplasty

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Study Aim: The purpose of this study is to better facilitate pre-operative identification of patients at-risk for instability after rTSA and to quantify the impact of accumulating risk factors.

Methods: A multi-center retrospective analysis looking at the instability rate associated with a single platform prosthesis (Equinoxe; Exactech Inc, USA) was performed. All primary rTSA's in the database were included. Exclusion criteria included revisions, infections, and fractures. Demographic, clinical and radiographic data were collected and the prevalence of risk factors and the instability rates were recorded. An odds ratio analysis quantified the impact of accumulating risk factors on the occurrence of dislocation.

Results: 8,301 patients with mean age of 71.9yrs and average follow-up of 27.2 months demonstrated an instability rate of 1.4% (n=119). Instability was significantly higher in males (2.3% $p<0.0001$), Patients $\leq$ 67 years (2.6% $p<0.0001$), cemented humeral stems (2.7% $p<0.0001$), glenospheres >40mm (2.2% $p<0.0001$), and expanded glenospheres (3.2% $p<0.0001$). The instability rate was observed to increase with the prevalence of risk factors, where patients with 3 and 4 risk factors had a higher instability rate than patients with less risk factors. 96.2% of patients had at least 1 risk factor. Stratifying instability rate by multiple instability risk factors identified numerous cohorts with odds ratios >4, meaning that these cohorts of patients were 4x more likely to experience instability.

Conclusion: This 8,301 rTSA study demonstrated that 1.4% of rTSA's experienced instability with 36.1% having 1 risk factor, 42.5% having 2, and 14.7% having 3 risk factors. Stratifying multiple combinations of risk factors demonstrates the impact of accumulating risk factors on incidence of dislocation. The patients with the most pronounced risk of instability were males, no subscapularis repair, and $\leq$67 years. Patients considering rTSA with multiple risk factors and high odds ratios for instability should be counseled on the higher risk.

Dynamic Measurement of Shoulder Range of Motion Using the Intel Realsense D435 Camera

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Background: Shoulder range of movement (ROM) assessment is important for evaluating shoulder pathologies. However, goniometric measurement of only peak range misses out on dynamic assessment of complex shoulder movements. The Intel Realsense 3D camera (D435) can digitally detect body movement in space without the need for markers to detect position. We aimed to determine whether this camera can dynamically assess shoulder movement smoothness, velocity and acceleration, in addition to quantifying the peak ROM.

Methods: 26 healthy subjects without any history of shoulder pathology participated and were instructed to perform maximum shoulder abduction. Measurement of the whole upper limb motion in

the coronal plane was recorded for both right and left sides using the Intel Realsense D435 camera and data processed using Microsoft. Processed video outputs of movements demonstrated the change in acceleration through the different phases of movement by displaying red or green segments of the movement arc corresponding to increasing or decreasing acceleration.

Results: Mean age was 39 years (+/-SD 11.6) with female: male ratio of 21:5. Mean abduction angles of 151.9 degrees (+/-SD 8.4) and 153 (+/- SD 8.7) were observed for right and left arms respectively. The mean area of abduction curve used to measure the total capacity of abduction was similar in both upper limbs. (P <0.49). There was a distinct difference in velocity in the first half of shoulder abduction compared to second half with mean acceleration (metres/second) in the 1st half of the total range of movement being 4.65 and 2.8 compared to 3.87 and 2.3 in the 2nd half for right and left arms respectively.

Conclusions: Infrared depth cameras like Intel Realsense D435 camera are capable of dynamically assessing shoulder movement in addition to quantifying shoulder ROM. This technology could be used to differentiate between shoulder pathologies in order to provide targeted treatment.

Recognizing a modifiable imaging pitfall to improve radiological detection of rotator cuff tears: the effect of internal humeral rotation during magnetic resonance imaging and the misdiagnosis of cuff tears

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Purpose of this study was to investigate relation of humeral head rotation during MRI scans and the correlaton of this with over-reporting of rotator cuff tears.

Magnetic Resonance Imaging (MRI) is one of the most commonly used modalities for the diagnosis of rotator cuff tears. In this study, we retrospectively evaluated the effect of a modifiable imaging pitfall; internal humeral rotation during scanning, on the accuracy of radiological diagnosis which was later corroborated by intraoperative findings. This has never been reported before in the literature. Humeral positioning during upper limb MRI was not standardised at our institution and represents a pragmatic representation of imaging practice. Thirty-one shoulder arthroscopies performed for presumed rotator cuff tears were analyzed retrospectively at our institution. All patients had a preoperative MRI. Fourteen (45%) patients were found to have the humerus in internal rotation during MRI and 10 of those were reported as a rotator cuff tear. Evaluation of intraoperative records showed that only 5 (positive predictive value = 50%) had a true rotator cuff tear.

Our findings indicate that caution should be exercised during interpretation of scans with the humerus in internal rotation and support standardised MRI humeral positioning protocols for shoulder imaging investigations.

Early outcomes of arthroscopic assisted Lower Trapezius Tendon Transfer for irreparable posterosuperior rotator cuff tears

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Statement of Purpose: In light of increasing incidence of massive irreparable rotator cuff tears, this study assesses the clinical outcomes of arthroscopic assisted lower trapezius tendon transfer which is emerging as an alternative to latissimus dorsi transfer.

Methods and Results: This is a consecutive prospective single-centre series. Clinical inclusion criteria were patients with a lag in external rotation with a positive horn-blower's sign along with an intact

subscapularis on clinical testing with a minimum follow up of 12 months post-operatively. The MRI scan should have shown evidence of irreparability in the form of significant fatty infiltration in the muscle, significant tendon retraction and short tendon length. Patients with arthropathy, subscapularis tears and axillary nerve injury were excluded.

The procedure was performed in a beachchair position with isolation of the lower trapezius tendon inferior to the medial portion of the spine of the scapula. The hamstring autograft/allograft was arthroscopically fixed over footprint after preparation. The graft was then tunneled and fixed to lower trapezius tendon using a Pulvertaft weave.

Eight patients had the procedure with either hamstring autograft or tendoachilles allograft (2020-2021)(Mean follow-up-16.5 months). The mean Oxford Shoulder score improved to 40.25 as opposed to 28.6 pre-operatively($p<0.05$)(Wilcoxon's test). The mean range of active external rotation improved from 20 degrees pre-operatively to 46.5 degrees($p<0.05$). All patients improved to Grade 3/4 Power on testing the Teres minor. The mean range of active forward elevation improved to 138.8 degrees from 107.6 degrees ($p<0.05$). One patient developed post-operative adhesive capsulitis which resolved with regular physiotherapy. There were no cases of deep infections, donor site morbidity or graft failures at the last follow up.

Conclusions: The early clinical outcomes of lower trapezius tendon transfer are encouraging and in line with biomechanical studies providing a suitable alternative for management of irreparable rotator cuff tears without glenohumeral osteoarthritis.

Outcomes Following Pyrocarbon hemiarthroplasty of the shoulder: A systematic review

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Purpose: This systematic review aimed to summarise existing literature on post-operative outcomes following pyrocarbon hemiarthroplasty.

Methods: A systematic review was performed of Pubmed, MEDLINE, EMBASE and Cochrane according to PRISMA guidelines. Inclusion criteria was all studies assessing outcomes following pyrocarbon hemiarthroplasty in patients under 70 years of age, with exclusion criteria including reviews, opinion based reports and surgical technique papers. Data collection included demographics, function and complications.

Results: 326 patients were studied with a mean age of 54. 65.8% were male. 61.6% underwent hemiarthroplasty for primary glenohumeral osteoarthritis. The mean pre-operative Constant Score (CS) was 37.4 (26-50). Post-operatively, patients were able to achieve a mean of 131.7 degrees abduction (131.4-131.9), 145 degrees forward flexion (132-160 degrees) and 43.8 degrees external rotation (30-57.2). The mean post-operative CS was 76.4 (69-81). The overall revision rate was 6.1% after a mean follow-up of 29.2 (24.3-60.0) months.

Conclusion: Short term follow-up results for pyrocarbon hemiarthroplasty of the shoulder prove positive in terms of functional benefit, range of motion and revision rate. Further long term study is required to ascertain implant longevity.

Shoulder strength and patient reported outcome measure, their relationship in atraumatic shoulder instability: a correlation study

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To investigate the relationship between patient reported outcome measure (PROM) and shoulder external and internal rotation strength in adults with atraumatic shoulder instability (ASI).

49 anonymised retrospective data sets were obtained from a larger clinical trial. 25 participants underwent an arthroscopic stabilisation, 24 had an arthroscopic investigation without surgical intervention. All participants received post-operative physiotherapy, with therapist and patient blinded to treatment allocation.

A hand-held dynamometer was used to measure isometric shoulder internal and external rotation strength. Strength scores were normalised to bodyweight. The Western Ontario Shoulder Instability Index (WOSI) was the chosen PROM for shoulder instability participants. The self-administered questionnaire containing 4 subcategories was completed at initial and 6month follow up assessment.

Descriptive statistics were calculated for each variable, with normality of data distribution checked and confirmed using Shapiro-Wilk and Skewness. Spearman's rank correlation coefficient was the non-parametric statistical test used to analyse the relationship between shoulder rotation strength with the WOSI, including subcategories, at each time point.

The median age of participants was 23 years. Most participants were right hand dominant (94%), and 57% presented with symptoms on their dominant side.

Both strength and WOSI scores showed significant improvement following 6months of intervention.

There was a statistically significant correlation between shoulder internal rotation strength and WOSI at baseline, and external rotation strength and WOSI at 6months. This significance was also present in WOSI subcategories physical, lifestyle and sport. No correlation existed between emotion subcategory and strength at either time point.

Results suggest a relationship may exist between WOSI and shoulder strength in adults with ASI. However, this does not appear to extend to a person's consciousness or frustration levels about their shoulder or concerns a person may have about the shoulder getting worse.

Further research is required of larger sample size to provide more conclusive results.

Mi-eye guided injections of microfragmented adipose tissue (mfat) for shoulder osteoarthritis - a safe and effective treatment to delay shoulder arthroplasty and avoid steroid injections. A prospective observational case series

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Purpose: To quantify the efficacy and safety of injectable microfragmented adipose tissue (mFat) for shoulder osteoarthritis using the mi eye needle arthroscope as both a visualisation and delivery device.

Methods: 13 patients with symptomatic shoulder osteoarthritis were prospectively recruited into the study after fully informed consent. All patients were clinically candidates for an arthroplasty but all wanted to try and delay arthroplasty and avoid steroid injections during the COVID-19 period.

mFat was harvested from the abdomen in a standard manner and injected into the GHJ using a needle arthroscope under direct vision as an outpatient procedure.

13 patients (9F) Mean age 64 (44-72) were prospectively recruited by a single surgeon. Validated shoulder PROMS including baseline Oxford shoulder scores were recorded. These scores were reviewed at intervals up to 52 weeks following mi eye guided injection into the glenohumeral joint with mFat.

Results: The mean Oxford Shoulder Score (OSS) improved from 18 preoperatively to 30 after 12 weeks and this was maintained at 52 weeks.
No infections reported.
No patients in this series had requested conversion to arthroplasty at three year follow up.

Conclusion: MFat is a safe and effective treatment for patients with symptomatic shoulder osteoarthritis leading to a sustained improvement in the Oxford shoulder scores at one year post injection. This duration cannot be explained by the mechanical effects of the injected fat alone. We postulate there is a humoral effect from an as yet undefined biological mediator that is stored within adipose tissue released when the adipose tissue is processed prior to injection. The authors accept this is an observational study and as such has methodological deficiencies, however; given our observed results we believe mFat merits further investigation with randomised controlled trials to see if these results are reproducible by others.

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