

Running title: A systematic review of aetiology and outcomes in shoulder adhesive capsulitis

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

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27 **Abstract**

28 **Introduction:**

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

33 **Hypothesis:**

34 Different aetiological groups yield variable outcomes following arthroscopic capsular  
35 release.

36 **Materials and Methods:**

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

42 **Results:**

43 Six studies met the eligibility criteria. The overall population included 463 patients;  
44 203 idiopathic, 61 diabetic and 199 secondary cases. Of four studies comparing  
45 idiopathic and diabetic patients, three reported significantly worse range of movement  
46 and function in the diabetic group at various follow up points. No significant difference  
47 in function and motion was reported between the idiopathic and secondary groups.  
48 Recurrent pain was highest in diabetic patients (26%) compared to idiopathic groups  
49 (0%) and the secondary group had a higher rate of revision surgery when compared to  
50 the idiopathic group (8.1% vs. 2.4%)

51 **Discussion:**

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

57 **Level of evidence:** Level IV, systematic review.

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

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62 **1. Introduction**

63 Adhesive capsulitis of the shoulder is common with an estimated incidence between 2  
64 and 5% in the normal population [1, 2]. Diabetic patients have a two to four times  
65 greater risk of developing frozen shoulder compared to the general population, with  
66 an estimated lifetime risk of 10-20%. [3, 4-6]. The condition was previously defined  
67 by Lundberg as restricted movement isolated to the glenohumeral joint with less than  
68 135° of shoulder elevation and no other clinical or radiological explanation for this  
69 reduced motion [3]. The condition is more common among females and has a peak  
70 incidence between 40 and 60 years [7-9]. Lundberg classified adhesive capsulitis into  
71 primary frozen shoulder, subdivided into diabetic patients and those with no other  
72 explanation, and secondary frozen shoulder, again subdivided into post-traumatic and  
73 iatrogenic [3]. The latter is a heterogeneous group of patients that is associated with  
74 great challenges in terms of both diagnosis and treatment. Ultimately, this group may  
75 require treatment of their underlying primary shoulder condition and their prognosis  
76 can be inferior. However, to our knowledge there are no systematic reviews prior to  
77 ours that have addressed this question.

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

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

## 97 **2. Material and Methods**

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

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

- 105 I. Participants – Adult patients with adhesive capsulitis considered for surgical  
106 treatment
- 107 II. Intervention – Arthroscopic capsular release in primary idiopathic adhesive  
108 capsulitis
- 109 III. Comparison – Arthroscopic capsular release in diabetic and secondary  
110 adhesive capsulitis

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

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

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

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

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### 138 **3. Results**

139 The search strategy, outlined in Figure 1, identified six studies eligible for inclusion  
140 from a total of 208 publications spanning the period from 1967 to 2014. All studies  
141 included were comparative case series (level IV) [21-26]; three studies compared  
142 idiopathic to diabetic cases [22, 25, 26], two compared idiopathic to secondary cases  
143 [23, 24], and the final study compared idiopathic to both diabetic and secondary  
144 adhesive capsulitis [21]. The overall population included 463 patients; 203 idiopathic,  
145 61 diabetic and 199 secondary cases. The secondary cases were made up of 69 post-  
146 trauma, 100 post-surgical and 30 degenerative conditions. The length of follow-up  
147 varied, with an overall mean of 37.5 months, the shortest at 13 months in Cinar et al  
148 and the longest at 8 years in Nicholson et al [21, 22]. Important details of the included  
149 clinical studies are given in Table 3. The latter depicts further details of studies, which  
150 were associated with marked heterogeneity in relation to patient selection especially in  
151 terms of primary shoulder condition associated with secondary frozen shoulder, as well  
152 as additional surgical intervention. Nicholson et al who reported 24 concomitant  
153 subacromial decompression and Jerosch et al who reported 55 variable additional  
154 surgical procedures [21, 24]. None of the studies used a defined power calculation and  
155 3 of the studies had sample sizes with less than 45 cases.

#### 156 *Range of Motion*

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

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

#### 172 *Patient reported outcome measures (PROMs)*

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

176 The Constant score was recorded in four studies. Two compared idiopathic and diabetic  
177 cases and demonstrated a significantly greater improvement in the idiopathic group [22,  
178 25]. Mehta et al [25] reported better results up until six months ( $p < 0.01$ ) whereas Cinar  
179 et al [22] demonstrated improved results at final follow up ( $p < 0.05$ ). The other two  
180 studies compared idiopathic and secondary cases but reported no significant differences  
181 between the groups [23, 24].

182 The American shoulder and elbow score (ASES) was used in two studies; one  
183 comparing idiopathic and diabetic cases that demonstrated greater improvements in the  
184 ASES amongst the idiopathic group at one year ( $p=0.025$ ) but not at final follow up  
185 [26]. The other compared idiopathic to both diabetic and secondary cases and reported  
186 a trend to improved ASES in the idiopathic group compared to the diabetic group  
187 ( $p=0.056$ ) [21].

### 188 *Pain*

189 Comparison of pain scores was reported in five of the included studies, details are  
190 illustrated in Table 6. The pain visual analogue score (VAS) was reported in three  
191 studies [21, 23, 26] one reported the severity of pain (none, mild, moderate or severe)  
192 [22] and residual pain at follow up in the last study [25]. Nicholson reported pain was  
193 a significant problem in 22% of cases in the first six weeks post-operatively but that  
194 only diabetic patients had a higher incidence of residual pain ( $p=0.0176$ ) [21]. Cinar et  
195 al. reported 26% of their diabetic patients had residual pain at final follow up (mean 54  
196 months) compared to 0% in the idiopathic group [22]. The remaining three studies  
197 demonstrated no significant differences in pain relief between the groups (mean follow  
198 up 24 to 46 months) [23, 25, 26].

### 199 *Revision procedures*

200 Only two studies clearly stated their revision rate. Nicholson reported no revision  
201 procedures were required in any group [21]. Elhassan et al. reported a revision rate of  
202 2.4% in the idiopathic group compared to 8.1% in the secondary group at a mean of 46  
203 months follow up. In comparison, among patients with secondary frozen shoulder the  
204 rate of revision was 10.4% in the post-surgical group, and 3.8 % in the post-traumatic  
205 group [23].



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#### 209 **4. Discussion**

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

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

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

231 The evidence reviewed supports these inferior outcomes in diabetics compared to  
232 idiopathic cases. A possible explanation is that diabetic patients may have more pain  
233 post-operatively and therefore do worse initially as pain can inhibit range of motion and  
234 function. Two included studies demonstrated worse early results in diabetic patients;  
235 Mehta et al [25] reported improved ROM and Constant score at 6 months and Cho et al  
236 [26] improved ROM and ASES at 12 months. These two studies also reported a non-  
237 significant increase in pain post-operatively in the diabetic group; Mehta et al. showed  
238 residual pain in 33% of diabetics compared to 9.5% of idiopathic cases [25] and Cho et  
239 al reported a residual mean VAS score of 2.2 in diabetics compared to 1.4 in idiopathic  
240 cases [26] Cinar et al demonstrated worse function and motion in diabetics at final  
241 follow up and similarly demonstrated a higher residual level of pain in diabetics (26%  
242 versus 0%) [22].

243 Comparison of idiopathic and secondary cases did not demonstrate any significant  
244 differences in ROM or PROMS in the studies reviewed. Elhassan et al. did report  
245 significantly poorer outcomes in the post-surgical subgroup in terms of forward flexion,  
246 pain and SSV but these findings were not reproduced in other studies [23]. However,  
247 the same authors reported revision rates for residual stiffness to be four times higher in  
248 these secondary cases [23]. The highest revision rate was in the post-surgical group  
249 (10.4%), of which 40% undergoing revision had continued unsatisfactory outcomes.  
250 Interpretation of these figures is difficult as the secondary group was heterogeneous  
251 and included 48 post-surgical and 26 post-trauma cases. Similarly, the post-surgical  
252 group included a variety of procedures including 17 rotator cuff repairs, 12  
253 stabilisations and 5 SLAP repairs. Arthroscopic release in post-surgical and post-

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

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

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

292 Evaluation of the reviewed studies against the MINORs criteria [20] demonstrated a  
293 variation in the quality of included studies as illustrated in Table 2. The included studies  
294 all provided level IV evidence. The use of different outcome measures limited the  
295 ability to compare or combine results and the variation in follow up from 13 months to  
296 99 months has the potential to influence results as previous work has demonstrated that  
297 outcomes improve significantly with time [43]. In addition, none of the studies reported  
298 outcomes stratification according to disease stage. Four studies reported complications,  
299 all stated none were observed but provided limited detail of what would be defined as  
300 a complication. Only two of the six studies explicitly stated the requirement for revision  
301 surgery and the lack of this information restricts the conclusions that can be drawn on  
302 this outcome. The availability of only six studies for review limited the number of

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

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## 306 **5. Conclusions**

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

## 313 **6. Declarations:**

### 314 **Conflicts of Interest:**

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

### 317 **Funding sources:**

318 No sources of funding have been obtained for the conduct and/or publication of the  
319 present study.

### 320 **Authors Contribution:**

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

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

324 **GB:** Drafting of manuscript and critical revision.

325 **CM:** Idea inception, and critical revision.

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

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

468 SAD: subacromial decompression. ACJ: acromio-clavicular joint

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484 **Table 4: Summary of the improvement in range of movement in included studies**

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)
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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



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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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