Title: Comparison of outcomes following arthroscopic capsular release for idiopathic, diabetic and secondary adhesive capsulitis of the shoulder: A Systematic Review

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Abstract

Introduction:

Arthroscopic capsular release for adhesive capsulitis of the shoulder is a treatment option. The present study aimed to investigate the clinical outcomes following arthroscopic capsular release among idiopathic, diabetic and secondary adhesive capsulitis.

Hypothesis:

Different aetiological groups yield variable outcomes following arthroscopic capsular release.

Materials and Methods:

A literature search was performed using MEDLINE, EMBASE, CINAHL and the Cochrane Database in April 2017. Comparative studies that reported range of motion or functional outcomes following arthroscopic capsular release in patients with adhesive capsulitis were included. A systematic review of the studies was conducted following the PRISMA guidelines.

Results:

Six studies met the eligibility criteria. The overall population included 463 patients; 203 idiopathic, 61 diabetic and 199 secondary cases. Of four studies comparing idiopathic and diabetic patients, three reported significantly worse range of movement and function in the diabetic group at various follow up points. No significant difference in function and motion was reported between the idiopathic and secondary groups. Recurrent pain was highest in diabetic patients (26%) compared to idiopathic groups (0%) and the secondary group had a higher rate of revision surgery when compared to the idiopathic group (8.1% vs. 2.4%)

Discussion:

Arthroscopic capsular release has a high success rate regardless of the underlying aetiology. However, diabetic patients are reported to have more residual pain, reduced motion and inferior function compared to idiopathic cases. The rate of revision capsular release is higher among patients with post-surgical adhesive capsulitis when compared to idiopathic cases.

Level of evidence: Level IV, systematic review.

Keywords Shoulder**;** Frozen shoulder**;** Adhesive capsulitis**;** Capsular release**;** Arthroscopy**;** Diabetes mellitus

1. Introduction

Adhesive capsulitis of the shoulder is common with an estimated incidence between 2 and 5% in the normal population [1, 2]. Diabetic patients have a two to four times greater risk of developing frozen shoulder compared to the general population, with an estimated lifetime risk of 10-20%. [3, 4-6]. The condition was previously defined by Lundberg as restricted movement isolated to the glenohumeral joint with less than 135° of shoulder elevation and no other clinical or radiological explanation for this reduced motion [3]. The condition is more common among females and has a peak incidence between 40 and 60 years [7-9]. Lundberg classified adhesive capsulitis into primary frozen shoulder, subdivided into diabetic patients and those with no other explanation, and secondary frozen shoulder, again subdivided into post-traumatic and iatrogenic [3]. The latter is a heterogeneous group of patients that is associated with great challenges in terms of both diagnosis and treatment. Ultimately, this group may require treatment of their underlying primary shoulder condition and their prognosis can be inferior. However, to our knowledge there are no systematic reviews prior to ours that have addressed this question.

Most cases of adhesive capsulitis are initially managed non-operatively with Griggs et al. reporting 90% satisfaction after an exercise programme and only 7% requiring surgical intervention [10]. However, Shaffer et al. demonstrated that 50% of patients continued to have mild pain, stiffness and a deficit in shoulder range of motion after seven years [11]. Failure to see an improvement in pain or function after 3 months of non-operative treatment should lead to consideration of surgical intervention [12, 13]. Arthroscopic capsular release allows a controlled and complete release of the contracted

capsule [14]. Studies have demonstrated significant early improvements in over 80% of patients within 2 to 6 weeks [15, 16], and these improvements in motion, pain and function have been maintained in the long-term [17]. In patients with resistant adhesive capsulitis, who have failed non-operative treatment and manipulation, arthroscopic capsular release has similarly been shown to improve function, pain relief and range of motion at intermediate-term follow up [18]. The underlying aetiology of adhesive capsulitis may alter the effectiveness of treatment. This systematic review therefore aims to identify whether there are any differences in outcomes between idiopathic, diabetic or secondary adhesive capsulitis following arthroscopic capsular release. The present hypothesis is that controversies on the effectiveness of arthroscopic capsular release stem from variable clinical and functional outcomes among the different aetiological groups.

2. Material and Methods

A systematic review of the literature was conducted according to the PRISMA guidelines [19] using the online databases MEDLINE®, Embase™, CINAHL® and the Cochrane Central Register of Controlled Trials. A summary of the Medline search is illustrated in Table 1. The searches were performed independently by two authors (TB and RJ) on 1 April 2017 and 19 April 2017 to ensure accuracy.

Eligibility criteria were derived from the hypothesis and the study parameters outlined here:

I. Participants – Adult patients with adhesive capsulitis considered for surgical treatment
II. Intervention – Arthroscopic capsular release in primary idiopathic adhesive capsulitis
III. Comparison – Arthroscopic capsular release in diabetic and secondary adhesive capsulitis

IV. Outcomes – Primary outcome measure: shoulder range of motion (ROM). Secondary outcome measure: clinical outcomes measure scores, health related questionnaires, complications/revision procedure, and patients satisfaction

All identified studies that compared the outcomes of arthroscopic capsular release in idiopathic adhesive capsulitis with those undergoing surgery for diabetic or secondary adhesive capsulitis were included, provided that functional outcome or shoulder range of movement was reported. Secondary outcome measures of interest included pain scores and requirement for further surgery. Only primary research published in the English language was considered for review. References of full texts were also reviewed to identify other potential relevant studies. The acquisition of articles is summarised as a flow diagram in Figure 1.

The principal exclusion criteria were: abstract only publications, conference proceedings, case reports, review articles, previous surgery unrelated to the aetiology or current treatment of adhesive capsulitis, open capsular release, and comparison with other treatments. Studies which reported on treatment of concomitant shoulder conditions only were excluded. Equally, studies, which looked at cadaveric models, biomechanics or laboratory analyses, only were excluded.

All relevant studies were critically appraised employing narrative data synthesis. This process was conducted by two independent reviewers (TB and RJ). Where there was discrepancy, it was resolved by a third independent reviewer (AS). Quality assessment and risk of bias was evaluated using criteria derived from the validated Methodological Index for Non-Randomised Studies (MINORS), outlined in Table 2 [20]. Data on functional outcomes, pain and range of movement were extracted from each study. Full quantitative data synthesis was not feasible due to the marked heterogeneity of the results and outcome measures reported by the studies.

3. Results

The search strategy, outlined in Figure 1, identified six studies eligible for inclusion from a total of 208 publications spanning the period from 1967 to 2014. All studies included were comparative case series (level IV) [21-26]; three studies compared idiopathic to diabetic cases [22, 25, 26], two compared idiopathic to secondary cases [23, 24], and the final study compared idiopathic to both diabetic and secondary adhesive capsulitis [21]. The overall population included 463 patients; 203 idiopathic, 61 diabetic and 199 secondary cases. The secondary cases were made up of 69 post-trauma, 100 post-surgical and 30 degenerative conditions. The length of follow-up varied, with an overall mean of 37.5 months, the shortest at 13 months in Cinar et al and the longest at 8 years in Nicholson et al [21, 22]. Important details of the included clinical studies are given in Table 3. The latter depicts further details of studies, which were associated with marked heterogeneity in relation to patient selection especially in terms of primary shoulder condition associated with secondary frozen shoulder, as well as additional surgical intervention. Nicholson et al who reported 24 concomitant subacromial decompression and Jerosch et al who reported 55 variable additional surgical procedures [21, 24]. None of the studies used a defined power calculation and 3 of the studies had sample sizes with less than 45 cases.

Range of Motion

Shoulder flexion, external rotation and internal rotation were the most commonly reported shoulder range of motion (ROM). Table 4 illustrates the recorded values in the

included studies. All studies demonstrated that arthroscopic capsular release produced a statistically significant improvement in ROM in all three subgroups of adhesive capsulitis. Three of the four studies comparing idiopathic and diabetic cases demonstrated a greater improvement of motion in the idiopathic group [22, 25, 26]. Two studies demonstrated improved range of motion at only the six month follow up point [25, 26], whereas Cinar et al. reported improved abduction and internal rotation until final follow up at a mean of 53 months ($p<0.05$) [22]. The two studies comparing idiopathic and secondary cases demonstrated no significant differences in range of motion between the groups [21, 23]. Three studies, Cinar et al. Mehta et al. and Cho et al, reported improvement in range of motion among different aetiological groups. Comparisons of results between different studies demonstrated no significant differences in these range of motions between the idiopathic and diabetic aetiological groups.

Patient reported outcome measures (PROMs)

A variety of PROMs were utilised by the reviewed studies and are illustrated in Table 5. All studies recorded a statistically significant improvement in PROMs in all three groups from pre-operative to post-operative scores.

The Constant score was recorded in four studies. Two compared idiopathic and diabetic cases and demonstrated a significantly greater improvement in the idiopathic group [22, 25]. Mehta et al [25] reported better results up until six months ($p<0.01$) whereas Cinar et al [22] demonstrated improved results at final follow up ($p<0.05$). The other two studies compared idiopathic and secondary cases but reported no significant differences between the groups [23, 24].

The American shoulder and elbow score (ASES) was used in two studies; one comparing idiopathic and diabetic cases that demonstrated greater improvements in the ASES amongst the idiopathic group at one year (p=0.025) but not at final follow up [26]. The other compared idiopathic to both diabetic and secondary cases and reported a trend to improved ASES in the idiopathic group compared to the diabetic group (p=0.056) [21].

Pain

Comparison of pain scores was reported in five of the included studies, details are illustrated in Table 6. The pain visual analogue score (VAS) was reported in three studies [21, 23, 26] one reported the severity of pain (none, mild, moderate or severe) [22] and residual pain at follow up in the last study [25]. Nicholson reported pain was a significant problem in 22% of cases in the first six weeks post-operatively but that only diabetic patients had a higher incidence of residual pain (p=0.0176) [21]. Cinar et al. reported 26% of their diabetic patients had residual pain at final follow up (mean 54 months) compared to 0% in the idiopathic group [22]. The remaining three studies demonstrated no significant differences in pain relief between the groups (mean follow up 24 to 46 months) [23, 25, 26].

Revision procedures

Only two studies clearly stated their revision rate. Nicholson reported no revision procedures were required in any group [21]. Elhassan et al. reported a revision rate of 2.4% in the idiopathic group compared to 8.1% in the secondary group at a mean of 46 months follow up. In comparison, among patients with secondary frozen shoulder the rate of revision was 10.4% in the post-surgical group, and 3.8 % in the post-traumatic group [23].

4. Discussion

The included studies demonstrate that regardless of aetiology, arthroscopic capsular release provides statistically significant improvements in PROMs, ROM and pain relief in adhesive capsulitis. Comparison of outcomes between idiopathic and diabetic cases suggested that greater improvement in ROM and PROMS could be achieved in the idiopathic group especially early post-operatively (up to six months) but two studies also reported continued improvement comparatively until later stages of follow up (mean 36 to 53 months).

The finding of poorer outcomes in diabetics when compared to idiopathic cases has previously been reported [27-29]. Moren-Hybbinette et al [19] demonstrated that 65% of diabetic patients with adhesive capsulitis had limitation of range of motion after non-operative treatment at a mean of 29 months [30]. Massoud et al reported that 22% of diabetics were unsatisfied and 68% still had limitation in motion after surgical intervention [31]. Studies comparing outcomes in idiopathic and diabetic patients have demonstrated inferior outcomes in diabetic patients after non-operative treatment [10], manipulation under anaesthesia [12, 32, 33], and arthroscopic release [34]. Jenkins et al. retrospectively compared manipulation under anaesthesia in diabetic and non-diabetic patients and showed that diabetics had a higher return to theatre for unsatisfactory outcomes (36% versus 15%) [33]. Pollock et al demonstrated that manipulation and arthroscopic release in resistant adhesive capsulitis was more

successful in idiopathic cases than diabetics with an excellent result seen in only 18% of diabetics compared to 62% of idiopathic and 83% of post traumatic cases [34].

The evidence reviewed supports these inferior outcomes in diabetics compared to idiopathic cases. A possible explanation is that diabetic patients may have more pain post-operatively and therefore do worse initially as pain can inhibit range of motion and function. Two included studies demonstrated worse early results in diabetic patients; Mehta et al [25] reported improved ROM and Constant score at 6 months and Cho et al [26] improved ROM and ASES at 12 months. These two studies also reported a non-significant increase in pain post-operatively in the diabetic group; Mehta et al. showed residual pain in 33% of diabetics compared to 9.5% of idiopathic cases [25] and Cho et al reported a residual mean VAS score of 2.2 in diabetics compared to 1.4 in idiopathic cases [26] Cinar et al demonstrated worse function and motion in diabetics at final follow up and similarly demonstrated a higher residual level of pain in diabetics (26% versus 0%) [22].

Comparison of idiopathic and secondary cases did not demonstrate any significant differences in ROM or PROMS in the studies reviewed. Elhassan et al. did report significantly poorer outcomes in the post-surgical subgroup in terms of forward flexion, pain and SSV but these findings were not reproduced in other studies [23]. However, the same authors reported revision rates for residual stiffness to be four times higher in these secondary cases [23]. The highest revision rate was in the post-surgical group (10.4%), of which 40% undergoing revision had continued unsatisfactory outcomes. Interpretation of these figures is difficult as the secondary group was heterogeneous and included 48 post-surgical and 26 post-trauma cases. Similarly, the post-surgical group included a variety of procedures including 17 rotator cuff repairs, 12 stabilisations and 5 SLAP repairs. Arthroscopic release in post-surgical and post-

trauma patients has been associated with worse outcomes than idiopathic cases. Holloway et al. compared outcomes after arthroscopic release in three groups; idiopathic, post-fracture and post- surgery cases. The authors reported that patients with post-operative adhesive capsulitis had significantly worse scores for pain (<0.03), satisfaction ($p<0.004$) and functional activity ($p<0.002$) [35]. Wang et al. compared the results of manipulation under anaesthesia in the same three groups and in contrast demonstrated that pain, range of motion and functional outcomes were all significantly worse in the post-traumatic group ($p<0.01$) [27]. Therefore, although the effectiveness of interventions for adhesive capsulitis seems to be dependent upon the underlying aetiology, the precise relationship remains uncertain.

The presence of concomitant stiffness and traumatic injuries complicates management of adhesive capsulitis, as there is concern that simultaneous treatment may result in increased stiffness post-operatively. Although controversial, the traditional treatment of concomitant stiffness and rotator cuff tear is to prioritise the treatment of the stiffness first and perform a delayed cuff repair in order to avoid the increased risk of post-operative stiffness and disability [36]. There is increasing evidence that simultaneous repair and arthroscopic release can give comparable range of motion and functional scores [37-39] as well as a lower re-tear rate 0% versus 20% ($p=0.009$) [37]. The response of the post-surgical adhesive capsulitis seems to be less predictable than in the idiopathic cases [35]. However, grouping post-surgical conditions together may limit the ability of studies to demonstrate differences in outcome for particular subgroups of operations. Further work is therefore required to know if specific prior surgical procedures place the patient at higher risk of recurrent symptoms and require earlier intervention. In addition, it is important to recognise the emergence of alterative techniques in the management of adhesive capsulitis. The use of capsular hydro-

dilatation has become a well-established approach in the treatment of this condition. A detailed review of relevant outcomes following this intervention was beyond the scope of the present study. Bell et al did however report variability in outcomes among different aetiological groups [40]. Following capsular hydrodilation all non-diabetic patients showed considerable improvement, compared to a shorter benefit in diabetic patients [40]. A recent randomised trial comparing arthroscopic capsular release with hydro-dilatation demonstrated overall equivalent results [41]. The group treated with arthroscopic release did however obtain significant superior results with 5 points difference on the Oxford shoulder score (P=0.023) [41]. In contrast, Yukata et al have recently reported the successful outcomes of limited minimally invasive ultrasound-guided coracohumeral ligament release [42]. Both studies were not powered to detect subgroup difference. Hence, larger comparative studies are still required to determine the long-term outcomes among different aetiological groups.

Evaluation of the reviewed studies against the MINORs criteria [20] demonstrated a variation in the quality of included studies as illustrated in Table 2. The included studies all provided level IV evidence. The use of different outcome measures limited the ability to compare or combine results and the variation in follow up from 13 months to 99 months has the potential to influence results as previous work has demonstrated that outcomes improve significantly with time [43]. In addition, none of the studies reported outcomes stratification according to disease stage. Four studies reported complications, all stated none were observed but provided limited detail of what would be defined as a complication. Only two of the six studies explicitly stated the requirement for revision surgery and the lack of this information restricts the conclusions that can be drawn on this outcome. The availability of only six studies for review limited the number of

patients included for the systematic review and further studies of high quality are likely to improve the data available and strengthen the conclusions that can be drawn.

5. Conclusions

Arthroscopic capsular release produces significant improvement in ROM and PROMs regardless of aetiology. The present review demonstrated that improvements are similar across idiopathic, diabetic and secondary shoulder adhesive capsulitis groups. Nonetheless, diabetic patients are reported to have more residual pain, reduced motion and function compared to idiopathic cases. The revision rate was also higher among post-surgical when compared to idiopathic cases of adhesive capsulitis.

6. Declarations:

Conflicts of Interest:

The senior author is a Consultant for Arthrex. None of the authors or their respective institutions received financial benefit in relation to the present article.

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Authors Contribution:

TB: Idea inception, acquisition of data, analysis and interpretation of data, drafting of manuscript.

RJ: Acquisition of data, Analysis and interpretation of data, drafting of manuscript

GB: Drafting of manuscript and critical revision.

CM: Idea inception, and critical revision.

AS: Drafting of manuscript and critical revision.

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448 **8. Figure Legends:**

449 **Figure 1:** flow diagram of review process

450 **9. Tables:**

451 **Table 1: Illustration of Medline Search Strategy**

Number	Search term	Search results
1	Adhesive capsulitis	581
2	Frozen shoulder	686
3	Diabetes	468,406
4	Primary	1,191,381
5	Secondary	555,476
6	Arthroscopy	22,696
7	Capsular release or Joint Capsule	292
8	Lysis	39,701
9	#1 OR #2	1,154
10	#3 OR #4 OR #5	2,008,474
11	#6 OR #7 OR #8	62,424
12	#9 AND #10 AND #11	66

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460 **Table 2: Assessment of methodological quality and risk of bias according to**

461 **MINORs criteria**

Criteria	Nicholson 2003	Cinar et al 2010	Elhassan et al 2010	Jerosch et al 2013	Mehta et al 2014	Cho et al 2016
Clearly stated aim	+	+	+	+	+	+
Generalizable results	-	+	-	-	-	-
Comprehensive inclusion and exclusion of patients	+	?	+	?	+	+
Baseline equivalence of study groups	-	-	+	+	+	+
Pragmatic approach (used and accepted method of treatment) rehab, indications	-	+	-	+	-	+
Study registered and/or protocol published	-	-	+	-	-	-
Adequate control group or standard treatment group	-	-	-	-	-	-
Data collection followed a pre-determined protocol	-	-	-	-	-	-
Outcome measures reflect the aim of the study	+	-	+	-	+	+
Clearly stated primary outcome measure	-	-	-	-	-	-
Analyses adjusted to account for multiple outcomes	-	-	-	-	-	-
No historical comparison between control and study groups	?	+	+	?	?	+
Blind evaluation of endpoints (Reasons for not blinding observers clearly stated)	-	-	-	-	-	+
Follow-up period appropriate for the aim of the study	-	-	+	-	+	+
All cases accounted for, no significant loss to follow-up	+	+	+	-	+	+
Level of evidence	IV	IV	IV	IV	IV	IV
Total (n/15)	3/15	5/15	8/15	3/15	6/15	9/15

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467 **Table 3: Summary of the included studies**

Study	Design	Sample Size	Intervention (s)	Follow up Mean +/- (range)	Outcome Measures
Nicholson 2003	Comparative case series	68 shoulders 17 idiopathic 8 diabetic 43 secondary 15 Post-trauma (5 Tuberosity Fracture, 1 dislocation, 9 other trauma) 20 Post-surgical (10 cuff repair, 9 acromioplasties, 1 surgical neck ORIF) 8 post subacromial impingement	3 months home physiotherapy 50% corticosteroid injection Arthroscopic capsular release (360° release) Post release MUA 24 concomitant SAD	Mean 3 years (2-8 years)	ASES SST VAS pain ROM
Cinar et al 2010	Comparative case series	28 shoulders 13 idiopathic 15 diabetic Mean age 50 years (40 to 65)	Min 6 months physiotherapy Arthroscopic capsular release (Selective release)	Mean 54.1 months (13-99 months)	UCLA score Constant score ROM
Elhassan et al 2010	Comparative case series	115 patients 41 idiopathic 74 secondary 26 post-trauma (7 fracture, 10 post cuff tear, 3 post SLAP tear, 1 dislocation and 5 others) 48 post-surgical (17 cuff repair, 12 stabilisations, 6 SAD, 5 SLAP repair, 4 arthroplasty, 4 other) Mean age 52 years (36 to 81)	Min 6 months conservative Arthroscopic capsular release (360° release)	Mean 46 months (24-89 months)	ROM SSV VAS pain Constant score
Jerosch et al 2013	Comparative case series	173 shoulders 91 idiopathic	Min 6 months conservative Arthroscopic capsular release	Median 36 months (14-67 months)	Constant score ROM

		82 secondary; 28 post-trauma, 32 post-surgical , 22 degenerative disease 48 years (25 to 80)	(360° release) 31 SAD 10 ACJ resection 7 calcium deposit excision 4 implant removal 3 rotator cuff repair		VAS pain
Mehta et al 2014	Comparative case series	42 patients 21 idiopathic 21 diabetic Mean age 54 years (48 to 65)	Min 6 months conservative Arthroscopic capsular release (360° release)	2 years	Constant score ROM
Cho et al 2016	Comparative case series	37 shoulders 20 idiopathic 17 diabetic Mean age 55.6 years	Min 3 months conservative Pre release MUA Arthroscopic capsular release (360° release) Intra-articular injection	24 months	ASES UCLA score VAS pain ROM

SAD: subacromial decompression. ACJ: acromio-clavicular joint

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Study	Idiopathic	Diabetic	Secondary	Statistically significant difference
Nicholson 2003 N = 68	FF 83 to 170 (87) ER 10 to 57 (47) IR buttock to T10	FF 85 to 154 (69) ER 12 to 45 (33) IR Buttock to T11	FF 99 to 164 (65) ER 15 to 58 (43) IR Buttock to T11	Diabetic group had lower active ER compared to all patients (44 vs. 58; p = 0.004)
Cinar et al 2010 N = 28	FF 69.2 to 153.1 Abduction 66.5 to 153 ER 3.2 to 72.3 IR 14.6 to 67.7	FF 75.3 to 141 Abduction 56.3 to 128.3 ER 11.7 to 56.7 IR 15.3 to 34.7	N/A N/A N/A N/A	Significantly greater improvement in abduction and IR in idiopathic group (P<0.05)
Elhassan et al 2010 N = 115	FF 100 to 140 ER 14 to 35 IR L5 to T12	N/A N/A N/A	FF 94.7 to 130 ER 13.1 to 37.6 IR sacrum to T12	Post-surgical worse FF than idiopathic cases (p=0.02)
Jerosch et al 2013 N = 173	Abduction 68 to 163 Adduction 28 to 35 FF 78 to 173 ER 11 to 69 IR 28 to 69	N/A N/A N/A N/A N/A	Abduction 68 to 169 Adduction 29 to 35 FF 92 to 172 ER 10 to 69 IR 39 to 69	Nil
Mehta et al 2014 N = 42	FF 80.2 to 173.2 Abduction 75.5 to 170.2 ER 15.6 to 68 IR 16.7 to 64.2	FF 78.1 to 165.2 Abduction 63.9 to 156 ER 15.8 to 58 IR 15.6 to 56.7	N/A N/A N/A N/A	Improved ROM at 6 months in idiopathic group (p<0.01)
Cho et al 2016 N = 37	FF 95 to 169.5 ER 15.3 to 65.8	FF 90 to 168.8 ER 15 to 65.9	N/A N/A	At 3 and 6 months FF better in idiopathic group (p=0.011 and p=0.045)

	IR 16.4 to 9	IR 17.2 to 9.8	N/A	At 6 months ER better in idiopathic group (p=0.021) At 6 and 12 months IR better in idiopathic group (p=0.006 and p=0.041)

485 FF: forward flexion, ER: external rotation, IR: internal rotation

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490 **Table 5: Summary of the improvement in functional outcome in included studies**

Study	Idiopathic	Diabetic	Secondary	Statistically significant difference
Nicholson 2003 N = 68	ASES 36.9 to 94.4 (57.5) SST 4 to 11 (7)	ASES 39.2 to 88 (48.8) SST 2.5 to 9 (6.5)	ASES 35.1 to 93.0 (57.9) SST 3 to 10.4 (7.4)	When diabetics compared against all other patients SST lower (9 vs. 10; p = 0.009)
Cinar et al 2010 N = 28	Constant 29.6 to 93.6 UCLA 10.0 to 32.7	Constant 30.4 to 82 UCLA 10.1 to 29	N/A N/A	Improved Constant score in idiopathic group (P<0.05)
Elhassan et al 2010 N = 115	Constant 37 to 92 SSV 26 to 77	N/A N/A	Constant 35 to 83.5 SSV 30.6 to 71.1	Post-surgical cases worse SSV than idiopathic cases (p=0.0001)
Jerosch et al 2013 N = 173	Constant 42 to 85	N/A	Constant 41 to 78	Nil
Mehta et al 2014 N = 42	Constant 38.4 to 88.6	Constant 36.6 to 84.4	N/A	At 6 weeks and 6 months idiopathic group higher constant score (p<0.01)
Cho et al 2016 N = 37	ASES 30 to 96.7 UCLA 12.8 to 34.2	ASES 28.1 to 95 UCLA 11.7 to 34.4	N/A N/A	At 1 year idiopathic group had higher ASES than diabetic (88.8 vs. 77.7; p=0.025)

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492 **Table 6: Summary of the improvement in pain in included studies**

Study	Idiopathic	Diabetic	Secondary	Statistically significant difference
Nicholson 2003 N = 68	VAS 7 to 0 (7)	VAS 4.5 to 1 (3.5)	VAS 6.4 to 0 (6.4)	Nil

Cinar et al 2010 N = 28	Recurrent pain 0%	Recurrent pain 26%	N/A	Nil
Elhassan et al 2010 N = 115	VAS 7.6 to 0.6	N/A	VAS 7.4 to 1.2	Post-surgical cases worse pain relief than idiopathic cases (p=0.01)
Mehta et al 2014 N = 42	No pain 19 Mild 2 Moderate 0 Severe 0	No pain 14 Mild 5 Moderate 2 Severe 0	N/A N/A N/A N/A	Nil
Cho et al 2016 N = 37	VAS 7.4 to 1.4 (6)	VAS 7 to 2.2 (4.8)	N/A	Nil

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