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Evaluation of Outcome after Anatomical Reconstruction of Acromioclavicular Ligament and Coracoclavicular Ligament for Acromioclavicular Joint Dislocation

Dr. Banamali Samanta, MS Ortho, RMO cum Clinical Tutor, SSKM & IPGMER, Kolkata, India
Dr. Ranjit Shaw D.Ortho, MS Ortho, MRCS (Glasgow), Associate professor, Midnapore medical college & Hospital, Midnapore, West Bengal, India
Professor (Dr)Kaushik Banerjee, MS Ortho, R. G. Kar Medical college , Kolkata, India
Dr. Md. Emdad Hossain, MS Ortho, Associate professor, Rampurhat Medical college, Birbhum, West Bengal, India
Dr. Navneet Agarwal, MS Ortho, Assistant Professor, N.R.S Medical college, Kolkata,India

***Corresponding Author:**
Dr. Ranjit Shaw
D.Ortho, MS Ortho, MRCS (Glasgow), Associate professor, Midnapore medical college & Hospital, Midnapore, West Bengal, India

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ABSTRACT

Acromioclavicular (AC) joint dislocation is common in young athletes . But today in modern high speed life it is also common in road traffic accidents. Low grade (I AND II) acromioclavicular joint dislocation can be managed conservatively. Whereas high grade acromioclavicular joint dislocation (Rockwood type III,IV,V,VI) need surgical management. Many operative procedures like k-wire fixation, Bosworth screw fixation, Weaver Dunn procedure have been tried but not a single one is gold standard. In our technique we anatomically reconstructed both the acromioclavicular and coracoclavicular ligament using Ashish Babhulkar technique (using semitendinosus graft). Our aim was to evaluate functional outcome after anatomical reconstruction.

Methodology: We studied 15 patients of acromioclavicular joint dislocation (type IV and V). Out of which 13 were male, 2 were female. We used Stryker notch view, Zanca view, axillary lateral view for radiological assessment. ASES and UCLA scores were used pre and post operatively to assess clinically.

Result: All patients had excellent postoperative outcomes at 1 year.

Conclusion: Anatomical acromioclavicular and coracoclavicular ligament reconstruction using semitendinosus autologous graft in acromioclavicular joint dislocation offered long-term stability and improved functional scores, had less complications and very cost effective.

Keywords: AC joint, Acromioclavicular joint dislocation, Coracoclavicular Ligament, AC Ligament, Semitendinosous Graft.

INTRODUCTION

Acromioclavicular joint dislocation is not uncommon and occurs in all age groups. Although a typical athlete injury, now in modern high speed life acromioclavicular joint dislocation is common in road traffic accident and fall on side[1]. Since historically in 400 BC Hippocrates (460- 377 BC) commented that acromioclavicular joint dislocation often misdiagnosed as glenohumeral injury[1]. Galen himself suffered from acromioclavicular joint dislocation and could not tolerate the tight bandage treatment recommended at that time ,becoming a non compliant patient [1]. Acromioclavicular joint classified by Tossy et. al and Allen[2]. Now Rockwood et al classification is widely followed as it guides the treatment protocol and predict the prognosis[3]. Low grade acromioclavicular joint injury involve Rockwood type I and II injury. High grade acromioclavicular joint injury involve

Rockwood type III,IV,V and VI [3]. Now a days Rockwood type I and II acromio-clavicular joint injury treated conservatively with good functional and favourable outcome [4,5]. Most commonly the management of acute high grade acromioclavicular joint injury (type III,IV,V,VI) is surgical and centre toward restoring of inherently unstable acromio-clavicular joint . Despite the frequency of these injury and these unified goal surgical strategy remain quite varied . More than 160 operative technique have been describe and till now there is no clear consensus about optimal approach[6,7,8,9,3,10,11]. First operative intervention was done by Samuel Cooper for acromioclavicular joint dislocation in 1861[3].

There is controversy regarding management of type III acromioclavicular joint injury[11,12,13]. In rockwood type IV,V and VI injury there is soft tissue injury , persistent dislocation ,change in scapular kinematics and shoulder dyskinesia.This type of injury needs operative intervention[14]. Various techniques from k-wire fixation to using synthetic graft which is costly to biological autograft have been used . Transarticular fixation of acromioclavicular joints with pins or wires was one of the first techniques to be described[3] . However, reports of fixation failure ,loss of reduction and disastrous migration of hardwire lead to abandonment of this technique [15,16,17]. Similarly Bosworth screw suspension technique was introduced in 1941. Hardwire failure,wire migration,coracoid fracture were reported with this procedure[18].Taking similar approach alternative “cc suspension” technique proposed in literature using Dracon graft ,wire and various types of sutures[3,11]. In 1972 Weaver Dunn technique published in literature of distal clavicle resection and transfer of the coracoacromial ligament to distal clavicle to reconstruct the coracoclavicular ligament[19]. But this technique does not recreate horizontal plane stability[20].

The modification of this nonanatomic technique used additional suture material along with coracoacromial ligament transfer [19]. Many consider this technique biomechanically inferior than other techniques[21, 22, 23]. Lateral clavicular hook plate also used but it show many complication like acromial fracture,hardwire irritation necessitate implant removal[24,25]. Many study show both acromioclavicular and coracoclavicular ligament play important functional role[26,27,28,29,30].

Some procedures reconstruct only one of the two structural parts (conoid and trapezoid) of coracoclavicular ligament not taking into account anatomical configuration of the ligament [31,32]. There is a chance of acromioclavicular joint arthritis after surgery. So literature suggested 8 mm lateral clavicular resection during surgery to prevent postoperative arthritis [32,33,34,35,36] . Babhulkar[43] found that coracoclavicular ligament reconstruction with biological graft offer long term stability.They anatomically reconstruct both acromioclavicular ligament and coracoclavicular ligament with autologous semitendinosus graft. They resect the lateral 8 mm clavicle to prevent AC joint arthritis after AC joint reconstruction.

Their surgical technique use minimal implant i.e. only ethibond#2 . If harvested autologous semitendinosus graft is small in length, they recommend using suture anchor to fix the graft to lateral end of clavicle

There is an increasing rate of failure of non anatomic reconstruction of acromioclavicular joint injury[38,39,40].This led us to find effectiveness of anatomical reconstruction in our proposed study.

MATERIAL AND METHOD

A simple longitudinal study of anatomical acromioclavicular joint reconstruction was done in the department of orthopaedics , R.G. Kar medical college and hospital from the period of July 2018 to August 2019. In acromioclavicular joint dislocation we address both anatomical abnormality - acromioclavicular ligament tear and coracoclavicular ligament tear . We include patient of both male and female sex in age betwwen 18-55 years age with Rockwood type IV and V acromioclavicular joint dislocation within 6 weeks duration from injury. We exclude the patient having any other significant injury or any previous major surgery to the same limb which may affect the rehabilitation . Sample was taken by simple random sampling method . Pre and post operative stryker notch view taken for type V acromioclavicular joint dislocation . Axillary lateral view taken for type IV acromioclavicular joint dislocation. We scheduled the post operative follow up at 6 weeks,3 months

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and 1year. Pre operative and post operative functional assessment done using ASES & UCLA scoring system. Statistical analysis done using IBM SPSS ver. 25. All 15 patients of acromioclavicular joint dislocation undergo anatomical reconstruction of both coracoclavicular ligament and acromioclavicular ligament using semitendinosus autologous graft . Harvested autologous semitendinosus graft first passed under the coracoid. Lateral 0.8 cm lateral clavicular resection done. With 4 mm cortical drill bit lateral clavicular drilling done 3.5 cm medial to acromioclavicular joint. Then medial end of the graft pass through the clavicular hole and after acromioclavicular joint reduction knot tied between two end of the graft and knot secure with ethibond #2 suture. Then acromion drilling was done and the medial end of the graft passed through the acromion hole . Lastly the end of graft tied with the remaining lateral end and knot secure with ethibond #2 suture. After first dressing on the second postoperative day the patient was discharged from hospital and advised for pendular exercise and use of an arm sling. After the 3rd postoperative week patients were allowed for assisted forward flexion and abduction upto 90 degrees. After 6 th postoperative week all restrictions were withdrawn.

RESULT AND ANALYSIS

We included all patients attending the outdoor patient department & emergency room with Rockwood type IV and type V acromioclavicular joint injury.

We did this study on 15 patients. We follow the Ashish Babhulkar technique to anatomically reconstruct the AC joint injury. In our study we only use ETHIBOND #2 sutures during surgery. No other implant was used.

In our study 13 (86.7%) patients were male, 2 (13.3%) patients were female.

In our study, the mean age of the patients was 33.7 years. Minimum age is 22 years and maximum is 55years.

In our study 2(13.3%) patients had injury due to fall, 12 (80.0%) patients had injury due to road traffic accidents, 1(6.7%) patient had injury due to sport activity.

In our study 13(86.67%) patients had injury over right side and 2(13.33%) patients had injury over left side.

In our study 13(86.67%) patients had Rockwood type V injury and 2(13.33%) patients had Rockwood type IV injury.

In our study 5(33.33%) patients underwent surgery 3 week after injury, 5(33.33%) patients underwent surgery 4 week after injury, 4 (26.67%) patients underwent surgery 3 week after injury, 1(6.67%) patient underwent surgery 6 week after injury.

In our study preoperative UCLA score mean value was 17.9. Minimum preoperative UCLA score was 14 and maximum was 20. All patients had poor/fair scores (<25).

In our study, the proportion of patients with good/excellent UCLA scores was significantly more at 3 months compared to pre-op and 6 weeks($p<.05$). UCLA scores significantly increase at each follow up. Mean UCLA value was 34.8 in 1 year. However there was no significant increase beyond 6 months.

The mean preoperative ASES score was 62. All patients were having ASES<70 pre-operatively. Repeated measures ANOVA showed significant increase in ASES score at all postoperative visits. Pairwise comparison was significant at 6 weeks post op. However, no difference was found between 6 months and 1-year ASES score. We found mean ASES score at 6month and 1 year was 99.9 with standard deviation 0.4.

There was only one complication in our study. One patient had type 3 dislocation at 6 weeks post- op. So, the complication rate was 7%.

DISCUSSION

In our study 15 patients underwent AC joint reconstruction with autologous semitendinosus graft with ASB technique as described by Babhulkar[37].

In our study patients belonged to 25-30 years with an average age of 33.7 years. Most of the studies regarding AC joint injury incidence report that the injury is common in young atheletes[41] . In the study done by Raj et al.[42] on 8 patients undergoing anatomical AC joint reconstruction by ASB technique; they had 8 patients with average age 38 years. In an incidence study done by Chillemi et

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al.[43] in the general population, the majority of dislocations (50.5%) occurred in individuals between 20 and 39 years. Even at 55 year age, our procedure had excellent outcome though intra operative care was taken to drill cautiously and more posteriorly placed hole over acromion to achieve longer tunnel.

Most of our patients were male (86.7%). In the epidemiologic study done by Pallis et al.[41], they found male patients were twice as likely to sustain an AC joint injury. Rockwood et al.[3] and Nordqvist and Petersson[44] noted that male patients were 5 and 8 times more likely to experience an AC joint injury than female patients, respectively. This finding compares well to our study and explained by men being more inclined to high-risk activities.

Most of our patients suffered injury by RTA (80%). Chillemi et al.[43] reported sport injury to be the most common traumatic mechanism accounting for 42.9% cases followed by road accidents(31.4% cases). In most cases, AC dislocation is the result of a direct and high-energy impact to the shoulder, which is a frequent occurrence in many sports as well as in road accidents. This explains why injuries to the AC joint are more common in the active population, highly exposed to forceful contacts. In particular, soccer, rugby, hockey and basketball are associated with a higher risk of AC injuries due to tackling or wrong landing after a jump.[41]

Most of our patients (86.67%) had injury to the right (dominant) side. This might be explained by more involvement of the dominant side in the activity leading to forceful injury to the side.

86.67% of our patients were having Rockwood type V injury and 13.33% were having type IV injury. We did not include patients with type 3 injury as surgical management in such patients is still controversial[45,12] in the non-athlete population, while type 1 and 2 only need conservative management. In type 3 injuries, early surgical treatment can be considered for patients with high sports demands, although this is controversial as most of these patients do well with conservative treatment and surgical repair does not restore normal strength to the ligaments of the AC joint[46,47].We did not find any Rockwood type VI AC joint injury. In the study by Chillemi et al.[43], they had 21% patient with Type 1, 16% type II, 40% type III, 1% type IV, 21% Type V and 1% type VI AC injury.

The average time to surgery was 4 weeks in our study. Cisneros et al [48.] did a study to compare the outcome of surgical management in the acute vs. chronic injury. The main finding of the study was that patients with unstable ACJ injuries managed with an anatomic reconstruction of the AC joint had same quality of life and radiological outcomes than patients managed with an anatomic reconstruction in chronic setting. Warren -Smith and Ward analysed 32 patients with Type 5 injuries managed with Weaver-dunn procedure.[49] There were no differences between the 10 early and the 22 late patients; but authors concluded that surgery was technically easier when performed in the acute setting. We agree with the authors in the technical aspects. In the chronic setting reduction of the ACJ is more difficult. Weinstein et al. described the time point distinguishing acute versus delayed surgery, as 3 weeks from the date of inury.[50] in their study satisfactory results were obtained in 96% cases treated in acute phase and 76% cases in chronic phase. However, we did not find any statistically significant difference in outcome depending on time to surgery. This might be explained by the superiority of anatomical reconstruction technique over others. It has been reported that infection rates are higher in chronic settings than in the acute setting[51] .This issue may be due to the fact that in the chronic setting, surgical times may be longer, and surgical approaches are usually wider.

The mean UCLA score was 17.9 preoperatively i.e. poor/fair (100%). And at 1 year follow up it was 34.8 i.e. good/excellent (100%). All patients had achieved a good/excellent score at 6 months postoperatively. There was a significant difference in mean UCLA score of the study patients even at 6 weeks compared to pre-op. However UCLA score did not differ significantly at any time between the Type IV and V injuries. And it was not correlated to time to surgery. In the study by Fraschini et al.[52] mean UCLA score was 15.3 Preop which increased to 28.4 in the anatomical reconstruction group compared to 27.9 in non-anatomical group at average 15 months follow up. 93 % patients in anatomical group achieved satisfactory outcomes compared to 53% patients in the non-anatomical reconstruction group.

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Mean preoperative ASES score was 62 with all patients having score<70. ASES score significantly increased at 6 weeks post op and was 99.9 at 6 month and 1 year. Only the Preop ASES score was correlated positively to time since injury. It was not significantly different in type IV and V injuries at any follow up and also did not correlate with time since injury. In the study by Tauber et al[53], mean ASES score was 74 before treatment and increased to 96 in anatomical group vs. 86 in non-anatomical groups at average 37 months follow-up. In the study of anatomical ACJ reconstruction by Sohayeb et al[54], with a mean follow up period of 6.8 months, 86.6% patients had good/excellent outcomes. In the study done by Raj et al.[42], ASB technique was employed and there was excellent/good result in 100% patients.

In a biomechanical study done by Banffy et al.[55], CC reconstruction with AC stabilization led to in vitro biomechanical properties comparable to those of the native ligaments (intact state). Additionally, use of a 5mm tunnel theoretically poses less risk of clavicle fracture. Recent biomechanical[56] and clinical[57] data prove that anatomical CC and AC reconstruction using autologous semitendinosus tendon is superior to the Weaver-Dunn procedure. Arthroscopic techniques provide an advantage over open techniques in reducing surgical morbidity and surgical site infection. On the other hand, loss of reduction or recurrence is the most frequent complications following arthroscopic reconstructions with reported failure rates of 50% or greater[58]. Similar functional outcomes have been reported in arthroscopic and open techniques.[59]

There was only one Type 3 dislocation at 6 weeks post op (complication rate=7%). However, the patient was clinically asymptomatic and had excellent UCLA and ASES scores. There was no superficial or deep infection.

A major concern after anatomic AC joint reconstruction is the risk of fracture. A recent meta-analysis by Gowd et al[60] found the pooled complication rate of 1,704 patients who had undergone AC joint reconstruction to be 14.2%. The second most complication was fracture of the coracoids , which was present in 5.7% of patients. Similarly, a systematic review by Moatshe at al.[61] analysed outcomes and complications of AC joint reconstruction segmented by reconstruction technique. They analysed 165 cases using free tendon graft and found an overall complication rate of 10.3%.

Loss of reduction is not unusual and it might be as high as 40%[66]. Failure of surgery or re dislocation or implant failure is more likely when the implant is not supplemented with a biological graft. Mechanical constructs in isolation can have a rather high failure rate[62, 63]. Brachial plexus injury is also possible as coracoid is adjacent to the brachial plexus. Procedures that involve blind drilling of coracoid without dissection may have a high chance of injury to the plexus.[37]

In the study of Babhulkar et al[37], 1 of 43 patients had a neuroma due to superficial injury, at a graft donor site. There was noticeable superior migration of clavicle in 4 of the 43 patients but none were clinically symptomatic.

The presence of an implant/material in the presence of persistent instability is always a concern for infection. A systematic review of the literature describes that the overall rate of superficial infections is around 3.8% for arthroscopic procedures, [64] in contrast to a rate of up to 5% for procedures performed by means of open surgery[64]; and up to 8% in those procedures in which a tendon graft was used[53].

***Table 1: Summary of outcome data for previous and current study for anatomical AC joint* reconstruction using free tendon graft**

Author, Year	No. of patients	ASES score	UCLA score	Mean Follow up, Months

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Tauber et al, 2016[65]	12	Pre-op:NR Post-op: 95.3±6.9	NR	27.1±6.4
Hegazy et al, 2016[57]	10	NR	NR	27.7(24-32)
Parnes et al, 2015 66	12	NR	NR	30.4(24-48)
Tauber et al, 2009[53]	12	Preop:74±4 Post-op:96±5	NR	34.9(24-48)
Millet et al.[58]	31	Pre op:58.9±27.3 Postop: 93.8±9.1	NR	42(24-74)
Fauci et al, 2013[67]	20	NR	Preop:NR Postop: 18.2±1.7	Minimum:48
Saccomanno et	18	NR	NR	26.4±2.3(24-30)
Tauber et al, 2007[69]	12	NR	NR	49.5(26-96)
Takase et al, 2007[70]	22	NR	Preop:NR Post op: 28.4(24-30)	38(24-63)
Kocaoglu et	16	Preop:73.1(68-78) Post-op:94.5(90-98)	NR	42(29-54)

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Total(mean ranges)	165	Pre-op:58.9-74.0 Post-op:93.8-96	Preop:NR Post-op:18.2-28.4	Mean range:27.1-49.5
Our study	15	Pre-op:62±6.1 Post-op:99.9±0.4	Pre-op:17.9±2.2 Post-op:34.8±0.8	12

NR-Not recorded

CONCLUSION

Anatomical acromio-clavicular and coracoclavicular ligament reconstruction using semi-t autologous graft in acromio-clavicular joint dislocation offered long-term stability and improved functional scores, had less complications and was very cost effective.

Clinical assessment was superior to radiological assessment even if complete reduction is not achieved radiologically as all patients had no pain and good range of motion postoperatively.

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