The clinical and cost effectiveness of surgical repair of partial rotator cuff tears in patients with subacromial shoulder pain: a comparison of surgical repair versus surgery with no repair.

Partial Rotator Cuff Repair Trial (PRoCuRe Trial)

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Study registration: ISRCTN: 60983694

Plain language summary

Aims and objectives: To assess if surgical repair of partial rotator cuff tears is effective in patients with persistent shoulder pain despite physiotherapy and steroid injection.

Background: Rotator cuff tears are shoulder tendon tears causing pain, weakness and loss of movement, leading to problems with daily activities, work, recreation and sleep. Tears can be full thickness (whole tendon) or partial. Patients who do not get better with non-operative treatments may choose surgery. Although rotator cuff tears cause pain and disability, it is not known which surgery is best or if repairing partial tears prevents full tears and worsening problems.

Methods: We planned a randomised controlled trial across 20 UK NHS hospitals . Between July 2021 and August 2022 we aimed to recruit 376 patients over 18 years of age suffering persistent shoulder pain and partial rotator cuff tears . Eligible patients received arthroscopic (keyhole) surgery to either debride (shave away inflamed tissue, rough tear edges and bone spurs) and repair the tear, or debride only without repair. Patients were followed up using questionnaires.

Key findings: This study of an elective surgical procedure was severely impacted by the COVID-19 pandemic, especially staff shortages, sickness and redeployment. Changes post pandemic to the patient pathway and national surgical prioritisation processes had a major impact on identifying

eligible patients with partial tears. All these factors effected site set-up and patient recruitment. The study closed early due to slow recruitment. Only 10 patients from 9 NHS Trusts were randomised, precluding any meaningful analysis .

Patient and public involvement: Patients were involved in the study design, set up and monitoring.

Conclusions and future plans: The impact of the pandemic prevented trial progression and this research question is now likely to remain unanswered. Detailed post-pandemic feasibility work is needed before attempting a similar study.

Keywords: Acromion, Arthroscopy, Debridement, Decompression, Randomised Controlled Trial, Rotator Cuff, Shoulder Pain, Steroids

Summary of research findings

Background.

The rotator cuff tendons of the shoulder connect the muscle bellies of Subscapularis, Supraspinatus, Infraspinatus and Teres Minor to the proximal humerus. These muscles play a critical role in the stability and function of the shoulder. Degenerative rotator cuff tendon tears are highly prevalent with increasing age and although some tears can be present without any symptoms, they can lead to subacromial shoulder pain and disability. Degenerative tears usually start at the leading edge of the supraspinatus tendon above the glenohumeral joint and underneath the acromion. Many surgeons and patients believe that these tears start as partial thickness tears (PTTs) and then progress to full thickness tears (FTTs)[1].

Surgical repair of FTTs is very common in the NHS with around 9,000 repairs/year at a cost of £6,628 per operation (£60 million in total) [2, 3]. We have already shown in the UKUFF Trial that many repairs of larger FTTs fail [(3)]. Some patients who develop larger FTTs also end up needing more expensive, complex repairs. In recent years, a rapidly increasing number of shoulder replacements are being undertaken for extensive FTTs. These expose patients to greater risks and are of great cost to the NHS [4]. Despite these realities, little has been done to investigate whether some PTTs have the potential to heal sufficiently without repair surgery, or whether surgery prevents FTTs. It is therefore important to know if repairing PTTs is worthwhile to patients in improving pain, function and also in preventing FTTs developing [5].

Current Practice: Patients with a partial rotator cuff tear can present with shoulder pain and loss of function. Arthroscopic shoulder surgery is offered as an option if physiotherapy and injection

treatments have failed to make any improvement [6]. As diagnosis of partial rotator cuff tears can only be confirmed during arthroscopic surgery [7], shoulder arthroscopy is commonly performed in the NHS to both confirm the diagnosis and then perform a subsequent therapeutic procedure at the same time. This can include debridement of inflamed bursal tissue and any ragged tear edges, and/or bony decompression, and/or a rotator cuff repair procedure. Physiotherapy and rehabilitation routinely follow surgery.

Current Evidence: There is limited evidence available on the effectiveness of repairing PTTs surgically. It is not currently known if this practice improves pain, function and prevents FTTs from developing. There is the possibility that debridement surgery alone might help, or that symptoms can improve without surgical intervention, but the evidence for best treatment, and the natural history of painful PTTs, remains uncertain [8, 9].

The only evidence that exists assessing outcomes from PTT surgical repair is from a multitude of surgical technique case studies and small cohort studies showing favourable outcomes for surgery [4, 5, 10]. Previous systematic reviews support surgery but unfortunately contain low quality studies [11, 12]. Other studies were not direct assessments of the surgical repair intervention, however these focused more on surgical technique. These also showed no difference in outcomes with different techniques and concluded that the best treatment method for this patient group is unknown [13-16].

To add further to complexity of the choice of treatment for PTTs, there is evidence indicating that imaging quality in diagnosis of rotator cuff problems is insufficient. A 2013 Cochrane Review by Lenza et al on the accuracy of shoulder imaging for rotator cuff problems reports the sensitivity and specificity of Magnetic Resonance Imaging (MRI) to be 74% and 93% respectively [7]. Ultrasound scans also showed problematic sensitivity and specificity rates, with 52% and 93% respectively. Therefore, in most cases, confirmation of PTT diagnosis can only be confirmed during an arthroscopic procedure. This issue of diagnostic inaccuracy (outside of arthroscopy) also needs careful consideration in any formal evaluation of PTT surgical intervention.

Evidence Based Surgery: The provision of any treatment of unknown efficacy or value is problematic for both individual patient wellbeing and the health service in general and this work fits with the current initiative (NHS England and RCS) to scrutinise and fully evaluate the efficacy of surgical procedures. As symptomatic FTTs requiring surgery are now highly prevalent in the UK [17] knowledge on the effectiveness of treatment in reducing pain and disability, and proof that PTTs progress to FTTs is needed. FTT's cause a significant health burden and their prevention should be a priority [2, 13]. The 2015 James Lind Alliance Priority Setting Partnership on shoulder surgery highlighted this research question and priority [5].

The limited work in this area highlights the uncertainty around whether there is a benefit to PTT repair. Responses from a survey of the shoulder surgeon community confirmed the existence of community equipoise and a willingness to engage in the provision of evidence-based practice. Given the lack of quality evidence and the potential effects of progression on NHS resources, a robust trial was required to address the issues surrounding PTTs and their management.

The PRoCuRe Trial was developed to answer whether arthroscopic surgical repair of PTTs is clinically and cost effective by comparing it to arthroscopic debridement surgery with no repair. The study was designed to help provide evidence on this patient population in relation to the short-medium term effects on pain and disability, and the longer-term effects including preventing progression to symptomatic FTTs.

Choice and Justification of Treatment Arms: In the NHS, surgeons treat PTTs with a variety of surgical options including cuff repair, debridement, subacromial decompression/acromioplasty, and any combination of these interventions. The primary research question surrounds the efficacy and cost effectiveness of arthroscopic repair of PTT. The treatment arms for the study were:

- Intervention = Arthroscopic Debridement and Arthroscopic Repair (ADAR)
- Comparator = Arthroscopic Debridement Only (No Repair) (ADO)

The treatment chosen for comparison against surgical repair (arthroscopy and debridement only - ADO) is a routine surgical procedure that some surgeons perform for PTT. It consists of all elements of the definitive repair intervention, but without the "*critical surgical element"* of that procedure, the repair itself. This high-fidelity treatment control is also useful from a design point of view as it will confirm or refute the theoretical mechanism for benefit by accounting for any placebo effects of surgery [18].

The previously outlined issue of diagnostic inaccuracy for PTTs without undergoing arthroscopy means that a non-operative arm is neither appropriate or possible [7]. Any comparison study employing a non-surgical intervention would be compromised by inclusion of incorrectly diagnosed PTTs. Moreover, previous experience in surgical versus non-surgical treatment trials using similar populations (and recent patient involvement work), indicate a non-surgical intervention would be difficult to recruit to and therefore not feasible [3]. Conducting a two-arm surgical trial in which both groups undergo arthroscopic surgery allows for essential confirmation of diagnosis, secure patient blinding and represents the most efficient design to assess efficacy of repairing PTTs. A QuinteT (Qualitative Research Integrated in Trials) Recruitment Intervention (QRI)[19] was included to support recruitment.

Aims and Objectives

The aim of the PRoCuRe trial was to determine the clinical and cost effectiveness of surgical repair of partial rotator cuff tears in patients with subacromial shoulder pain, with the primary objective of answering the question, 'In patients with suspected PTT listed for arthroscopic surgery, is ADAR more beneficial than ADO as measured by pain reduction and functional restoration at 24 months post operation?'

The secondary objectives of the PRoCuRe trial were to assess and compare:

- early patient reported pain and function outcome (Baseline 6, 12 and 24 months)
- patients' quality of life
- patient resource use.
- patient satisfaction and perceptions
- tear progression
- long term health care usage, complications, further surgery, patient reported pain and function and quality of life for randomised patients.

The study also had exploratory objectives to:

- optimise the accuracy of MRI and USS imaging in diagnosing PTTs
- assess the long-term health care usage, complications, further surgery, for the non-randomised patients

Methods

Study design: The PRoCuRe trial (Ethics Ref: 21/LO/0081) was designed to be a multicentre superiority randomised controlled trial (ISRCTN60983694) using a two-arm parallel group design with 1:1 allocation ratio as outlined in Figure 1. The trial had an internal pilot phase leading to the definitive trial and a Quintet Recruitment Intervention (QRI) with two iterative stages:

- Stage I: To develop a detailed understanding of the recruitment process leading to,
- Stage II: The use of tailored interventions to improve recruitment.

The trial was designed so that participants would be blinded to the randomised allocation i.e. as to whether they had their PTT repaired or not. Due to the nature of the interventions, it was not possible to blind theatre staff nor the surgeon.

Participants were recruited to the study in NHS hospitals across England. The study overall was modelled on participation from 20 centres, with additional sites to be included depending on recruitment rates in the 6-month pilot phase.

Participants (patients) were expected to be enrolled in the study for up to 5 years. During this time, they would complete questionnaires at baseline, 6-, 12- and 24-months post randomisation. They would also be asked to have an MRI scan two years after their surgery. Routine healthcare data would be collected up to five years to assess for any longer- term shoulder diagnoses and healthcare resource use following the repair. Participants would have received a short questionnaire at 5 years to assess patient reported outcomes, so that long-term clinical and cost effectiveness could be estimated.

Pilot phase: An internal pilot was planned that would progress to the definitive trial if predefined evaluation criteria regarding recruitment rate, randomisation process and adherence to allocated treatment were met. The pilot trial was to mirror the procedures and logistics to be undertaken in the main definitive trial. We planned for the data that were collected in the pilot trial to contribute to the final analysis.

The pilot aimed to randomise 30 patients or more over a 6-month period from at least 6 sites with staggered initiation, with a target recruitment rate of one patient per site per month. If any issues were identified, it was proposed that they be discussed with the TSC; any changes required for the definitive trial were to be discussed with the funder and submitted as amendments for approval.

The QRI is a well-established intervention involving rapid data collection and analysis, to identify and understand any challenges to recruitment, with feedback to the trial management team, the development of action plans and provision of tailored recruitment support and training.

The pilot phase included close monitoring of discrepancies between suspected diagnosis from imaging and true diagnosis from operation. Any patterns in these errors and inaccuracies based on imaging type, imaging sequencing, content or seniority of reporting formed part of feedback to centres, and surgeons in order to make improvements during the full recruitment phase [20, 21]. Adherence with protocol was assessed as part of the pilot.

The Trial Management Group (TMG) and independent oversight committees monitored progress and success during the pilot phase using the following traffic light system for progression; green light for 30 recruited patients, no other action needed, trial continues. Amber light for between 15-30 recruits, actions to include; auditing of centres, analysis and implementation of QRI results, refresher training, amendment of study procedures. Red light for less than 15 recruits, next steps and measures would be discussed with the funder.

Inclusion Criteria for potential recruitment into trial: Each participant in the trial were patients who had decided on surgical treatment based on ongoing subacromial shoulder pain and who:

- Had MRI or USS imaging suggesting a PTT diagnosis in Supraspinatus or any small FTT in Supraspinatus where there is radiologist or surgeon uncertainty between a PTT and small FTT and were:
    - Over 18 years of age
    - Willing and able to provide informed consent
    - An understanding of the English language sufficient to receive written and verbal information about the trial, its consent process and complete study questionnaires

Inclusion Criteria for randomisation in the operating theatre during surgery:

- PTT more than 50% tendon thickness confirmed in Supraspinatus during arthroscopy

Exclusion Criteria. Individuals who met any of the following criteria were excluded from the trial:

- Patient has not had at least one steroid injection on the side to be operated
- Steroid injection within six weeks of planned surgery date on the side to be operated
- Inflammatory arthritis (e.g. rheumatoid)
- Established Glenohumeral Osteoarthritis (Grades II, III and IV)
- Current active malignancy of any kind
- Tears associated with acute fractures
- Tears associated with shoulder dislocations
- Upper limb neurological deficit on either side
- Cardiac Pacemaker (absolute contraindication for MRI)
- Unable to complete the written follow up questionnaires

Screening and recruitment: Potential participants were recruited through routine shoulder services such as outpatient clinics, pre-op assessment clinics, surgical waiting lists; depending on local procedures and new ways of working post COVID pandemic, the format of this initial contact was face-to-face or virtual/remote. The clinical team identified potential participants and, if trained, discussed the trial before referring the patient to the research team for further information. At some centres QRI intervention(s) were used to support recruitment and training; clinical team members who had not received training would advise the patient of their potential eligibility for PRoCuRe and refer them on appropriately.

In addition to verbal information, potential participants were given, or sent, written study information to read at home. They were informed that participation in the trial was optional and would not affect their medical or legal rights. All patients were made aware of the trial's aims, anticipated benefits and potential risks. Patients were allowed a period of reflection adequate to their individual needs to decide whether they would like to consent to take part in the trial or not. No delay to surgery was incurred as a result of being invited to take part in the study i.e. patients with a surgery date that did not allow for the minimum reflection period needed were not consented.

During their outpatient clinic appointment, a patient may decide to pursue surgical treatment; making them potentially eligible for PRoCuRe. All patients who decided on surgery were routinely added to the waiting list at this point. This included patients who expressed an interest in taking part in PRoCuRe, but they were not prioritised for surgery above those who were not participating. They proceeded through the standard clinical pathway as per routine care.

The eligibility assessment formed a 2-stage process:

Stage 1: Initial eligibility assessment; confirm patient as potentially eligible for randomisation

This initial stage of the assessment was conducted by an appropriately qualified member of the clinical team and depended on routine history, shoulder examination and interpretation of the MRI or USS imaging conducted as part of normal care (as per local hospital policy), to confirm the initial diagnosis and rule out any exclusion criteria. The PI/co-PI at each site would take overall responsibility for confirming patient eligibility but was able to delegate the eligibility assessment to a suitably qualified and experienced member of the clinical team. Details relating to the scan report such as reviewer staff level and information on the type of scanner, methods and sequences used were collected at this stage. Screening forms were completed for each potential participant, with reasons for ineligibility and non-participation documented.

Stage 2: Confirmation of eligibility for randomisation

This stage of the eligibility assessment was conducted and finalised in theatre. During surgery, via arthroscopic exploration of the shoulder joint and tendons the surgeon would either confirm or refute the presence of a partial tendon thickness tear of >50% in Supraspinatus. Patients who did not meet the inclusion criteria received the appropriate surgical management for their problem and were not randomised.

Informed consent: Participants had to personally sign and date the latest approved version of the ICF before any trial-specific procedures were performed.

Written and verbal versions of the PIS and ICF detailing the exact nature of the trial, what it involved for the participant, the implications and constraints of the protocol; the known side effects and any risks involved in taking part were presented to participants. Both documents clearly stated that the participant was free to withdraw from the trial at any time and for any reason without prejudice to future care, without affecting their legal rights and with no obligation to provide a reason for withdrawal.

The participant was allowed as much time as needed to consider the information and had the opportunity to question the investigator, their general practitioner (GP) or other independent parties when deciding whether or not they wished to participate in the trial. Written informed consent was obtained by means of a participant-dated signature and dated signature of the person who presented and obtained the informed consent.

The person who obtained the consent had to be suitably qualified and experienced, and have been authorised to do so by the CI or relevant PI. A copy of the signed ICF was given to the participant, and the original signed ICF was retained at the trial site.

Randomisation and allocation procedure: Randomisation to the interventions was undertaken via the centralised secure web-based randomisation service Registration/Randomisation And Management of Product [RRAMP (OCTRU, Oxford, UK)], run through OCTRU. In the event that sites were unable to randomise patients using RRAMP, they had to contact the central research office, and a member of the trial team was then able to randomise the patient via RRAMP. An emergency backup randomisation system was in place if the central research office was also unable to use RRAMP.

Participants were randomised in theatre after confirmation of a partial tendon tear (PTT) in supraspinatus that was more than 50% thickness of the tendon. The randomisation followed a 1:1 allocation ratio and used a minimisation algorithm; initially simple randomisation seeding was used and minimisation also incorporated a “random twist” element to protect allocation concealment throughout. Randomisation was minimised according to age, type of tear and study site.

Treatment groups: All surgical procedures were undertaken as per NHS practice by specialist shoulder surgeons. They were carried out either as a day case or as an overnight stay; any extended stays involving randomised participants were recorded. The operations were usually conducted under a general anaesthetic with an accompanying nerve block.

The arthroscopy was planned to be carried out in the standard sterile environment of an operating theatre with standard arthroscopic equipment as per routine practice. The shoulder glenohumeral joint would be assessed for evidence of arthritis or frozen shoulder or biceps problems or any other

condition that might be causing the patients symptoms. The rotator cuff would then be assessed for evidence of any articular sided partial thickness tears (PTTs) or a full thickness tear (FTT). Surgeons would then routinely inspect the rotator cuff from its upper surface in the subacromial bursa for evidence of a bursal sided tear. This part of the arthroscopy can involve debriding bursal tissue, bone spurs and any ragged tear edges. This procedure is done routinely in the NHS in order to fully inspect, evaluate and confirm the presence and size of a PTT on either side of the tendon. Many surgeons also regard it as a therapeutic symptomatic treatment and possibly a tendon healing one and so would not add in an additional formal tendon repair. Other surgeons do believe in a benefit of an additional tendon repair and so would proceed to do this.

In the PRoCuRe Trial, patients with PTTs (of more than 50% tendon thickness) present were randomised in theatre to receive the additional tendon repair procedure or not i.e. either the intervention (Arthroscopic Debridement and Arthroscopic Repair (ADAR)) or the control (Arthroscopic Debridement Only (ADO)). Patient blinding was planned to be maintained, as both these surgical procedures included only two to three arthroscopic portal skin incisions that are similar.

Arthroscopic Debridement and Arthroscopic Repair (ADAR): A PTT in the supraspinatus rotator cuff tendon either on the joint side or bursal side of the tendon randomised for repair will be repaired using either of the following techniques, whichever is the surgeon's preference for that tear:

• "take-down" repair which involves the surgeons converting the partial tear to full thickness tear first before repair, or

• "in-situ" repair where the surgeon directly repairs the partial tear, without converting it to a full thickness tear

Such partial tendon repairs are performed completely arthroscopically. The small amount of tendon tissue removed during tear edge debridement, and regarded as clinical waste, may, with the participant's consent be used for further research. Following repair, sutures or steristrips were used to close the keyhole wounds and dressings and a sling was applied as per routine practice at all sites.

Arthroscopic Debridement Only (ADO): This surgical procedure is the same as above, but without the tendon repair. It includes the assessment and confirmation of diagnosis and can involve debriding bursal tissue, bone spurs and any ragged tear edges. The small amount of tendon tissue removed during tear edge debridement, and regarded as clinical waste, may, with the participant's consent, be used for further research. The characteristics of the tear were recorded but no formal repair was undertaken. The procedure was finished at this point with the same routine closure and dressings applied.

The ADO group consisted of patients who were undergoing the same arthroscopic surgery as the intervention (repair) group but with the established critical surgical element of tendon tissue repair omitted. The control group underwent surgery which exhibited moderate fidelity to the intervention group but importantly had all other characteristics of the procedure which accounted for any placebo effect of undergoing surgery.

Outcome measures: The Primary Objective was measured using the Oxford Shoulder Score questionnaire at Baseline and 24 months.

Secondary objectives would be measured using the following questionnaires:

- Oxford Shoulder Score at Baseline, 6 and 12 months and 5 years,
- EuroQol EQ-5D-5L at Baseline, 6, 12, and 24 months and 5 years
- Patient Satisfaction and perception questions measured by health resource use at 6, 12 and 24 months
- Progression to full thickness cuff tears would be assessed by MRI imaging at 24 months
- Long term health usage was planned to be assessed by recording any readmission for further surgery and associated costs from routinely collected observational hospital data (HES) at 5 years.

Sample size and statistical analysis: The sample size was calculated using the Oxford Shoulder Score and a minimum important difference (MID) in the OSS to be around 4-5 points for patients with shoulder conditions [22, 23]. The observed SD of the OSS at 12 and 24 months in the CSAW & UKUFF trials was 9 & 8 points respectively [3, 24]. To detect a target difference of 4 OSS points & assuming a SD of 9 with 2- sided 5% significance level & 90% statistical power, requires 108 participants per group (216 overall). Allowing for 20% attrition (16% observed in the UKUFF trial at 24 months) [3] (the final sample size was calculated at 135 per group (270 overall). Allowing for 30% ineligibility in theatre at time of arthroscopy means 386 patients will be recruited.

Due to the early halt in trial recruitment, only 10 participants were randomised. Therefore, no formal statistical analyses were planned, as the sample size was too small to provide adequate power for hypothesis testing.

Findings/Discussion

Explanatory statement: Following the Trial Management Group meeting on 3rd August 2022, at which the difficulties in recruiting patients were discussed, it was decided by the CI and TMG in discussion with the Chair of the TSC and NIHR that the PRoCuRe Study should be closed with immediate effect.

The reason for moving to closure was that despite attempts to improve recruitment rates through opening additional sites and implementing a protocol amendment to address the challenges identified, recruitment to this trial remained difficult. Reaching the funder target of one recruit per site per month was not seen to be feasible. Target recruitment was 386 consented and 270 randomised. Actual recruitment was 33 consented with 10 randomised. Recruitment closure date before trial closure was June 2023 and revised predictions, allowing for a three-month lag between recruitment and randomisation estimated 98 recruited and 48 randomisations by this date. In order to achieve overall targets the predicted end of recruitment date would have to move to January 2026 which would have required an extension of 30 months and was not feasible from a funding perspective.

No formal statistical tests were possible due to the small number of participants recruited into the trial.

Sites open to recruitment: The trial aimed to open 20 sites. By 21st October 2022, when the trial was shut prematurely, only 9 sites had opened to recruitment.

Figure 2 shows the target number of sites compared with the actual number of sites open to recruitment month by month.

Of the 9 open sites, 7 had recruited at least one participant before the trial was closed to recruitment.

Study participants: The flow of participants through the trial from screening through randomisation to follow-up is presented in a CONSORT (Consolidated Standards of Reporting Trials) flow diagram (Figure 3). Most randomised participants had not yet reached the primary outcome time point when the trial was stopped.

QuinteT Recruitment Intervention response

Unfortunately, despite general enthusiasm for the QRI and the QRI team's best efforts, site engagement with the QRI was limited, mainly due to ongoing pandemic burden and delays to site set up. Of 23 staff from 5 sites invited to participate in the QRI, 10 consented and six took part in interviews/audio-recording consultations. Seven did not respond to invitations and 6 declined. Three of nine eligible patients were approached for the QRI, two agreed to take part.

Recruitment breakdown: Across 9 hospitals, a total of 104 patients were screened for eligibility. 46 patients were eligible at Part 1 screening and 45 were approached. 33 patients consented of which 10 were randomised to either ADAR or ADO.

Screening and randomisation data, including conversion rates, are summarised by recruitment site in Table 1.

Out of 104 patients screened for the PRoCuRe trial, 58 patients (56%) were deemed ineligible at Part 1 screening for reasons detailed in Table 2. The most common reason was: "Has not had MRI or USS imaging suggesting a PTT (Partial Thickness Tear) diagnosis in Supraspinatus or any small FTT in Supraspinatus where there is radiologist or surgeon uncertainty between a PTT and small FTT" (81%). Out of 46 patients eligible for inclusion 33 consented and 13 patients declined consent for reasons shown in Table 3:

QRI review of screening data shows that 72% of eligible patients approached about PRoCuRe gave their consent to participate. That so many eligible patients approached were willing to consent suggests this study was relatively straightforward to explain to patients and/or that patients are willing to accept this kind of study.

Follow-up of patients: Early closure of the study has meant that only 4 patients have reached the 6-month questionnaire follow-up point out of 10 recruited. Once the study closed early, there was no further follow up planned for the recruited patients as the amount of data generated would be too small to be significant. As a result, there will be no follow-up data at 6, 12 and 24 months and 5 years for the remaining 6 recruited patients. There will be no data from MRI imaging at 24 months to assess any progression to full thickness tears.

Identified challenges and Issues identified for the PRoCuRe Trial

The pandemic had a profound effect on the viability and deliverability of elective surgical trials like PRoCuRe that were designed pre-pandemic, with many needing to close early due to lack of recruitment

Data from the QRI highlighted particular challenges faced by the study:

Proposed numbers of participating sites were not achieved. Of the sites approached who declined to participate in the study reasons given included: lack of clinical capacity (4 sites); lack of eligible patients (3 sites); patients being treated privately (2 sites); conflict of interest (2 sites); PI has left or is not interested (2 sites); other studies prioritised (2 sites); payment not seen as high enough (1 site); long waiting lists (1 site).

Rates of recruitment were lower at all sites than expected figures. Final recruitment figures show that sites consented on average 0.3 patients/month and randomised 1.25 patients/site. Poor recruitment was attributed to:

- A low number of patients with PTT identified. Although interview data indicated this was anticipated as a recruitment challenge prior to the study starting as PTTs in secondary care are less common that FTTs, but numbers were even lower and more unpredictable due to the Covid-19 pandemic. This was partly attributed to progression of PTTs to more severe conditions or full thickness tears from patients being unable/unwilling to seek help during the pandemic.
- Difficulty identifying PTTs, reflecting general radiological "uncertainty" around diagnosis prior to surgery – a concern frequently raised at site initiation visits.
- The proportion of recruited patients identified as ineligible during surgery across sites was higher than anticipated – 40% rather than the 30% accounted for in the protocol based on previous studies.
- Impact of the Covid-19 pandemic:
    - staffing issues: staff shortages, due to conducting ongoing Covid-19 research and other studies, staff sickness/Covid-19-related self-isolation, and annual leave over the summer period.
    - reduced capacity for surgery during the pandemic, long waiting lists after and deprioritisation of some elective orthopaedic procedures.
    - multiple locations for surgery at sites and lack of space for research activities
- PRoCuRe included a sponsor-led requirement for 48 hours between giving information and asking patients to consent. This was rapidly identified as challenging – one recruiter described it as a "nightmare" and "hard work", causing extra workload, especially for RNs. It was removed in an ethics approval amendment in Dec 2021, although this did not improve recruitment.
- Having to obtain consent on paper (rather than electronically)
- At site initiation visits some sites mentioned concerns, which may have restricted their engagement in PRoCuRe and impacted recruitment – specifically, about blinding, randomisation and inclusion criteria. There is a chance recruitment may have improved if these had been addressed at an earlier stage.

Conclusions:

The research question for the PRoCuRe Trial was commissioned and was identified in the 2015 James Lind Alliance Priority Setting Partnership for 'Surgery for common shoulder problems'. Elective surgical treatments make up a large part of NHS care, and surgical trials are needed to answer ongoing treatment uncertainties. While surgical trials have always been difficult to deliver, mainly limited by patient recruitment, good progress has been made in recent years especially with the setting up of networks and with the support of NIHR funding. Many successful trials pre-pandemic were delivered with better evidence for healthcare and significant cost savings when some treatments proved no better than some non-operative treatments.

What we discovered with the PROCURE Trial is that despite this being a commissioned study, carefully prepared to be delivered successfully with the support of the NHS shoulder community, it had to be closed early, mainly due to the impact of the pandemic, initially on non-COVID research, and then on the changes seen post pandemic to NHS patient pathways. The QRI work also highlighted the challenges identifying patients with PTT, reflecting general radiological uncertainty with the diagnosis on imaging, and the need to make the consent process as smooth and low-burden as possible, which needs to be taken into account in future studies. With huge increases in waiting times, prioritisation of different surgical treatments and no spare resources or capacity in the NHS, this trial failed and the future of elective surgical trials is generally concerning.

Elective surgical trials will be more challenging post pandemic than pre-pandemic. The NHS has changed, perhaps irreversibly, with a backlog for all surgery coupled with staff leaving, low morale, different surgical procedures being prioritised, and the ongoing winter problems and cancellations. These all make managing elective surgical pathways and hence any elective surgical trial designs a major challenge.

As such, those with an understanding of the new NHS patient pathways need to be involved in trial design. We would recommend more feasibility studies being conducted post pandemic to explore these issues before full trial applications are awarded. NIHR should not rely on internal pilots within study designs alone before a trial is discovered viable or not.

We would suggest that NIHR consider a new dedicated Feasibility funding stream as part of a staged funding approach to full HTA applications.

Patient and public involvement

Patient and public involvement (PPI) was present at all stages of the development and execution of the trial, including during the feasibility and pilot stages. We planned to maintain a strong ethos of working collaboratively with patients and public throughout study setup, implementation and dissemination. Patient focus groups were held at an early stage to ascertain the acceptability of the study format. The Chief Investigator ran the 2015 JLA Shoulder Surgery PSP and a patient from that PSP was a lay co-applicant on the HTA application contributing to its production and content. There was also a patient representative on the Trial Steering Committee.

Research Design Services supported an initial PPI meeting at Oxford. Two further patient focus groups were conducted in preparation for the application, one in Middlesbrough and one in Oxford. The PPI groups greatly strengthened the application, contributing to trial design, choice of treatment arms and outcome measures. Our patients have informed the design that would ensure high recruitment levels and engagement from patients and also decided on the name PRoCuRe for this Trial.

The aim of Patient Focus groups:

- To present an overview of the proposed study, the current situation with treatments and evidence for partial rotator cuff tears and explain the purpose of the PPI patient focus group meeting
- To find out about patient experiences with shoulder pain
- To find out about patient expectations with their treatment
- To discuss outcomes such as inconvenience, quality of life (QoL), recovery, days off work, pain, cost, strength, function, movement and ask patients to rank them
- To discuss randomisation and blinding and find out patients' views on this.

Patient focus groups were held in Oxford and Middlesborough. The Patient Focus Groups were asked to rank the following outcomes:

- Inconvenience, QoL, Recovery, Days off work, Pain, Cost, Strength, Function/Movement

Pain was the most important issue to the patients as it caused tiredness in general and was bad at night (lack of sleep). Pain also caused restricted movement and activity with patients having to adapt plans to account for this resulting in loss of independence and also affecting quality of life. Discussions

on current pathways in the region and how this has hindered their progress with the pain. They would like care to be streamlined more than it currently is.

Patients' expectations of treatment were:

- Increased movement
- Improved quality of life`
- Sorting out the problem once and for all
- ‘‘Nipping it in the bud”

When discussing blinding and randomisation, in principle, the patients were happy with the treatments on offer in the trial. They preferred a straightforward approach to recruitment and were not interested in a non-operative treatment as they didn't feel that it would do what they wanted. Therefore, they were happy with the 2 surgical arm comparison suggested. The group stated a preference for electronic questionnaires and felt text message reminders would be helpful. It was indicated that claustrophobia should be considered when requesting MRI's.

Further Outcomes

A patient representative joined as a co-applicant on the study application, and once the funding was awarded a further patient representative joined the TSC and offered invaluable input throughout especially regards the patient information sheets and rehabilitation instructions post- surgery.

Reflective/critical perspective

As mentioned in previous sections the main learning points from this study are that trials need to be designed for the NHS treatment pathways in which they are to be delivered. The changes now seen with waiting times and patient pathways post pandemic need to be carefully considered when designing elective surgery trials and we would recommend more feasibility work prior to NIHR HTA applications.

Data sharing statement

All data requests should be submitted to the corresponding author for consideration. Access to available anonymised data may be granted following review.

Acknowledgements

The study was managed by the Surgical Intervention Trials Unit (SITU) in collaboration with the Oxford Clinical Trials Research Unit (OCTRU).We are grateful to the participants and research teams at collaborating hospital sites:

Calderdale & Huddersfield NHS Foundation Trust

Lee-Ann Bayo, Megan Collins, Chantelle Coughlan, Simon Fogerty (PI), Kathryn Hanson, Laura Hedley, Diane Kelly, Tonicha Nortcliffe, Matthew Robinson

Epsom & St Helier University Hospitals NHS Trust

Sarah Abbott, Irrum Afzal, Anna Cebula, Georgina Crate, Margo Dirckz, Christopher Fenner, Matthew Hague, Jenny Hisole, Aanchal Jain, Vipul Patel (PI), Holly Weatherell

Oxford University Hospitals NHS Foundation Trust

Salma Chaudhry, Steve Gwilym, Alice Harin, Chris Little, Jonathan Rees (PI), Germana Sallemi, Alex Woods

Royal Free London NHS Foundation Trust

Philip Ahrens (PI), Francesca Gowing

South Tees Hospitals NHS Foundation Trust

Marc Atkinson, Natalie Clark, Hussam Elamin Ahmed, Philip Holland (PI), Juliet James, Lucksy Kottam, Amar Rangan, Aparna Viswanash

University Hospitals Coventry and Warwickshire NHS Trust

Joanna Brough, Howard Bush, Richard Craig, Edward Dickinson, Steven Drew (PI), Tom Lawrence, Kerri McGowan, Chetan Modi

University Hospitals of Leicester NHS Trust

Alison Armstrong (PI), Salve Catina, Christina Haines, Tracey Lee, Amit Modi, Radhakant Pandey, Kathryn Robinson, Harvinder Singh

University Hospitals Southampton NHS Trust

David Baker, Maria Baggott, Andrew Cole, Aurore Gerrish, Campbell Hand (PI), Gemma Lewis, Daniel Orock, Debbie Prince, Rachel Schranz

Wrightington, Wigan & Leigh NHS Foundation Trust

Steve Bale, Katy Boland, Lindsay Cunningham, Anne Evans, Lennard Funk, Puneet Monga (PI), Amy Newell, Valerie Parkinson, Mustafa Rashid, Emma Robinson, Rebecca Smith, Krishna Swarmy, Tracey Taylor, Caroline Tierney, Ian Trail, Mike Walton

We would like to thank the external members of the Trial Steering Committee and Data Monitoring Committee for their advice and support for the project:

Trial Steering Committee

Marion Campbell (Chair), Chris Peach, Michael Thomas, Clare Connor, Helen Parsons, Lazaros Andronis, John Pengelly.

Data Monitoring Committee

Catherine Hewitt (Chair), Andrew Elders, John Skinner.

Disclaimer

This project is funded by the National Institute for Health and Care Research (NIHR) under its HTA Programme (Grant Reference Number 128043). The views expressed are those of the author(s) and not necessarily those of the NIHR or the Department of Health and Social Care.

This project was carried out between September 2020 and February 2023. This final report has not been peer-reviewed. The report was examined by the Programme at the time of submission to assess completeness against the stated aims. These reports do not undergo a peer review process

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The clinical and cost effectiveness of surgical repair of partial rotator cuff tears in patients with subacromial shoulder pain: a comparison of surgical repair versus surgery with no repair.

Partial Rotator Cuff Repair Trial (PRoCuRe Trial)

Figure 1. PRoCuRe Trial schematic

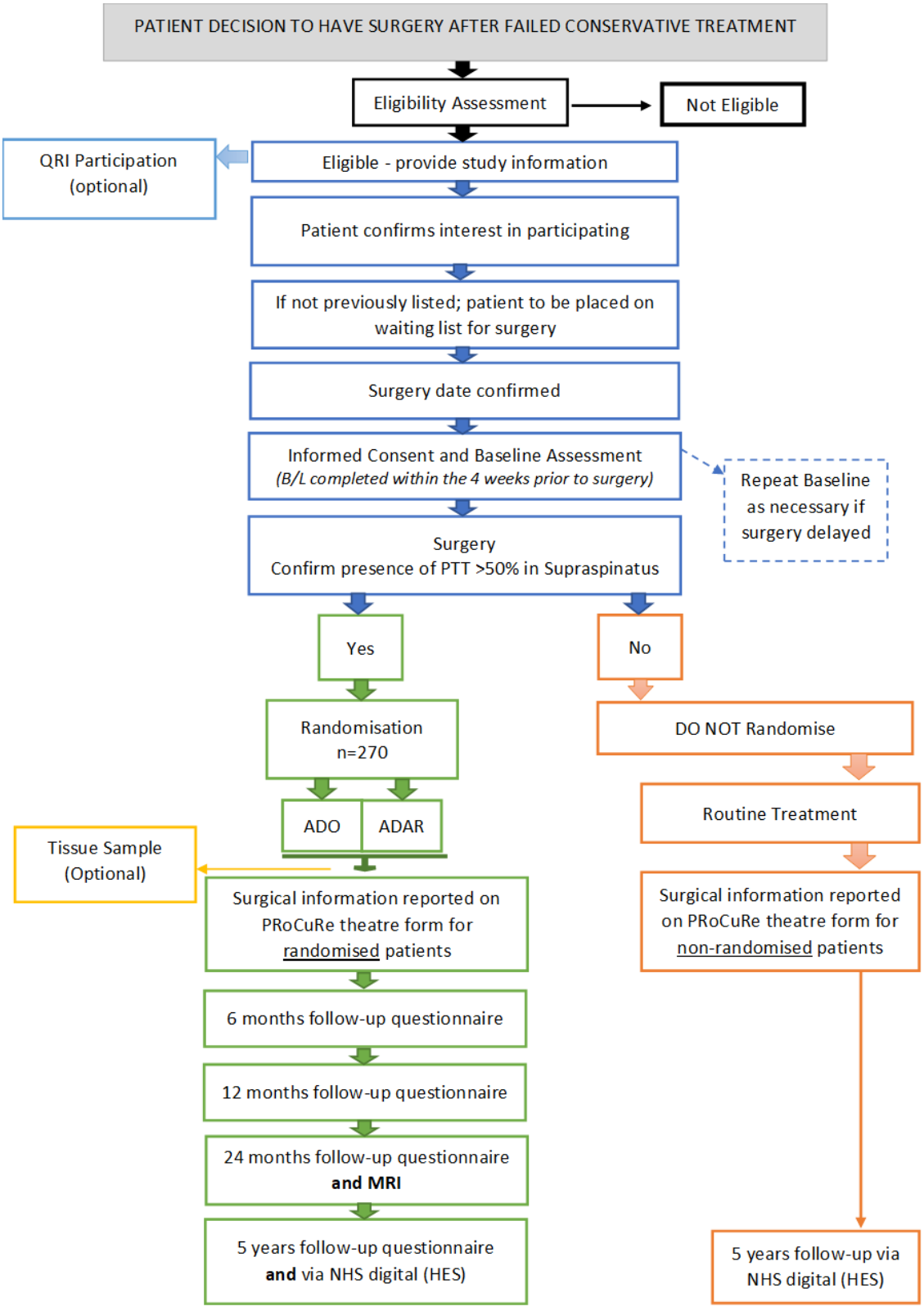


Figure 2: ProCuRe Site Set-Up: Target v Actual

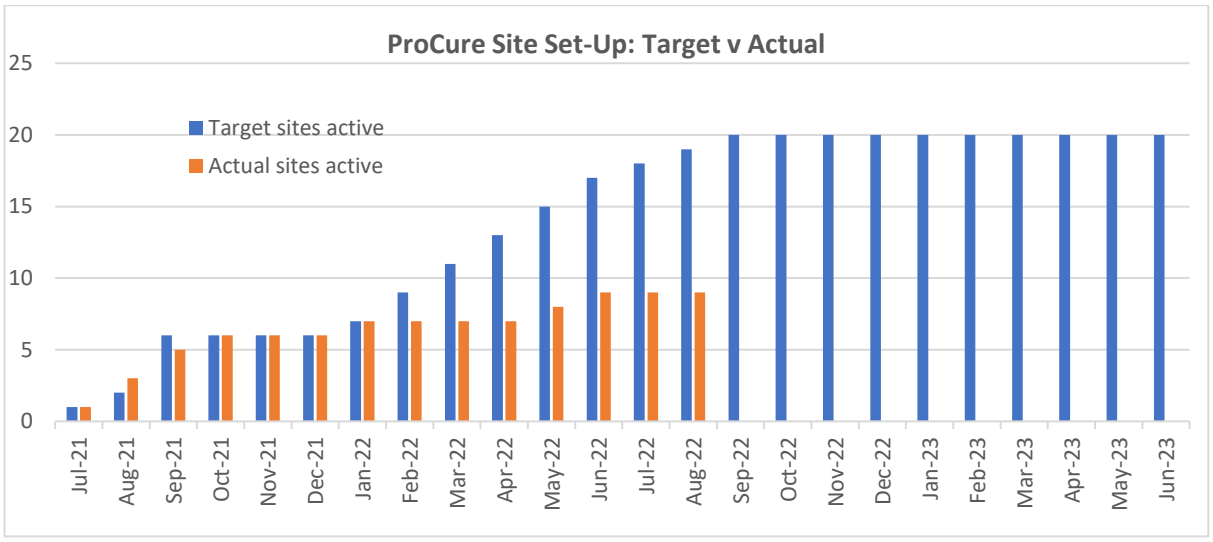
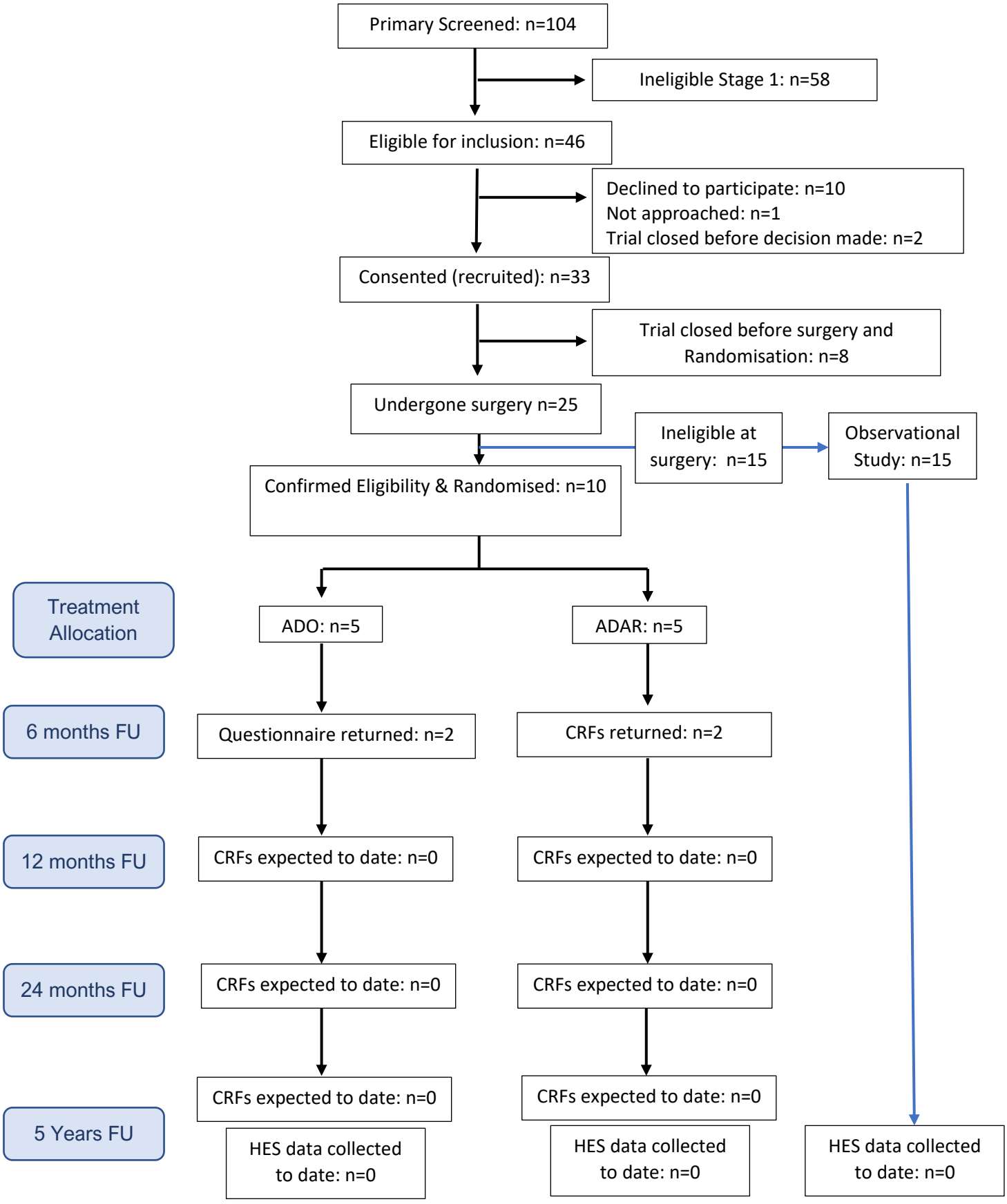


Figure 3: PRoCuRe Participant Flow Diagram



The clinical and cost effectiveness of surgical repair of partial rotator cuff tears in patients with subacromial shoulder pain: a comparison of surgical repair versus surgery with no repair.

Partial Rotator Cuff Repair Trial (PRoCuRe Trial)

Table 1: PRoCuRe: Screening and Randomisation

Sites*	Nº Screened	Nº Screened per month	Nº Approached	Nº Consented	% of approached consented	Nº Undergone surgery	Nº Randomised	Conversion Rate (%)
STE	11	0.9	8	4	50%	2	1	50%
COV	6	0.5	6	6	100%	6	4	67%
OUH	11	0.8	10	10	100%	7	3	43%
WWL	64	5.2	15	7	47%	5	0	-
EPS	4	0.3	4	4	100%	4	2	50%
CHT	6	0.5	1	1	100%	0	0	-
LEI	1	0.1	1	1	100%	1	0	-
RAL	1	0.3	1	-	-	-	-	-
Total	104	8.6	46	33	**72%**	25	10	40%
Average per site	13	1	6	4	**67%**	3	1.25	42%

*Nine sites opened in total. One site opened just before trial closure and did not screen any participants

Table 2: PRoCuRe: Reasons for ineligibility at screening

Reason for ineligibility at screening, n (%)	Timepoint	
	Screening (N=58)	Theatre (N=15)
Imaging (MRI or USS) does not suggest a PTT or small FTT	47 (81%)	
Inflammatory Arthritis (e.g. Rheumatoid)	4 (7%)	
Patient has decided not to have surgical treatment	1 (2%)	
FTT on imaging	3 (5%)	
Patient has not had sufficient number of steroid injections	2 (3%)	
Tears associated with shoulder dislocations	1 (2%)	
Patient had established Glenohumeral Osteoarthritis		1 (6%)
PTT >50% thickness at arthroscopy		13 (88%)
Unknown		1 (6%)

PTT partial thickness tear, FTT full thickness tear, MRI Magnetic resonance imaging, USS Ultrasound scan

Table 3: Reasons eligible patients did not consent

REASON	N=13
Not interested	7 (53%)
No reason	1 (8%)
Wants standard care	1 (8%)
Not enough time to consider	1 (8%)
Trial closed to recruitment before decision made	2 (15%)
Not approached for consent	1 (8%)