



Research paper

Physiotherapy treatment for atraumatic recurrent shoulder instability: Updated results of the Derby Shoulder Instability Rehabilitation Programme



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ABSTRACT

Background: There is limited evidence to guide therapists in the management of patients with atraumatic shoulder instability however physiotherapy remains the recommended course of treatment. In this paper we report the updated results of a rehabilitation programme designed for this patient group.

Method: A service evaluation was conducted at a large university teaching hospital in the UK between August 2013 and September 2018 including patients with atraumatic Stanmore type 2 or 3 instability. Western Ontario Shoulder Index (WOSI) and Oxford Instability Shoulder Scores (OISS) were measured at baseline and final follow-up. OISS was also repeated at every clinic visit. Patients were treated using the Derby Shoulder Instability Rehabilitation Programme until a point of agreed discharge.

Results: 66 patients were included but 15 were lost to follow-up. Patients attended for a mean of 6.9 sessions over 30 weeks. The mean OISS (n = 51) improved from 38.00 to 21.96 (p < 0.001). Including patients that did not complete follow-up in a sensitivity analysis, the mean OISS (n = 63) improved from 38.41 to 24.46 (p < 0.001). The mean WOSI (n = 51) improved from 45.10% to 85.81% (p < 0.001). In terms of the four WOSI sub-groups: the 'Physical' domain improved from mean 47.98%–81.19% (p < 0.001), the 'Sport & Work' domain improved from mean 40.17%–82.00% (p < 0.001), the 'Lifestyle' domain improved from 50.73% to 83.45% (p < 0.001) and the 'Emotions' domain improved from 32.84% to 79.78% (p < 0.001).

Conclusion: For patients with atraumatic shoulder instability the Derby Shoulder Instability Rehabilitation Programme provides significant benefit to patients in terms of pain, stability and function. Further study is required to assess whether such improvements can be sustained in the medium and long terms.

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1. Introduction

The shoulder is the most commonly dislocated joint and whilst in the majority of cases this occurs as a result of trauma, it can also occur in the absence of trauma. Atraumatic shoulder instability is associated with underlying dysfunction of the joint capsule where laxity can lead to symptomatic instability: usually pain, repeated subluxation or full dislocation.^{1,2} In such cases the recommended

management is conservative, in the form of physiotherapy rehabilitation, and surgery is regarded as a last resort.³ There is limited evidence to guide physiotherapists regarding the most effective strategies of rehabilitation.⁴ For this reason the Derby Shoulder Instability Rehabilitation Programme was developed. Early results were published in 2015 on a small group of 18 patients suggesting that the programme showed promising outcomes.⁵ In this paper the results of a larger patient population are reported.

The Derby Programme is designed to be simple for both patients and therapists to understand. It consists of two groups of exercises (see Fig. 1) and the patient is instructed to only practice two exercises at any one time. The exercises are ordered in increasing difficulty with the patients required to achieve a target number of repetitions or performance time without a rest before progressing

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Derby Shoulder Instability Rehabilitation Programme

Only prescribe one exercise from each section at any one time.

Each set of exercises is listed in order of treatment progression and can also be used for functional assessment. If the patient can achieve the target then progress to the next exercise.

Section 1: Working on speed of muscle activation, plyometrics, deceleration of fast movement

Prescribe maximum repetitions until fatigue or the specified target.
Two sessions per day.

	Target Reps
Drop & catch 1kg weight at 90° scaption	100
Drop & catch 1kg weight at 90° scaption on 1 leg (opposite side)	100
Drop & catch 1kg weight at 90° scaption with eyes closed	100
Drop & catch 1kg weight in AER/AIR	100
Falling press up in standing	50
Falling press up to waist level	50
Plyometric push up with hand clap	20
Doorway fall	20

Section 2: Working on proprioception, muscle balance, trunk stability

Prescribe 5 repetitions of the patient's maximum ability or specified target time.
Two sessions per day.

	Target Time
Single handed ball roll on wall	60s
Single handed kneeling crosses	60s
Kneeling single handed ball roll	60s
Single handed crosses in push up position	60s
Double handed ball roll in push up position	60s
Double ball roll in push up positions	60s

Note: For patients with significant posterior instability modify the position for the single hand exercises to do with the shoulder in an abducted rather than flexed position.

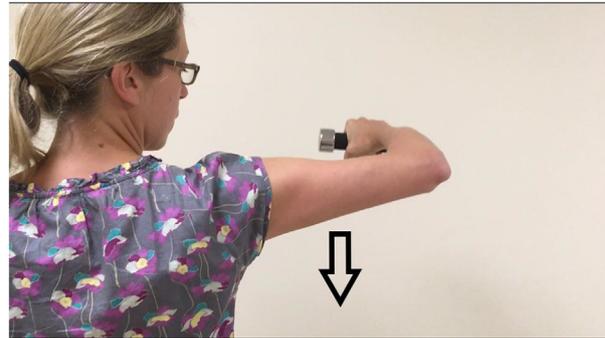
Fig. 1. The Derby Shoulder Instability Rehabilitation Programme overview.

to the next exercise in the section. The exercises are intended not just to improve strength but also stamina, speed of muscle activation, proprioception and absorption of impact to help rehabilitate patients back to both functional daily activity and high level sport. There is evidence to suggest that patients with shoulder instability lack proprioception⁶ and that exercise that includes weight-bearing

through the arm on an unsteady surface⁷ or plyometrics⁸ can help patients restore it. Patients are therefore instructed in exercises from the outset involving weight-bearing through their arm and perform fast plyometric movements to gain strength. Details of the exercises are shown in Fig. 2 and exercise videos can be accessed via DerbyShoulderUnit.co.uk. The focus of all of the exercises is based



Exercise 1a: Drop and catch a 1kg weight at 90° abduction in the scapular plane. If this is too difficult to begin with then use a smaller weight or lower the arm to 45° abduction. Target repetitions: 100. The exercise can then be modified to be performed with the patient's eyes closed or standing on the contra-lateral leg.



Exercise 1b: Drop and catch a 1kg weight at 90° abduction but with the elbow flexed. The patient is instructed to keep the elbow high so that the movement is primarily internal rotation of the shoulder. Target repetitions: 100.



Exercise 1c: For patients with anterior instability symptoms progress to dropping and catching a 1kg weight into external rotation at 90° abduction. This is performed lying supine. Target repetitions: 100.



Exercise 1d: Falling push up in standing. The patient stands one arm length from the wall. They are instructed to fall towards the wall and save themselves with their hands in a push up position. They then plyometrically push away from the wall back to a standing position. Target repetitions: 50.



Exercise 1e: Falling push up to waist level. With a similar technique to exercise 1d the patient now falls to waist level, for example to the height of a kitchen work surface. Target repetitions: 50.



Exercise 1f: Plyometric push up with hand clap. Target repetitions: 20. If this is too difficult then it can be performed in kneeling first before progressing to the full push up position.



Exercise 1g: Doorway fall. For patients with anterior instability this end stage exercise involves falling through a doorway. The patient is instructed to stand one arm length from the doorway, fall forwards and then save themselves by positioning their shoulders in an abducted and externally rotated position. They then push back up into a standing position. Target repetitions: 20.

Figure 2. Detailed instructions for each exercise used in the Derby Shoulder Instability Rehabilitation Programme.



Exercise 2a: Single hand ball roll on the wall. The patient is instructed to stand 1.5 arm lengths from the wall. They lean forward with their hand on a firm ball at 90° shoulder flexion. Applying as much body weight as possible the patient is instructed to roll the ball very slowly up and down trying to control and tremor. If tremor is present then the patient continues this exercise at home. If they can perform it for 1 minute smoothly they progress to the next exercise.



Exercise 2b: Kneeling crosses. The patient kneels with their weight on their symptomatic arm. With their free arm they point to the corners of a cross or square thereby transferring weight over the symptomatic arm. Patients are encouraged to make as large a movement as possible. The movement should be performed smoothly, without tremor, for 1 minute before progressing to the next exercise.



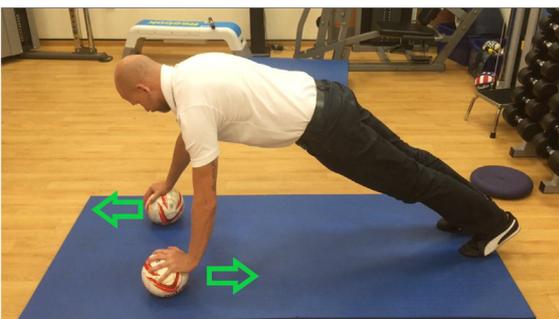
Exercise 2c: Kneeling single hand ball roll. The patient kneels with as much weight as possible through their symptomatic arm on a firm ball. They then roll the ball slowly forwards and backwards. The movement should be performed smoothly, without tremor, for 1 minute before progressing to the next exercise.



Exercise 2d: Crosses in a push up position. The patient adopts a push up position but then keeps their weight on their symptomatic arm whilst pointing to the corners of a cross or square with their other hand. Patients are encouraged to make as large a movement as possible. The movement should be performed smoothly, without tremor, for 1 minute before progressing to the next exercise.



Exercise 2e: Double handed ball roll in push up position. The patient adopts a push up position weight-bearing on a firm ball. The ball is then rolled slowly forwards and backwards. The movement should be performed smoothly, without tremor, for 1 minute before progressing to the next exercise.



Exercise 2f: Double ball roll in push up position. The patient adopts a push up position with each hand on a firm ball. One ball is rolled slowly forwards while the other ball is rolled slowly backwards and vice versa. The movement should be performed smoothly, without tremor, for 1 minute.

Figure 2. (continued).

upon an activity using the hand rather than a correction of posture or 'abnormal' pattern of movement. The reasoning behind this is to reduce the over-medicalisation of the problem, reduce the focus on the shoulder, reduce the emphasis on what is abnormal and concentrate on improving functional ability instead. Alongside the prescription of exercise patients also receive education regarding the condition with emphasis that this is a lifelong condition that requires self-management. This is to reduce the demand of a 'quick fix' and set appropriate expectations regarding timescales for improvement: usually several months. Patients are also advised that mild or moderate pain during exercise is normal and to be expected, to help reduce the fear of pain during activity, with reassurance that pain does not equate to tissue damage.⁹ There is evidence to suggest that performing exercises that are painful may have a greater effect than those that are pain free in the short term.¹⁰ Patients are told to expect improvements in ability to perform the exercises but not necessarily a corresponding initial

improvements in pain or reduction in subluxation. Our observation is that patients typically reach a certain threshold of exercise ability, unique to them, when symptoms suddenly begin to improve rather than a steady improvement from the outset. It is important therefore to try and encourage patients to persevere with the programme even if there is little benefit in the short term.

2. Methods

A prospective service evaluation was implemented in August 2013 in both the adult and paediatric physiotherapy outpatient clinics in our large university teaching hospital and continues to the present day. Included patients had a history of atraumatic recurrent shoulder instability. Patients were clinically assessed by an experienced physiotherapist and findings were correlated with the patient's history and imaging findings. Classification of instability was made using the Stanmore system.² Those with a history of trauma

(type 1) or a single instability episode only were excluded. Those classified as type 2 or type 3 were included. All patients were treated using the Derby Shoulder Instability Rehabilitation Programme provided they met the basic inclusion criteria detailed in the programme:

- No clinical evidence of neurological muscle weakness compared with the contralateral side
- No true scapula winging that would indicate a long thoracic nerve lesion (but asymmetrical patterning is accepted)
- Able to maintain sitting balance on a gymball as a means of assessing basic trunk stability
- Able to achieve 90° scaption as required to perform the exercises in section 1 of the programme.

Any patients who were unable to fulfil these last two criteria were first instructed in other exercises to perform before starting the programme. Examples of this were to practice single leg balance or sitting balance on a gymball; or isotonic elastic band shoulder external rotation exercises.

Results were reviewed from August 2013 up to September 2018. All patients are invited to complete a Western Ontario Shoulder Index (WOSI)¹¹ and Oxford Instability Shoulder Score (OISS)¹² at their initial consultation. The OISS is repeated at every clinic visit but the WOSI is only repeated at the time of agreed discharge, for logistical reasons, due to the fact that it takes longer to complete. The OISS is scored from 12 to 60 points with 12 indicating a perfect score for a normal healthy stable shoulder. The WOSI is presented as a percentage, with a higher score meaning a better level of function and shoulder stability. The minimum clinically important difference for the OISS is 4.5 points¹³ and for the WOSI is 10.4%.¹⁴ Baseline measures were compared to those from final follow up with statistical analysis performed using Microsoft Excel. Normality of data was assessed using Skewness and Kurtosis tests and deemed to be normally distributed if both results fell between -2 and $+2$. OISS data were normally distributed so were subsequently tested for significance using a two-tailed student t-test. WOSI data, including subgroups, were not normally distributed so analysed using the Wilcoxon signed ranks test. For those patients that did not complete the programme to an agreed time of discharge the OISS up until their last clinic appointment could still be used for a sensitivity analysis but WOSI data could only be analysed for those that had completed the package of care.

3. Results

68 patients with atraumatic recurrent shoulder instability were treated over the five year period. Two patients were excluded from the programme: one due to a congenital hand deformity meaning they could not perform the exercises and the other likewise due to comorbidities and multiple other joint pathologies. The population demographics of the 66 patients that started the programme included 23 males and 43 females. Mean age 21.65 (range 12–52) with mean symptom duration of 34 months (range 1 month–21 years). Only nine patients had symptoms for less than six months. Adult patients were typically referred for further investigation with 29 patients undergoing magnetic resonance imaging and seven patients diagnostic arthroscopy. Children were not referred for imaging routinely. In more severe child cases plain radiography was used to exclude dysplasia. Six patients were classified as Stanmore type 2 with the majority of 60 classified as type 3 (with the caveat that 30 of the youngest patients had not had detailed investigations). All patients displayed clinical signs of shoulder laxity in at least one direction. Five patients had a prior formal diagnosis of Ehlers-Danlos Syndrome (hypermobility-type). 18 patients had

symptomatic anterior instability, 17 posterior instability and 31 had both anterior and posterior instability. Patients with type 2 instability despite some structural abnormality still responded well to treatment with mean OSIS improvement 16.83 points (range 6–32) and WOSI 40.25% (range 24.71–63.29), all above the MCID for each outcome measure. Patients who completed the programme ($n = 51$) attended for a mean of 6.9 sessions over a mean of 30 weeks.

Of the 66 patients, 51 completed the programme up to a point of agreed discharge. Three patients did not re-attend after the first visit so no OISS data was available for comparison from these patients. The mean OISS ($n = 51$) improved from 38.00 to 21.96 ($p < 0.001$). Including patients that did not complete follow-up in a sensitivity analysis, the mean OISS ($n = 63$) improved from 38.41 to 24.46 ($p < 0.001$). The mean WOSI ($n = 51$) improved from 45.10% to 85.81% ($p < 0.001$). In terms of the four WOSI sub-groups: the 'Physical' domain improved from mean 47.98%–81.19% ($p < 0.001$), the 'Sport & Work' domain improved from mean 40.17%–82.00% ($p < 0.001$), the 'Lifestyle' domain improved from 50.73% to 83.45% ($p < 0.001$) and the 'Emotions' domain improved from 32.84% to 79.78% ($p < 0.001$). The results are summarised in [Table 1](#).

4. Discussion

Our findings suggest that the Derby Shoulder Instability Rehabilitation Programme significantly improves the symptoms of patients with atraumatic shoulder instability whether they have a structural lesion (i.e. Stanmore Type 2) or not. Likewise, there was no difference if the patient suffered from anterior instability, posterior instability or both. Adherence to treatment was high with 51 out of 66 patients (77%) completing the programme to an agreed end point. Of the remaining 15 that did not, two relocated geographically due to work/university, one suspended treatment due to pregnancy and is yet to return, and one contacted the department to state they were much improved but failed to return the final outcome questionnaires. Five of the 15 patients that failed to complete the programme had achieved greater than the 4.5-point MCID of the OISS at their last visit. Of those that completed the programme 46 out of 51 (90%) surpassed the MCID of the OISS. Interestingly one 13-year-old patient did not meet the MCID of both the OISS and WOSI but subjectively reported that they were greatly improved. This perhaps suggests an initial lack of understanding of the outcome questionnaires having scored very highly at baseline. Two other patients that failed to meet the MCID of the OISS had a clinically important 26- and 27-point respective improvement in WOSI suggesting that the outcome measures may not correlate perfectly. Indeed, analysis of our complete dataset found a Pearson's correlation coefficient of 0.70 between the change in OISS and the change in WOSI scores. Overall, 54 of 66 patients (82%) found a meaningful improvement in symptoms based upon the MCID of the OISS.

As mentioned previously, there is limited evidence to guide physiotherapists when treating patients with atraumatic shoulder instability. Until recently the protocol by Burkhead & Rockwood¹⁵ was the only reproducible exercise regime but this lacked detailed assessment of patient outcomes. Watson and colleagues have devised a different regime and reported their results of a service evaluation in 2017.¹⁶ They also conducted a randomised clinical trial to compare the Watson protocol against the Burkhead & Rockwood protocol.¹⁷ Whilst both regimes were found to be effective patients following the Watson protocol achieved greater improvements based upon the WOSI and Melbourne Instability Shoulder Scores. In [Table 2](#) the outcomes of our study are compared against the WOSI and OISS scores reported by the Watson group.¹⁶ This suggests that similar results can be achieved using the Derby

Table 1
Results – The change in mean Oxford Instability Shoulder Score (OISS) and Western Ontario Shoulder Index (WOSI) domains between baseline and final follow-up.

	Baseline (Mean)	Final Follow-up (Mean)	Significance	Number of patients
OISS	38.00 points	21.96 points	p < 0.001	51
OISS (sensitivity analysis)	38.41 points	24.46 points	p < 0.001	63
WOSI (Total)	45.10%	85.81%	p < 0.001	51
WOSI (Physical)	47.98%	81.19%	p < 0.001	51
WOSI (Sport & Work)	40.17%	82.00%	p < 0.001	51
WOSI (Lifestyle)	50.73%	83.45%	p < 0.001	51
WOSI (Emotions)	32.84%	79.78%	p < 0.001	51

Table 2
A comparison of treatment outcomes between the Derby and Watson protocols.

	Derby Protocol	Watson Protocol ¹⁶
Total Patients	66	43
Patients Completed Treatment	51	39
Follow up	30 weeks (mean, n = 51)	24 weeks
Sessions	6.9 (mean, n = 51)	12
Baseline WOSI	45.10% (SD 18.00)	39.78% (SD 15.61)
End WOSI	85.81% (SD 16.33)	77.04% (SD 12.01)
Change in WOSI	40.71% (n = 51)	37.26% (n = 39)
Baseline OSIS	38.00 (SD 8.19)	35.76 (SD 8.59)
End OSIS	21.96 (SD 7.03)	20.67 (SD 6.97)
Change in OSIS	16.04 (n = 51)	15.09 (n = 39)
Sensitivity Analysis	13.95 (n = 63)	–

protocol. The studies differ in the fact that the Watson study was conducted over a fixed 12-week time frame with patients attending on a weekly basis then outcomes measured at 24 weeks. Patients were only included if they had multi-directional instability (i.e. anterior and posterior) and were excluded if there was an underlying structural lesion. The Derby results are reported at final follow up ranging from 6 to 51 weeks with a mean of 30 weeks, though patients attended fewer times (mean 6.9). This is due to the nature of the Derby programme being self-managed, meaning that patients decide on their own follow-up intervals based upon their own schedules and target-driven exercise progressions.

It is important to acknowledge the limitations of this study. Atraumatic shoulder instability is potentially a life long condition and therefore conclusions drawn from a mean follow up of 30 weeks should be interpreted with some caution. Long term follow up is required for this patient group to assess whether such exercise programmes result in sustained improvements over long periods of time. Whilst our patients are advised to continue with regular exercise to maintain their functional improvement it remains to be seen whether this is achievable. Interestingly one patient in our cohort was previously treated as a young teenager based upon similar exercise principles, prior to the implementation of the formal programme, and their symptoms resolved. Seven years later as a university student they began to experience symptoms again with posterior subluxation every time the shoulder flexed beyond 90°. They attributed this to a change of lifestyle from regular sport and exercise to long hours spent at a desk. Having been guided through the rehabilitation programme again their symptoms resolved but it highlights the point that levels of exercise need to be maintained to prevent re-occurrence.

This study is also from a single centre and lacks a control or comparator intervention. It is though unlikely that patients' symptoms would have resolved naturally without treatment due to the length of symptoms (mean 34 months) and many of the patients having failed to improve with different physiotherapy interventions previously with other providers. This group of patients with atraumatic shoulder instability is difficult to study due to the relatively uncommon nature of the condition. We were only able to

identify such 66 patients over a five-year period in a large teaching hospital with wide catchment area. The only randomised trial on the subject conducted in Australia managed 41 patients over two years.¹⁷ Our group of 66 patients though is the largest reported, equal to Burkhead & Rockwood,¹⁵ and includes validated pathology-specific outcome measures. There is though a need to continue following this patient cohort to ascertain the outcomes in the longer term.

5. Conclusions

For patients with atraumatic shoulder instability the Derby Shoulder Instability Rehabilitation Programme provides significant benefit to patients in terms of pain, stability and function. Further study is required to assess whether such improvements can be sustained in the medium and long terms.

Ethics

Ethical approval was not required because this was a service evaluation of current treatment practice.

Declarations of interest

BS and SO: none.

MB reports personal fees from educational courses related to the assessment and treatment of shoulder disorders, outside the submitted work.

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