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Arthroscopic Capsular Release of Adhesive Capsulitis- A Systematic Review

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Abstract

Background: Adhesive capsulitis is one of the commonest disabling problem of the shoulder. Management of this pathology has multiple conservative and surgical options. Among the surgical options arthroscopic capsular release is the most researched technique. The aim of this study is to find the relevance of the procedure in current practice, by systematically reviewing the recent literatures.

Methods: A rigorous online data search was done for scientific English publications between 2000 and 2020. Search engines used were Medline, Google scholar and Cochrane. Keywords used were shoulder stiffness, adhesive capsulitis, frozen shoulder, capsular release and shoulder arthroscopy. Inclusion criteria were original studies, minimum sample size of 10 patients, arthroscopic capsular release as one of the treatment modalities, minimum follow up duration of 6 months, minimum duration of symptoms of 3 months. Studies with secondary adhesive capsulitis, additional procedures such as rotator cuff repairs were excluded from this review. All articles were evaluated by both the authors and data were extracted and analyzed.

Results: Twenty articles met with all inclusion criteria. There were 10 prospective and 10 retrospective studies. Two were level 2 studies, four were level 3 studies and 14 were level 4 studies. Total of 797 patients (810 shoulder) underwent arthroscopic capsular release. The average age was 52. 285 were males. 466 were females. 205 were right shoulders. 204 were left shoulders. Average follow up was 20.25 months. Arthroscopic capsular release resulted in significant improvement in range of motion at all planes and reduced VAS scores. There was a significant improvement in post-operative shoulder functional outcome scores. Complication rate was 3.1%, but none of them were major and recurrence rate was 0.25%.

Conclusion: Arthroscopic capsular release is a very good option for adhesive capsulitis with failed conservative treatment. It results in a significant improvement in range of motion and functional outcome scores. Good result of arthroscopic capsular release was observed very quickly and was maintained in long term. It is a very safe procedure with very minimal complication.

Keywords: Periarthritis; Adhesive capsulitis; Frozen shoulder; Arthroscopic capsular release; Shoulder arthroscopy.

Introduction

Adhesive capsulitis is one of the commonest pathologies seen by shoulder surgeons. It causes pain, stiffness and severe disability. This was first described as "frozen shoulder" by Codman in 1934 [1]. Later it was Neviaser who in 1945 used the term "adhesive capsulitis" and described the pathology as an inflammatory condition of the shoulder joint capsule that leads to contracture, stiffness and pain [2]. Since then our knowledge of this pathology has increased a lot. It is believed to affect 2% to 5% of the general population [1] and an extremely high prevalence rate of 11% has been reported in diabetics [3]. People between 4th and 7th decades of life being the commonest age group affected [4]. This condition can occur without any precipitating condition or can be secondary to any pre-existing pathology viz. diabetes mellitus, hypothyroidism, prolonged immobilization, trauma or following shoulder, breast or cervical spine surgeries [5,6]. The natural history of the disease is believed to be benign and self-limiting, with improvement of symptoms between 18 and 24 months. This prompted the surgeons in early days to follow the principle of benign neglect [7]. However, a subset of patients continues to be symptomatic, in spite of adequate conservative management. Management of adhesive capsulitis is controversial. Conservative measures include physical therapy, intra-articular steroid injections, and anti-inflammatory drugs. Nearly 50 % of patients treated conservatively have been found to have some residual pain and loss of motion at long-term follow-up [8]. Surgical interventions include manipulation under anesthesia, an open release, hydro dilatation, arthroscopic capsular release (ACR) or a combination of the above procedures [4]. Considering the controlled nature of arthroscopic capsular release some authors have speculated that it is safe and effective than a manipulation [9]. The purpose of this review article is to find the clinical and functional out-comes of arthroscopic release of recalcitrant adhesive capsulitis, through a comprehensive systematic review of the literature.

Material & Methods

We followed the PRISMA guidelines statement on systematic review and meta-

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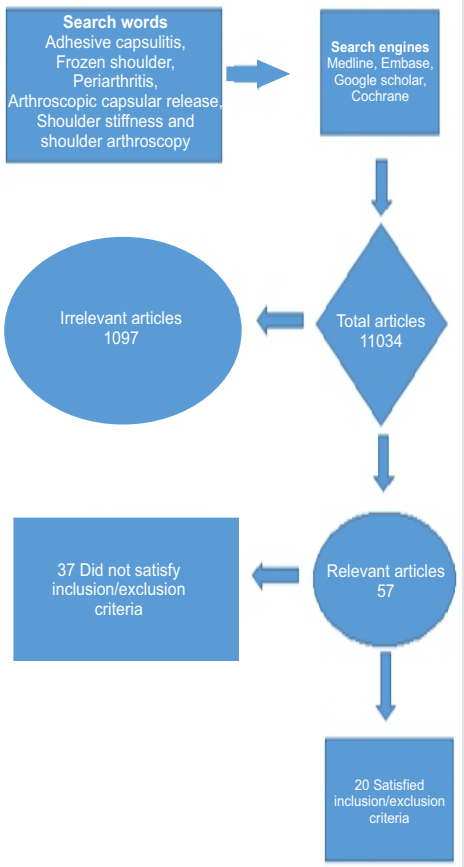

Figure 1: A flowchart showing the selection process of the studies included in the review

Table 1: The details of level 3 and level 2 studies

Author	Year of publication	Type of study	Comparative groups	No. of patients	Mean age	Mean follow up
Walther et al	2014	Retrospective comparative study (Level 3)	Decompression and release	21	52	28 weeks
			ACR	15	52	42 weeks
			Decompression and MUA	18	50	32 weeks
Decarli et al	2012	Prospective comparative study (Level 3)	MUA	23	57	12 months
			ACR	21	54	
Rill et al	2011	Retrospective cohort study (Level 3)	Conservative	64	52	24 months
			ACR	25		
Masoud et al	2002	Prospective comparative study (Level 3)	MUA	36	48	35 months
			ACR	11		
Mukerji et al	2017	Randomized control trial (Level 2)	ACR	28	50	5 months
			Steroid injection	28		
Gallachar et al	2018	Randomized control trial (Level 2)	ACR	19	52.6	6 months
			Hydro dilatation	20	55.2	

ACR – Arthroscopic capsular release
MUA – Manipulation under anesthesia

analysis in selecting the articles. Electronic databases including PubMed, Google scholar, Embase, and the Cochrane Library were searched using the following terms: Shoulder stiffness, Adhesive capsulitis, Frozen shoulder, Periarthritis, Capsular release and Shoulder arthroscopy (Figure 1). The search was performed by the authors individually. All studies reporting clinical and functional outcomes in patients suffering from adhesive capsulitis treated with arthroscopic capsular release were assessed for eligibility.

Inclusion criteria were -

1. Studies published in English language between the year 2000 and 2020
2. Primary idiopathic adhesive capsulitis only but diabetic patients were included
3. Arthroscopic release was employed as one of the treatment modalities
4. Minimum sample size of 10 patients
5. Minimum duration of symptoms of 3 months
6. Minimum follow up duration of 6 months.

Studies with secondary adhesive capsulitis, additional procedures such as rotator cuff repairs, were excluded from this review. Literature search and double data extraction was performed and tabulated in a master chart. The following data were analyzed: Patient demographics, level of evidence of the articles, duration of conservative treatment, duration of symptoms, type of surgery performed (anterior versus 360^0 release), patient positioning (beach chair versus lateral decubitus), whether the intra articular portion of subscapularis and biceps tendon were cut or not, dominant versus non-dominant limb, improvement in shoulder ROM, mean follow up duration, patient-reported outcomes, muscle strength and complications following capsular release. Limitations of the studies and future recommendations were also noted. The Mean and range of various variables were extracted wherever provided.

Results

Our online data search identified a total of 57 articles. After application of our inclusion/exclusion criteria, the list was reduced to 20 articles. There were no level I studies, two Level II (Table 1) [10,11], four Level III (Table 1) [12 – 15] and 14 Level IV (Table 2) studies [1, 4, 7, 9, 16 – 25], with a total of 797 patients (810 shoulder) who underwent ACR, ranging from 10 to 133 with a mean of 40 patients per study. 129 patients were diabetic. In five studies diabetics were excluded. In one study with 25 patients all were diabetic. In two studies information about diabetes was not available. 7 studies were performed in beach chair position and 8 in lateral decubitus position. 5 studies did not mention about the patient position. The average age of the 797 patients was 52 years. 285 were males. 466 were females. In three studies with a total of 46 patients' gender was not mentioned. 205 were right shoulders. 204 were left shoulders. In 13 studies with a total of 388 patients' side was not mentioned. Average follow up of all the studies ranged from six months to seven years. On the whole, average follow-up was 20.25 months. In 8 studies a 360-degree release was performed. In one of those a biceps tenotomy was done in addition to 360-degree release. In rest of the studies a limited release was done. In two studies a subacromial decompression was done in selected patients (32 out of 100, 21 out of 36) in addition to capsular release. In two studies bursectomy of subacromial space was done in all cases (66 patients). In one study with 43 patients a release of intra-articular subscapularis was done. In 5 studies an intra-articular steroid injection along with local anesthetic agent was given to all patients (321

Table 2: Details of all level 4 studies

Author	Year of publication	Type of study	No. of patients	Average age	Position	Type of release	Additional procedures	Average follow up
Tsai et al	2017	Retrospective	26	51.2	LD	selective	nil	28 months
Mubarak et al	2015	Prospective	40	48.2	BC	selective	nil	6 months
Waszczykowski et al	2014	Prospective	27	51.6	BC	selective	nil	24 months
Smith et al	2014	Prospective	101	52	Not mentioned	selective	Steroid + LA	12 months
Dattani et al	2013	Retrospective	100	54.3	LD	360° release	SAD (32 patients)	6 months
Baums et al	2007	Retrospective	30	50	LD	selective	Bursectomy	36 months
Berghs et al	2004	Prospective	25	50.8	LD	selective	Steroid + LA	14.8 months
Klinger et al	2002	Prospective	36	49	LD	selective	bursectomy	18 months
Ranalletta et al	2016	Prospective	32	49.6	BC	selective	nil	63 months
Puah et al	2018	Retrospective	25	57.3	BC	selective	nil	4.8 years
Jerosch J	2001	Retrospective	28	49	Not mentioned	360° release	10 CC LA	22 months
Barnes et al	2016	Retrospective	133	56	BC	360° release	Steroid + LA	6 months
Le Lievre et al	2012	Retrospective	43	61	BC	360° release	Steroid + LA	84 months
Lafosse et al	2012	Retrospective	10	47	BC	360° release	Biceps tenotomy	42 months

BC – Beach chair position, LD – Lateral Decubitus position, LA – Local anesthetic agent, SAD – Sub acromial decompression

Table 3: The change in range of motion (in degrees) in all the studies

Author	Abduction		Flexion		Internal rotation		External rotation	
	Pre op	Post op	Pre op	Post op	Pre op	Post op	Pre op	Post op
Tsai et al	120	168	101	172	7	29	12	91
Mubarak et al	85	155	95	160	5	55	10	80
Waszczykowski et al	60.8	147.45	81.9	166.3	Buttock *	T11 *	6.1	57.8
Smith et al								
Dattani et al	70	160	90	160			20	70
Baums et al	70	150	85	160	15	60	10	65
Berghs et al			73.4	163.2			10.6	46.8
Klinger et al	71	148	83	165	14	58	12	46
Ranalletta et al	74.5	164.2	78.2	171.2	15.6	62.2	17.6	66
Puah et al			110.4	157.6	Coccyx *	T12 *	14.4	63.8
Jerosch J	75	167			17	63	3	72
Barnes et al	74	144	96	156	S2 *	T11 *	21	49
Le Lievre et al		172		174		T9 *		74
Lafosse et al	40	166	55	175			6	58
Walther et al **	76	139	83	146			20	37
	65	130	77	82			8	39
Decarli et al	60	154	75	174	Sacrum *	L5 *	20	40
Rill et al			116	156	Gluteal *	T12 *	23	46
Masoud et al								
Mukerji et al	78.3	135.6	99.8	152.9	28.9	50.4	39.1	73.4
Gallachar et al	54	130	90	173			9	56

* - This study had two groups 1. Patients who underwent decompression and capsular release

2. Patients who underwent only release

** - Indicates the level up to which the hand can reach in the back, indirectly indicating the amount of internal rotation

patients out of whom 32 were diabetic) at the end of the procedure. In one study only a local anesthetic agent was injected to all patients (28 patients) at the end of the procedure.

In 4 studies with 85 patients a gentle manipulation was attempted under anesthesia and subsequently capsular release was done. In the rest of the studies capsular release was done followed by manipulation. Mean preoperative abduction among 568 patients in 14 studies whose data were available was 73.4°. Mean post-operative abduction was 151° with a gain of 77.6°. Among 614 patients (16 studies) whose data for flexion was available, mean preoperative flexion was 90.3°. Mean post-operative flexion was 159° with a gain of 68.7°. Among 642 patients (17 studies) whose data regarding external rotation was available, mean preoperative external rotation gained was 16.4°. Mean postoperative external rotation was 59.5° (gain of 43.1°). Among 220 patients (7 studies) whose internal rotation was available in numeric data, average preoperative internal rotation was 14.1°. Mean postoperative internal rotation was 54.5°. In five studies internal rotation was measured in terms of the level of vertebrae that the patient can reach with his hand at the back. The preoperative level in those five studies were buttock, coccyx, S2, sacrum and gluteal region. Their corresponding postoperative levels were T11, T12, T11, L5 and T12 respectively (Table 3). Functional outcome was measured using a variety of outcome measures (Table 4). In four studies with 169 patients average preoperative VAS score was 7 which got improved to1.2 postoperatively. In 10 studies with 259 patients average preoperative constant score was 34.5 which got improved to 79.2. In another four studies with 106 patients ASES scoring was used. Average preoperative and postoperative ASES scores were 36.29 and 90.21 respectively. Three studies with 51 patients which used UCLA scoring, the average preoperative and postoperative scores were 14.3 and 33.6 respectively. Two studies with 120 patients Oxford shoulder scoring system was used which had an average preoperative and postoperative score of 18.8 and 39.

Following are the list of complications observed among these 20 studies- There were two superficial infections which were treated with oral antibiotic and got settled, one delayed wound healing and one periarticular hematoma which were treated conservatively. Nineteen patients had persistence of symptoms in the early post-operative period which was treated with steroid injection (6 in subacromial space and 13 in glenohumeral joint) and got improved. There were two recurrences which needed a repeat arthroscopic capsular release and one was refractory to further treatment. On the whole 25 patients out of 797 patients (3.13%) had some form of complication. Only 2 patient had recurrence making the recurrence rate very negligible (0.25%).

Discussion

In this systematic review we analyzed 797 patients (810 shoulders) patients from 20 studies with recalcitrant adhesive capsulitis. Out of the 20 studies, 2 were Level II studies, 4 were Level III studies and 14 were Level IV studies. In this review we have found that females were more commonly affected than males (285 males and 466 females). Both the shoulders were equally affected (205 Right and 204 Left) although in 388 patients the involved side was not mentioned. Also, information

Table 4: table showing the functional outcome of all the studies

Author	VAS score		Constant score		ASES score		UCLA score		Oxford score	
	Pre op	Post op	Pre op	Post op	Pre op	Post op	Pre op	Post op	Pre op	Post op
Tsai et al	8.2	1.7	44	91	38	90	13	34		
Mubarak et al			36.35	85.8						
Waszczykowski et al					25.6	91.2				
Smith et al	6.6	1							19	38.1
Dattani et al										
Baums et al	7	2			35	91				
Berghs et al			25.3	75.5						
Klinger et al			29	66						
Ranalletta et al	7.4	1.5	42.4	86						
Puah et al							15.8	33.3		
Jerosch J			44	85						
Barnes et al										
Le Lievre et al										
Lafosse et al	7	1.6	21	72						
Walther et al										
Decarli et al			37.5	91.2	48.6	88.3	44.2	91.9		
Rill et al						85.5				
Masoud et al			17.3	49.9						
Mukerji et al			29.5	70.4						
Gallachar et al									17	43.8

about dominant vs non dominant side was provided only by few authors. Baums [21] in their cohort of 30 patients found that dominant arm was affected in 18 cases, the non-dominant arm in 12 cases. Waszczykowski [18] reported no statistically significant differences between dominant and non-dominant sides (15 dominant and 12 non dominant). However, Berghs (52%), Ranalletta (59%), Smith (55%), Mukherjee (61%) have reported relatively more involvement of the non-dominant shoulder [7, 10, 19, 23].

Surgical Technique

Patient positioning depends on the surgeon's preference and we observed that arthroscopic capsular release was done in both beach chair or in the Lateral decubitus position. Out of 20 articles 7 were done in beach chair and 8 in lateral decubitus position. Position was not specified in 5 series. Proponents of capsular release in the lateral position feel that there is increased glenohumeral joint space as a result of lateral and axial traction providing adequate visualization of the joint and improved access to the inferior capsule and labrum. Also, there is reduced chance of cerebral hypoxia due to decreased cerebral perfusion. In addition, the capsular tissues are under tension, which retracts when cut, exposing the underlying rotator cuff musculature to ensure complete release. We found that there were no major complications with regards to patient positioning and feel that it is the choice of the operating surgeon with regards to patient positioning.

In 8 studies a 360-degree release was performed. In one of those a biceps tenotomy was done in addition to 360-degree release. In rest of the studies a limited release was done. Gallacher et al [11] performed posterior release only if the patient had poor internal rotation during the pre-operative examination. Also, Jerosch et al [25] recommended that it is essential to release the posterior capsule to regain internal rotation. Axillary nerve injury is one of the major concerns while performing an inferior release. Protection of the axillary nerve is critical while releasing the inferior capsule. Placing the shoulder in external rotation and abduction while performing an inferior release reduces the chance of axillary nerve injury [17]. Uno et al found in their anatomical study, it is in this position the nerve is farthest from the inferior capsule [26]. Release of intra articular portion of the subscapularis is controversial. Most of the surgeons just debrided the tissues circumferentially and released the capsular adhesions for adequate excursion of the subscapularis tendon. Only if this does not give sufficient external rotation, we should consider the release of upper fourth of the subscapularis tendon. Releasing of subscapularis involves cutting approximately 5% to 7% of the entire tendon near its insertion. This represents about a 3 to 4-mm cut through the tendon [3]. The intra- articular portion of the subscapularis tendon represents only a small fraction of the entire tendon. Most important concern while releasing the subscapularis tendon is postoperative weakness of internal rotation and unbalanced force couple. Waszczykowski et al [18] measured the muscle strength of abductors, flexors, external rotators, and internal rotators of the arm and analyzed whether good clinical outcomes according to ASES score correlated with good muscle strength of operated shoulder. In their series they did not find statistically significant differences in muscular strength of shoulder, when compared with unaffected one. Also, the improvement of function after arthroscopic capsular release correlated with good muscular strength of operated shoulder. However, a small but statistically significant decrease of muscular strength of external rotators was noted. Although the reason behind this is unclear, one plausible explanation is, it could probably be a result of atrophy of the muscle group during prolonged shoulder dysfunction before the surgery.

Biceps Tenotomy

In this review, the biceps tendon was preserved in all the studies except one. Lafosse et al [1] performed biceps tenotomy in all of their 10 patients. The mean age in their series was 47 years (range 33 to 56 years). None of his patients underwent a tenodesis. They believed that performing a biceps tenotomy reduces the risk of any further scarring or adhesions within the shoulder. None of his patients had any issues with cosmesis or function. They felt that the biceps tendon undergoes self-tenodesis in the bicipital groove because of the surgery and the pre-existing inflammation. In another cohort, depending on the intra operative examination of biceps, tenotomy was performed in four patients and tenodesis in two patients. However, the authors have excluded the patients from their study [23].

Pain

We analyzed the improvement in the pain scores following arthroscopic capsular release. Although pain measurement is a component of Constant score, few authors (4 studies) have recorded it separately using VAS (Table 4). The mean preoperative pain score was 7.0 which improved to 1.2 post operatively. We found that arthroscopic capsular release yields promising results with regards to improvement in pain in the early post- operative period and it continues to improve over the next few months. Jerosch et al [25] found that although, patients with diabetes did worse initially, but the final outcome was similar to patients without diabetes and concluded that diabetics may particularly benefit from early intervention. The improvement of pain is believed to be denervation of pain fibers in the glenohumeral joint capsule. Barnes [9] in their series found that improvement in all forms of pain which was continuous up to 24th week.

Also, the Duration of symptoms before release was not correlated with any variable concerning pain at any time during follow-up point. Smith [19] stated that in over half (51%) of his patients, pain was reduced significantly in the first postoperative week. By week 6, 80% stated that they had good pain relief and at three months, 90% had good pain relief. Lievre et al [4], in 43 patients (49 shoulders) found that gains in the relief of shoulder pain severity and frequency continue up to 1 to 2 years. Also 85 percentage of patients felt that reduction in pain to be excellent. Ranalletta [23] also reported most of his patients experienced a significant improvement in pain and shoulder function before 6 months, especially during the first 8 weeks. Interestingly, Berghs [7] in his series found, 36% had dramatic improvement in terms of pain relief and functional gain on the first postoperative day, and 88% within the first 2 weeks. Persistent pain following arthroscopic capsular release was usually managed with steroid injections and rarely a revision ACR [17, 20]. Smith [19] reported that 10% of his patients who are unhappy with the initial surgery continued to have some pain even with further interventions to alleviate pain.

Functional Outcome Scores

In our review, we have found that the following scores were used by different authors; Constant score, ASES, Oxford scores and UCLA scores. Although there was no single uniform means to measure the outcome among these studies, with the available data we observed that there was a significant improvement in functional outcome following the procedure. Improved functional outcome emphasizes that ACR not just increases the range of motion, but provides better strength, stability and function (Table 4). Ranalletta [23] found that the improvement was more pronounced during the first 6 months and then levelled off and remained similar between the sixth month and the final follow-up.

Range of Motion

Arthroscopic capsular release has been found to improve the range of motion in all planes. We had a mixture of studies with varying follow ups (both long term and short term). A general inference was there was a steady increase in outcome in the initial period which was maintained in long term. Some authors have reported that there is no statistical difference in postoperative range of motion of the affected shoulder following surgery to that of the contralateral shoulder [4, 16, 18]. Barnes et al [9], observed that although, there is mild regression in range of motion between the immediate postoperative range and the range at subsequent follow-up (6 weeks, 12 weeks, and 24 weeks), they were still significantly better than preoperative measurements. Ranalletta [23] found that the ROM improved significantly the first 6 months and then remained stable after that. Interestingly, there was an additional minor improvement between the sixth month and the final follow-up; however, this was lower than in the first 6 months and was not statistically significant. Baums et al [21] have found that ROM could be improved after three months postoperatively with the mild drop at six months but could be preserved the following assessments. The gain in range of motion following the intervention is correlated to the range of motion at initial presentation. The correlations were strongest for external rotation and forward elevation. However, Initial and postoperative internal rotation did not correlate in the immediate post-operative period, but continued to improve during the subsequent follow up visits. Mubarak [17] in their cohort of 40 patients reported that the four patients with fair results showed the least improvement in internal rotation postoperatively with residual restriction in internal rotation of more than 50% of the contralateral side.

Complications

The major complications reported in the literature are injury to axillary nerve, hemarthrosis, infections, and shoulder instability [16]. We found none of these major complications in these studies. Complication rate was very low in these 20 studies, therefore arthroscopic capsular release is a very safe procedure in expert hands. Very few patients (19/797) failed to improve in the initial postoperative period. They too improved with an intra-articular/subacromial steroid injection. Adequate anti-inflammatory medications in the postoperative period will avoid postoperative inflammation and maintain the amount of movement gained. Also, as done in these studies one must not hesitate to give one or two shots of steroid injection to avoid poor outcome. Axillary nerve injury, a commonly feared complication was not encountered in any of these studies, even in those where a 360^0 release was done. This implies that with adequate anatomical knowledge and skills this can be an avoidable complication. There was no deep infection and very few wound healing problems. Being a minimally invasive procedure, these are its unsaid advantages. A recurrence rate of 0.25% is very negligible for any kind of invasive procedure.

Duration of Symptoms & Clinical Results

We examined the articles to find out whether there is any relationship between the duration of symptoms and the clinical outcomes. Various authors have found that there is no correlation between postoperative outcomes and the duration of symptoms prior to surgery at any time of follow up and the improvements are maintained in the long term. We feel that initial trial of conservative management needs be offered to all patients before a surgical intervention.

The strength of this review article are double data extraction and relatively large number of patients. Also, we analyzed the various data available such as the surgical techniques, muscle strength following capsular release, progression in the range of motion and complication rates. In the systematic review we have observed that arthroscopic capsular release provides adequate pain relief and improved clinical outcomes with minimal complication rates. The duration of symptoms before surgery does not dictate the outcome of the surgery and can be offered to patients with failed conservative treatment with better results.

Future Recommendations

1. More level one studies comparing other surgical intervention, with adequate power.
2. Level one studies to compare the clinical outcome between complete and selective capsular release, biceps preserving Vs. biceps sacrificing procedure.
3. More research with regards to role of middle glenohumeral ligament and selective upper subscapularis release.

Clinical Relevance

Arthroscopic capsular release is a good surgical option for recalcitrant adhesive capsulitis with failed conservative treatment. It provides good functional outcome in both short and long term. Complications and morbidity following the procedure is very minimal making it a very safe procedure. Recurrence following the procedure is extremely rare. There is no uniform consensus in the amount of release and structures to be released and should be guided by the pre-operative restriction in the range of motion.

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