MUSCULOSKELETAL CARE
Musculoskelet. Care **4(3)**: 140–151 (2006)
Published online in Wiley InterScience
(www.interscience.wiley.com) **DOI**: 10.1002/msc.85

Main article

Physiotherapy rehabilitation in patients with massive, irreparable rotator cuff tears

Roberta Ainsworth FSCP SRP MSc BA (Hons)
Physiotherapy Department, Torbay Hospital, Torquay, UK

Abstract

Background: Massive rotator cuff tears provide a challenge for effective rehabilitation. Work has been ongoing at Torbay Hospital, Devon since 2000 to develop an exercise programme for the management of this patient group. This programme has been evaluated in a pilot study and a further randomised controlled trial is currently taking place which will enable us to estimate the treatment effect. This paper discusses the background to the development of the rehabilitation programme, the programme itself and the results of the pilot study. The pilot study was an evaluation of the rehabilitation programme.

Objectives: This study examined the effectiveness of a physiotherapy regime for the treatment of patients with massive rotator cuff tears.

Methods: Patients identified through primary and secondary care referrals to physiotherapy with a clinical diagnosis of a massive rotator cuff tear underwent an ultrasound scan to confirm the diagnosis. A massive cuff tear was one where the leading edge of the tear had retracted past the glenoid margin. The clinical diagnosis was based on the presence of some or all of the following signs: positive humeral thrust on elevation, gross weakness and wasting of supraspinatus and infraspinatus, infraspinatus lag and rupture of the long head of biceps. Eligible patients were invited to take part in the study and informed consent was obtained. The baseline assessment was carried out and then the patient undertook the treatment programme. Outcome measures were reassessed 12 weeks from the baseline assessment.

Design: A cohort study of 10 patients evaluating the change from baseline to twelve weeks in the shoulder function of patients undergoing a programme of anterior deltoid strengthening and functional rehabilitation. The outcome measures used were the Oxford Shoulder Disability Questionnaire (OSDQ) and SF36. The OSDQ is validated for use with the UK population and has 12 questions with 5 point responses. The lowest (best) score is 12 and the highest (worse) score is 60.

Results: Scores on the OSDQ improved with all patients. The mean improvement was 9 (range 3 to 16, standard deviation 10.3). The SF36 showed an improvement in the pain scores for all patients (mean 22 points) and an overall improvement of 10 points for the sections on role limitation due to physical health. There was an overall decline in perceived general health (9 points) and in role limitation due to emotional health (23 points).
Conclusions: As all 10 patients showed improved scores on the OSDQ, in spite of the long-standing nature of many of their shoulder problems, this rehabilitation programme was shown to improve shoulder function in this group of patients. The variation shown in the quality of life scores reflects the age group of this cohort who had a mean age of 75.5 years. All patients deemed their pain and function to have improved over the three-month period.

Key words: Rotator cuff tear, rehabilitation, physiotherapy, physical therapy

Introduction

The rotator cuff is a group of four muscles and their tendons which form a hood over the head of the humerus. These muscles all arise from the scapula and form a single tendon unit, with the fibres coming from the supraspinatus, infraspinatus, and teres minor inserting into the greater tuberosity of the humerus, while those from the subscapularis insert into the lesser tuberosity. The function of the rotator cuff is to stabilize the humeral head in the glenoid and to assist with elevation and rotation of the humerus.

The shoulder problems most commonly faced by the older population are those associated with later life degenerative rotator cuff tears – age associated tendinopathies (Sher et al.,1995). Many studies have been undertaken to try and establish just how common this problem is. A study by Milgrom et al. (1995) looked at 90 asymptomatic adults between the ages of 30 and 99. It was noted that there was a marked increase in cuff tears in the over-50s. By the seventh decade 50% of this group had full thickness tears, and 80% had them by the age of 80. A more recent study by Worland et al. (2003) looked at 59 asymptomatic adults and found that 40% of those over the age of 50 had full thickness tears. In spite of such a high percentage of asymptomatic people having cuff tears, it is still deemed to be a common cause of shoulder pain and dysfunction. Many patients with rotator cuff tears are successfully managed non-operatively (Arcuni, 2000; Rodgers and Crosby, 1996). Hawkins and Dunlop (1995) studied a group of 33 patients with full thickness tears who had been managed conservatively. Of the 33 patients, 14 were dissatisfied at 3.5 year follow up. Twelve of these patients opted for surgery but two were still dissatisfied with the result of surgery. The size of the tear is deemed to

DOI: 10.1002/msc

be an important determinant in outcome for these patients (Bartolozzi et al., 1994; Cofield et al., 2001) and it is those with massive cuff tears which cause the greatest challenge to successful surgical management. It is recognized that muscles such as the deltoid, which are used for power and speed, often create subluxing shear forces as well as the desired anatomical movement (Perry 1983). One of the features of massive rotator cuff tears is the subsequent upward migration of the humeral head which develops over time due to these shear forces. This can eventually lead to erosion of the underside of the acromion. Olsewski and Depew (1994) and Klinger et al. (2005) found that sub-acromial decompression was successful for the management of patients with full thickness tears who do not have demands of strength and repeated shoulder elevation and whose principal complaint is pain. However, as this procedure reduces the thickness of the acromion, concern is felt that this could increase the long-term problems facing these patients.

In spite of the view of the American Academy of Orthopaedic Surgeons (2002) that rehabilitation is not an option for patients with massive irreparable cuff tears, many patients with an irreparable cuff tear have been found to have good overhead function (Rockwood et al., 1995). With so many people being able to compensate for full thickness cuff tears, it is felt that rehabilitation options should be explored. It is also recognized that rotator cuff repair is less successful in the elderly population and in those with tears retracting back past the glenoid rim (Harryman et al., 1991; Gerber et al., 2000; Gazielly et al., 1994). Rockwood et al. (1995) identified the importance of the anterior portion of the deltoid muscle as being an important determinant of good recovery following decompression surgery for massive, irreparable cuff tears. A small study involving 10 patients (Burkhart, 1991) showed that normal shoulder function was possible with massive unrepaired cuff tears if there was a balance in two force couples, one in the transverse plane and one in the coronal plane. There is little in the literature that discusses conservative rehabilitation of patients with massive, irreparable cuff tears.

A rehabilitation programme was developed at Torbay hospital following observation studies of patients who were known to have full thickness rotator cuff tears, but who still retained good function. These observation studies suggested that the patients utilized the anterior portion of deltoid in order to achieve elevation without upward shearing of the humeral head. It was also observed that patients who had active lateral rotation fared better than those who struggled to activate lateral rotation. One other factor was taken into account with the development of the programme and this was the phenomenon that certain patients suddenly become symptomatic with what was obviously a long-standing cuff tear. The conclusion that the cuff tear was long-standing was made on the basis of the X-ray appearance. If there was evidence of significant upward migration of the humeral head then

DOI: 10.1002/msc

this indicated that the cuff tear was long-standing as the migration only develops over time. This indicated that some factor other than the cuff tear has made the shoulder symptomatic. Many patients also had reasonable function into lateral rotation in spite of wasting and dysfunction in the infraspinatus. These patients seemed to be recruiting teres minor in order to improve their lateral rotation function enough to enable the greater tuberosity of the humerus to clear the undersurface of the acromion during elevation.

Background to the Torbay rehabilitation programme

The initial programme was used in the rehabilitation of one patient who presented with a massive cuff tear. In August 2000 Mr S was sitting in the driving seat of his car, and on twisting to reach for his seatbelt, he felt a sudden 'bang' in his shoulder, which was apparently audible to his wife. This was associated with pain and a dead feeling in his arm. The altered sensation recovered but he was left with reduced function and some pain. Following various visits to his GP who treated him with anti-inflammatories, Mr S was seen in the fracture clinic at Torbay Hospital in October 2000. On examination he had 30 degrees of forward elevation and abduction with weakness on resisted testing of both infraspinatus and supraspinatus muscles. A magnetic resonance imaging (MRI) scan was arranged which showed a large cuff tear with atrophy of the muscle bellies. In view of these findings, surgery to repair the cuff was not an option. The patient had had no previous physiotherapy, but was very willing to try anything that would improve his function. The patient was very distressed that the cuff tear was not reparable as his hobby was wood-turning and he was no longer able to engage in this pastime.

After assessing Mr S, and with his agreement, a decision was taken to focus the rehabilitation on activating and strengthening the anterior portion of the deltoid. After two treatment sessions he had increased from 30 degrees to 170 degrees of active flexion and abduction. Unexpectedly, he also noticed a significant improvement in his level of pain which was reduced from continuous pain to an occasional ache. This was an additional benefit to the improvement in function for the patient. It was necessary to make sure that the programme was tailored to the activities that were important to the patient, and so a home visit was undertaken to gain a better understanding of the shoulder dynamics that were necessary for wood-turning. The shoulder strengthening programme was then adapted to meet the patient's needs. Mr S resumed wood-turning within four weeks of beginning the programme.

The Torbay programme for the rehabilitation of patients with massive cuff tears is adapted to meet the needs and abilities of the individual patient. It is recognized that successful rehabilitation depends on proper clinical assessment and

Musculoskelet. Care **4**: 140–151 (2006)
DOI: 10.1002/msc

individualized treatment (Dalton, 1994). The pace and intensity of the rehabilitation programme must be governed by the degree of damage, the patient's physical fitness and personal activity requirements.

Principles of the programme

The overall aim of the programme is to improve shoulder function and this is achieved through the following objectives:

- Patient education.
- Posture correction.
- Re-education of muscle recruitment.
- Strengthening.
- Stretching.
- Improving proprioception.
- Adaptation.

Patient education

All patients are given a thorough explanation of what has happened to their shoulder and why the function is impaired. Time is also spent reassuring the patient that while pain in the shoulder does not correlate with damage being done to it, there is little to be gained by using the shoulder to the extent that it is more irritable. Patients are also made aware of the goals of the rehabilitation programme because no progress will be made if the patient fails to engage with the process. The physiotherapist works with the patient to establish goals and it is necessary to ensure that these are realistic and achievable.

Posture correction

Posture correction is felt to be important in order to optimize glenoid position and sub-acromial space. Many of these patients have stiff, kyphotic thoracic spines and so any efforts to improve posture must be associated with realistic goals.

Re-education of muscle recruitment

Timing of muscle co-contraction around the shoulder is a particular problem with many shoulder conditions, and so time is spent trying to adjust and normalize timing of muscle contractions and to encourage recruitment of compensating muscles.

DOI: 10.1002/msc

Strengthening

Due to the absence of the cuff, efforts are made to strengthen other muscles to compensate. The anterior portion of the deltoid and teres minor are given particular attention as these muscles seem to be particularly important in compensating for the cuff tear.

Stretching

Disuse and degenerative changes frequently lead to stiffness in the shoulder and so gentle stretches within the limits of pain are encouraged.

Improving proprioception

Activities that encourage weight bearing through the limb can be important where there is proprioceptive deficit.

Adaptation

Activities that improve function without increasing pain are also taught. These include activities such as using short arm levers to gain elevation and discouraging use of long arm levers. One of the early functional activities taught to patients is turning a light switch on and off. Patients are taught to bend the elbow fully with the arm by the side, to raise the point of the elbow and then to straighten the elbow towards the lightswitch.

Progression of the programme

Depending on the level of disability experienced by the patient, the programme usually starts with the patient lying in supine. They are taught to flex the humerus to 90 degrees (i.e. vertical position) with the scapula stabilized. The patient always starts and ends the manoeuvre with a bent elbow (i.e. short lever). Particular attention is paid to control on the eccentric (i.e. lowering) phase. Different patients require different angles of abduction and rotation in this position in order to be able to accomplish it with the minimum of discomfort, so finding the optimum arc can be a case of trial and error. When patients have good control going to the vertical and back then they begin to do controlled swaying movements. The sways go through an arc of approximately 20 degrees from cephalad to caudad. When they have achieved this, then they repeat these manoeuvres using weights (about 1 kg). Empty 1 litre tonic water bottles are given to the patient so that the amount

Musculoskelet. Care **4**: 140–151 (2006)
DOI: 10.1002/msc

of water in the bottle and thus the weight can be gradually increased. Patients are advised to hold the neck of the bottle with the screw top towards their face while they elevate it, so that if they drop it then it will fall away from them and not land on their head. Again, it is control in the eccentric lowering phase that is focused on. After the patients have achieved these exercises in supine the plinth is gradually inclined until they can elevate the arm in a sitting position. When they can tolerate the exercises with a 45 degree incline, they start wall slides. This is performed by pushing a duster up the wall and then eccentrically controlling the arm on the way down. Some patients need minimal assistance to gain elevation in sitting. There is often a point at about 70 degrees of flexion that they struggle to get through. Using assistance at this point to gain elevation, and then concentrating on overhead control (i.e. raising and lowering in an elevated position down to 90 degrees with control) is a useful technique. Some patients are able to get through this 'sticking' point by using momentum, i.e. the elevation phase is done as quickly as possible. The patients also work to strengthen lateral rotation with yellow theraband, carry out self-stretches to improve joint range and work on proprioception and posture. Manual techniques are also used to facilitate timing of co-contraction of muscle groups. See Table 1 for details of the programme.

As part of the education element of the rehabilitation, patients should be advised that even if they achieve a good range of functional, pain-free movement, they are likely to remain weak with overhead activities. They should also be advised that it can take many months of work to achieve their maximum function although some patients achieve this very quickly. The programme has been designed so that patients work at their own pace, moving onto the next level in the programme when they have mastered the previous one.

TABLE 1. Progression of treatment programme

	Position	Activity
1	Supine	Shoulder flexion to 90 degrees
2	Supine	External rotation with yellow theraband
3	Supine	20 degree sways with arm straight
4	Supine	Flexion with progressive weights
5	Incline	Activities 1–4 with progressive inclination of the plinth
6	Standing	Wall slides with eccentric control
7	Sitting	Elevation through flexed elbow
8	Sitting	Raising and lowering hand in elevation
9	Sitting	External rotation with yellow theraband
10	Sitting/standing	Proprioceptive activities

DOI: 10.1002/msc

Evaluation of the programme

Following discussions with the Local Research Ethics Committee, a pilot study was designed to monitor the progress of patients who were undertaking the rehabilitation programme. Ethical approval was given for the pilot evaluation study to begin in 2002.

Methods

A cohort study of 10 patients with a clinical and radiological diagnosis of massive, irreparable rotator cuff tear was carried out. This study evaluated the change from baseline to 12 weeks in the shoulder function of patients undergoing the Torbay rehabilitation programme previously described.

Subjects

The pilot study was an evaluation of change over a 3 month period in patients undertaking the rehabilitation programme. Ten patients were recruited to the pilot study, six female and four male. The mean age of the patients was 76 years (range 70–83). The inclusion and exclusion criteria are outlined in Table 2. Patients were identified from primary and secondary care referrals to physiotherapy with a clinical diagnosis of a massive rotator cuff tear. Clinical diagnosis of a full thickness rotator cuff tear was based on the presence of some or all of the following signs: positive humeral thrust on elevation, gross weakness and wasting of the supraspinatus and infraspinatus, infraspinatus lag and rupture of the long head of the biceps. All patients had an ultrasound scan to confirm the diagnosis. A massive cuff tear is one where the leading edge of the tear has retracted past the glenoid margin. Eligible patients were invited to take part in the study and informed consent was

TABLE 2. Inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria
18 years or over	Diagnosed neurological abnormality affecting the shoulder joint complex
Clinical and ultrasonographic diagnosis of massive rotator cuff tear	Patients involved in an industrial claim or litigation
Patient's ability to understand and co-operate with research and the capability of giving informed consent	Patients whose rotator cuff tear is considered to be operable

Musculoskelet. Care **4**: 140–151 (2006)
DOI: 10.1002/msc

obtained. The baseline assessment was carried out and then the patient undertook the treatment programme. Outcome measures were assessed at baseline and at 12 weeks after the start of the programme.

Outcome measures

The outcome measures used for this study were the Oxford Shoulder Disability Questionnaire (OSDQ) and SF36. The OSDQ is validated for use with the UK population and has 12 questions with 5 point responses (Dawson et al., 1996, 2001). The lowest (best) score is 12 and the highest (worst) score is 60. This outcome measure is widely used with patients with rotator cuff problems, and at Torbay hospital, all patients attending the orthopaedic clinic self-administer the questionnaire on every visit using a touchscreen.

The SF36 is a 36-item questionnaire that has become one of the most widely used generic assessments of general health (Ware and Sherbourne, 1992). It assesses eight dimensions: physical function, social function, role limitation due to physical problems, role limitation due to mental problems, mental health, energy/vitality, pain, and general health perception. With the SF36, an increase in score shows an improvement. This outcome measure was used because, in this elderly population, it was felt that it would reflect other aspects of their health that could impact on their shoulder pain and function.

Procedures

All patients recruited into the pilot study underwent the rehabilitation programme previously described. All patients attended for approximately half an hour a week for the first four weeks, and then at two to three weekly intervals. At each visit the patient was given a home exercise programme. Each programme focused on three exercises to be completed two to three times a day and the exercises were progressed as the patient's condition improved.

Results

Scores on the OSDQ improved in all patients (Table 3). The mean improvement was 10 (range 3–16). The SF36 showed an improvement in the pain scores for all patients (mean 22 points) and an overall improvement of 10 points for the sections on role limitation due to physical health. There was an overall decline in perceived general health (9 points) and in role limitation due to emotional health (23 points).

DOI: 10.1002/msc

TABLE 3. Changes in outcome measures

Patient	Age	Sex	Symptom duration	Oxford Shoulder Score			SF36								
							Role limitation due to physical health			Role limitation due to emotional health			General health		
			Months	Base	3 months	Change	Base	3 months	Change	Base	3 months	Change	Base	3 months	Change
Mean	75.6		10.8	34.2	23.6	10	25	35	10	80	57	–23	70	61	–9
1	71	F	24	27	23	4	50	100	50	100	100	0	65	65	0
2	70	F	2	34	23	11	25	100	75	100	100	0	80	70	–10
3	78	M	3	32	16	16	25	50	25	66.67	33.33	–33.34	85	70	–15
4	77	F	6	31	28	3	0	0	0	0	0	0	70	60	–10
5	72	F	11	34	18	16	100	75	–25	100	100	0	90	90	0
6	83	M	2	38	15	17	25	0	–25	100	0	–100	55	35	–20
7	72	F	18	47	34	13	0	0	0	100	0	–100	65	40	–25
8	79	F	36	32	29	3	25	25	0	33.33	33.33	0	70	70	0
9	73	M	3	44	31	13	0	0	0	100	100	0	100	85	–15
10	81	M	3	23	19	4	0	0	0	100	100	0	20	25	5

Musculoskelet. Care **4**: 140–151 (2006)
DOI: 10.1002/msc

Discussion

Many of the patients recruited into the study had long-standing shoulder pain and had undergone previous courses of physiotherapy. The pilot study was limited by its lack of a control group, but the purpose of this study was to confirm the impression that these patients did improve, and to provide some indication of the level of change in order to give the information necessary to determine the sample size needed for a controlled study. It is also recognized that these patients were only followed up for a period of 3 months and that it is necessary to see if the improvements observed at 3 months can be sustained over time. The decline noticed in the SF36 scores for general health and role limitation due to emotional health reflected problems unrelated to the patients' rotator cuff tears. One patient suffered a stroke during the three month period and another patient experienced the breakdown of her lower limb amputation stump.

Conclusion

The pilot study reinforced our impression that patients can improve with this rehabilitation programme. All patients showed improved scores on the Oxford Shoulder Disability Questionnaire in spite of the long-standing nature of many of their shoulder problems. The variation shown in the quality of life scores reflects the age group of this cohort who had a mean age 75.5 years. All patients deemed their pain and function to have improved over the three month period. This work needs to be evaluated further and developed to ensure that the improvement was due to this specific programme and that it can be sustained over time.

Acknowledgements

The author would like to thank Miss Veronica Conboy, Consultant Orthopedic Surgeon, for her collaboration with developing the rehabilitation programme. Thanks are also due to the patients for participating in the study and to Dr Richard Seymour, Consultant Radiologist, for carrying out the ultrasound scans on the participants.

References

American Academy of Orthopaedic Surgeons (2002). Criteria for Shoulder Surgery. Rosemont (IL): American Academy of Orthopaedic Surgeons. Available at www.guideline.gov.

Arcuni SE (2000). Rotator cuff pathology and subacromial impingement. Nurse Practitioner 25: 65–6.

DOI: 10.1002/msc

Bartolozzi A, Andreychik D, Ahmad S (1994). Determinants of outcome in the treatment of rotator cuff disease. Clinical Orthopaedics and Related Research 308: 90–7.
Burkhart SS (1991). Arthroscopic treatment of massive rotator cuff tears. Clinical results and biomechanical rationale. Clinical Orthopaedics 267: 45–56.
Cofield RH, Parvizi J, Hoffmeyer PJ, Lanzer WL, Ilstrup DM, Rowland CM (2001). Surgical repair of chronic rotator cuff tears. A prospective long-term study. Journal of Bone and Joint Surgery (America) 83A: 71–7.
Dalton SE (1994). The conservative management of rotator cuff disorders. British Journal of Rheumatology 33(7): 663–7.
Dawson J, Fitzpatrick R, Carr A (1996). Questionnaire on the perceptions of patients about shoulder surgery. Journal of Bone and Joint Surgery (British) 78(B): 593–600.
Dawson J, Hill G, Fitzpatrick R, Carr A (2001). The benefits of using patient-based methods of assessment: Medium-term results of an observational study of shoulder surgery Journal of Bone and Joint Surgery (British) 83(B): 877–82.
Gazielly DF, Gleyze P, Montagnon C (1994). Functional and anatomical results after rotator cuff repair. Clinical Orthopaedics 304: 43–53.
Gerber C, Fuchs B, Hodler J (2000). The results of repair of massive tears of the rotator cuff. Journal of Bone and Joint Surgery (America) 82: 505–15.
Harryman DT 2nd, Mack LA, Wang KY, Jackins SE, Richardson ML, Matsen FA 3rd (1991). Repairs of the rotator cuff. Correlation of functional results with integrity of the cuff. Journal of Bone and Joint Surgery (America) 73: 982–9.
Hawkins RH, Dunlop R (1995). Non-operative treatment of rotator cuff tears. Clinical Orthopaedics and Related Research 321: 178–88.
Klinger HM, Steckel H, Ernstberger T, Baums MH (2005). Arthroscopic debridement of massive rotator cuff tears: Negative prognostic factors. Archives of Orthopaedic Trauma Surgery 125(4): 261–6.
Milgrom C, Shaffler M, Gilbert S, van Holsbeeck M (1995). Rotator cuff changes in asymptomatic adults. The effects of age, hand dominance and gender. Journal of Bone and Joint Surgery 77(2): 296–8.
Olsewski JM, Depew AD (1994). Arthroscopic subacromial decompression and rotator cuff debridement for stage II and stage III impingement. Arthroscopy 10: 61–8.
Perry J (1983). Anatomy and biomechanics of the shoulder in throwing, swimming, gymnastics and tennis. Clinical Sports Medicine 2(2): 247–70.
Rockwood CA Jr, Williams GR Jr, Burkhead WZ Jr (1995). Debridement of degenerative, irreparable lesions of the rotator cuff. Journal of Bone and Joint Surgery (America) 77(6): 857–66.
Rodgers JA, Crosby LA (1996). Rotator cuff disorders. American Family Physician 54: 127–34.
Sher JS, Uribe JW, Posada A, Murphy BJ, Zlatkin MB (1995). Abnormal findings on magnetic resonance images of asymptomatic shoulders. Journal of Bone and Joint Surgery 77: 10–15.
Ware JE, Sherbourne CD (1992). The MOS 36-ltem Short-Form Health Survey (SDF-36):1: conceptual framework and item selection. Medical Care 30: 473–83.
Worland RL, Lee D, Orozco CG, SozaRex F, Keenan J (2003). Correlation of age, acromial morphology, and rotator cuff tear pathology diagnosed by ultrasound in asymptomatic patients. Journal of the Southern Orthopaedic Association 12(1): 23–6.

Correspondence should be sent to Roberta Ainsworth, Midcreek, Lower Contour Road, Kingswear, Dartmouth TQ6 0AL. Tel: 01803 752846. **E-mail: roberta.ainsworth@nhs.net**

Received November 2005
Accepted February 2006

Musculoskelet. Care **4**: 140–151 (2006)
DOI: 10.1002/msc