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Dr. Suresh Kriplani
Department of Orthopaedics, P.G.I. Swasthiyog Pratishthan, Miraj, Maharashtra, India

Dr. Yash Parikh
Department of Orthopaedics, P.G.I. Swasthiyog Pratishthan, Miraj, Maharashtra, India

Dr. Vidisha Kulkarni
Department of Orthopaedics, P.G.I. Swasthiyog Pratishthan, Miraj, Maharashtra, India

Dr. Tejas Patil
Department of Orthopaedics, P.G.I. Swasthiyog Pratishthan, Miraj, Maharashtra, India

Dr. Supreet Bajwa
Department of Orthopaedics, P.G.I. Swasthiyog Pratishthan, Miraj, Maharashtra, India

Dr. Saksham Tripathi
Department of Orthopaedics, P.G.I. Swasthiyog Pratishthan, Miraj, Maharashtra, India

Corresponding Author:
Dr. Yash Parikh
Department of Orthopaedics, P.G.I. Swasthiyog Pratishthan, Miraj, Maharashtra, India

A study on functional outcome of modified weaver-dunn procedure for acromioclavicular joint dislocation in rural setup

Dr. Suresh Kriplani, Dr. Yash Parikh, Dr. Vidisha Kulkarni, Dr. Tejas Patil, Dr. Supreet Bajwa and Dr. Saksham Tripathi

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Abstract
Background: The ideal surgical management for Acromioclavicular joint dislocation (ACJ) is debatable and is unsolved as newer and more sophisticated techniques are being continuously evolved. The present study evaluates the functional outcome of ACJ reconstruction using the modified Weaver-Dunn procedure in rural setup where availability of latest implant is difficult.
Materials and Methods: 30 patients (20 males, 10 females) with ACJ dislocation, between the age group of 18 years to 48 years (mean age 30 years), were operated using modified Weaver-Dunn procedure at our institute from JUNE 2017 to DECEMBER 2019. The dominant side was involved in 25 patients (17 right side, 8 left side). The mean period from the time of injury to the surgery was 8 days (range 3 to 16 days). All the patients were assessed with Oxford Shoulder Score (OSS) and time required to complete functional return to their work was assessed.
Results: At the mean follow up of 6 months, the mean Oxford Shoulder Score improved from 23.36 (± 5.56) to 44.0 (± 4.1), 25 out of 30 patients had satisfactory results, while 5 out of 30 patients had mild shoulder dysfunction using Oxford Shoulder scoring system. Of these 5 patients who had mild shoulder dysfunction, 2 developed ossification around the coracoclavicular ligament and 1 patient had intermittent mild pain without any functional disability, 1 patient had a moderate stiffness at shoulder joint movements, and 1 patient had postoperative superficial infection.
Conclusion: ACJ reconstruction using the modified Weaver-Dunn procedure in ACJ dislocation in rural setup is a good method and provides a good functional outcome without the use of latest sophisticated implants and instruments.

Keywords: Acromioclavicular joint dislocation (ACJ), modified Weaver-Dunn procedure, Oxford Shoulder Score (OSS)

Introduction
Acromioclavicular joint (ACJ) dislocation accounts for nearly 12% of all shoulder injuries in high demand professionals (labourers), sports injuries as well as in road traffic injuries [1]. The most common mechanism of injury is force acting on the shoulder from the lateral side with the arm in adducted position [2]. On the basis of direction and amount of clavicular displacement, Rockwood classified the ACJ dislocation from grade I to VI [3]. The majority of these injuries are low grade (grade I and II) and can be managed nonoperatively resulting in good functional outcome. However, higher grade injuries (grade III to grade VI) may require surgical intervention, especially in high demand professionals (manual labourers) and athletes requiring overhead abduction activities [3, 4]. The discussion concerning conservative or operative treatment is still controversial for grade III injuries [4-6].
The Commonly used techniques for management of ACJ dislocation include: (1) fixation of ACJ using wires/screw/sutures/hook plate, etc., which can be done along with repair of ligaments, (2) coracoclavicular fixation using screw/anchors/free tendon graft with ACJ reconstruction, and (3) excision of distal part of clavicle along with coracoclavicular ligament reconstruction, especially in arthritic joint [3, 7, 8, 9, 10]. The main aim of surgical management is accurate reduction in both coronal and sagittal plane [11]. However, the best operative treatment for ACJ reconstruction remains still debatable [3, 10, 12, 13].

The recent studies did advocate open or arthroscopic fixation of coracoclavicular ligament using modern synthetic loops, flip buttons, tendon autografts or allografts has been advocated but with mixed results [14-17]. These newer techniques have often been compared with modified Weaver-Dunn procedure which has given consistently fair and satisfactory results [16, 18, 19, 20].

The literature support is lacking on functional outcome of surgical management of ACJ reconstruction using Weaver-Dunn procedure especially from India. The aim of present study is to evaluate functional outcomes of ACJ reconstruction using modified Weaver-Dunn procedure especially in rural setup lacking modern sophisticated implants and instruments.

Materials and methods

The present study is a prospective study of patients with ACJ dislocation operated with the modified Weaver-Dunn reconstruction procedure which was done in the Department of Orthopaedics in Post Graduate Institute of Swasthiyog Pratishthan, Miraj, Maharashtra between JUNE 2017 and DECEMBER 2019. Patients with acute injury (less than 4 weeks) were included while those with chronic injury, preexisting shoulder problem or cervical degeneration or concomitant neurological weakness, open injuries were excluded. 30 patients fulfilling the inclusion criteria were selected and operated using Modified Weaver-Dunn procedure. These patients were classified on the basis of Rockwood classification [3]. Out of these 30 patients, 4 were Grade III, 9 were Grade IV, 14 were Grade V and 3 were grade VI. The grade VI injuries are very rare.

Operative procedure

The patient was placed in beach chair position under general anesthesia/ brachial block for the procedure. A "strap" incision was made starting 2-3 cm posterior and medial to acromion clavicular joint, the incision extending towards the tip of the coracoid process (Figure 1A). The acromioclavicular joint and lateral part of the clavicle was exposed. Initially the resection of about 1 cm of the lateral end of the clavicle was performed. The direction of resection of distal end of clavicle was specific in the way that it was performed from posterosuperior and lateral to antero-inferior and medial (Figure 1B). The coracoacromial ligament was identified and its boundaries were identified. The coracoacromial ligament was made to slit along its length in the center dividing the ligament into two straps of equal sizes. The lateral part of coracoacromial ligament was kept attached to acromion process, while the medial strap of coracoacromial ligament was detached from its attachment on the acromion with a small piece of bone, enhancing bone to bone healing (Figure 1C). Laterally, a small curette was used to open up medullary cavity of clavicle. Two drill holes were made 5-6 mm apart and 5-7 mm from the edge from the lateral end of the clavicle. The drill holes were made in such a way that they were neither too near to the resected end of the clavicle nor too near to each other (Figure 1D). A double loop non absorbable no.2 ETHIBOND suture material (poly ethylene terephthalate, Ethicon, Inc., Johnson and Jonson, NJ™) was passed underneath the coracoid process to be used at later stages to reinforce coracoclavicular ligament. The detached medial strap of coraco-acromion ligament along with small bone piece was pulled into the medullary cavity of clavicle using two no. 2 ETHIBOND suture material (Ethicon, Inc., Johnson and Johnson, NJ™) through the two holes already drilled in the lateral end of the clavicle and attached with the clavicle after giving downward pressure to lateral end of clavicle to realign with the acromion process and attaching to clavicle using surgical knots (Figure 1E). This reconstruction was further reinforced by the double loop no. 2 ETHIBOND (Ethicon, Inc., Johnson and Johnson, Somerville, NJ™) already passed underneath the coracoid process and tied over the clavicle (Figure 1F). Normal saline wash was given to remove bone debris. The closure was done in layers.

The arm was placed in a sling for 6 weeks post operatively. Suture removal was done at postoperative day 15. During this phase, active movements of the elbow, wrist and fingers were allowed. From 6 to 12 weeks, physiotheraphy regimen was initiated with passive shoulder range of movements initially for few weeks followed by active movements and later muscle strengthening exercises using thera-band. Patients were advised not to lift heavy weights or perform heavy labour work for these 12 weeks and to gradually return to pre-injury level activities in the next 4 to 6 weeks. The patients were followed up at suture removal (15 days), 4 weeks and thereafter every month for atleast 6 months followed by regular visit at an interval of 3 months. Oxford shoulder score (OSS) was used to assess the functional outcome at every visit and score was noted and the time to return to pre-injury level was recorded [21].

Results

Table 1: Socio demographic characteristics of study group.

Criteria		No. of Patient	Percentage
Age	18-24	8	26.7 %
	25-30	11	36.7 %
	31-36	4	13.3 %
	37-42	1	3.3 %
	43-48	6	20 %
	Total	30	100 %
	Mean (±SD) (years)	30 (±8.76)	
Sex	Male	20	66.7 %
	Female	10	33.3 %
	Total	30	100 %
Side	Right	20	66.7 %
	Left	10	33.3 %
	Total	30	100 %
Dominant	Right	17	56.7 %
	Left	8	26.7 %
Non-Dominant	Right	3	10 %
	Left	2	6.7 %
	Total	30	100 %
Time of Surgery From Day of Trauma	Mean (±SD) (days)	8 (±3.67)	

The average age of patients in the study was 30 years (range 18 to 48 years). There were 20 males and 10 females patients. Right shoulder injury was present in 20 patients and left side shoulder injury was present in 10 patients. Dominant side was involved in 25 patients (17 right side dominant, 8 left side dominant), while in 5 patients non dominant side was involved. The mean period of the time of injury to the surgery was 8(±3.67) days (range 3 days to 16 days). The mean follow up was of 6 months.

Table 2: Rockwood Classification Type III, Type IV, Type V, and Type VI.

Type	No. of Patient	Percentage
Type III	4	13.3 %
Type IV	9	30 %
Type V	14	46.7 %
Type VI	3	10 %
Total	30	100 %

According to Rockwood classification, 4 were Grade III, 9 were Grade IV, 14 were Grade V and 3 were grade VI injuries.

Table 3: Oxford shoulder Score at 1st month, 3rd month and 6th month.

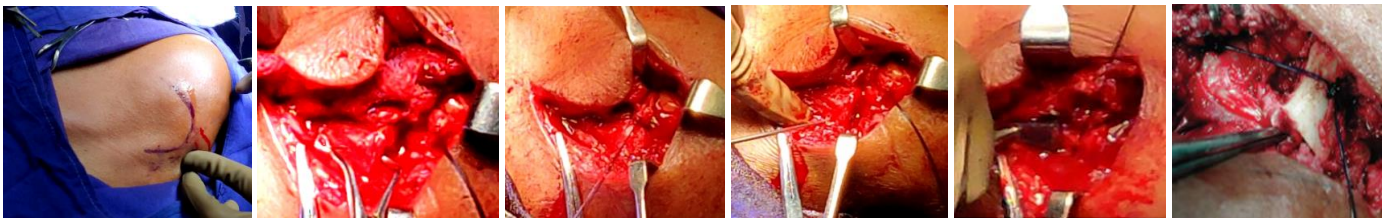
Months of Follow Up	At 1st Month Mean (±Sd)	At 3rd Month Mean (±Sd)	At 6th Month Mean (±Sd)
OSS	23.36 (± 5.56)	33.3 (± 5.75)	44.0 (± 4.1)

P Value between 1st and 3rd month <0.001, 3rd and 6th months <0.001 both were statistically significant.

At the final follow up, the mean Oxford Shoulder Score (OSS) was improved from 23.36 (± 5.56) (range 10 to 29) to 44.0 (± 4.1) (range 34 to 48) in our study. The improvement in Oxford shoulder score was statistically significant (P value, <0.001). About 83.34 % (25 out of 30 patients) of the patients had satisfactory results, while 16.67 % (5 out of 30 patients) had mild shoulder dysfunction using this scoring system.

Complication

Of these 5 patients who had mild shoulder dysfunction, 2 developed ossification around the coracoclavicular ligament and 1 patient had intermittent mild pain without any functional disability, 1 patient had a moderate stiffness at shoulder joint movements, and 1 patient had postoperative superficial infection.



1A 1B 1C 1D 1E 1F

Figure 1A: Skin incision, 1B: Excision of 1cm lateral end of clavicle, 1C: Identification of coracoacromial ligament and split into two half, 1D: Drilling of bony tunnels at lateral end of clavicle, 1E: Attachment of separated coracoacromial ligament to clavicle, 1F: Reinforcement with double loop Ethibond suture attached to coracoid.

Fig 1: Intraoperative picture.

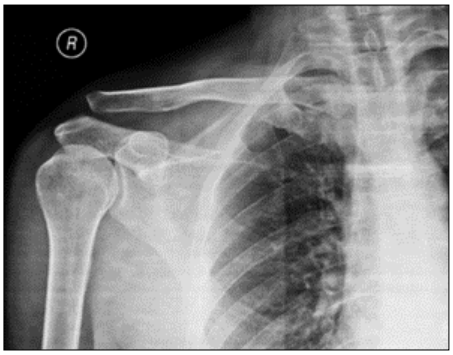


Fig 2: Preoperative x- ray shoulder AP view.

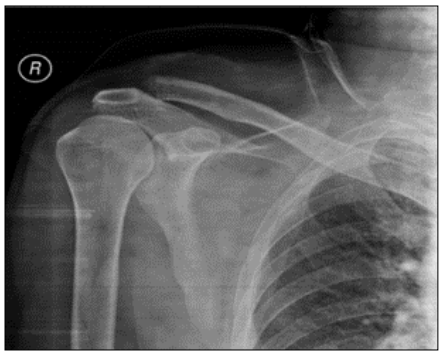


Fig 3: Follow up x-rays at 6months shoulder AP view.

Fig 4: Range of movements of shoulder joints at 6 months follow up.

Discussion

Acromioclavicular joint dislocation (ACJ) injuries account for 10% to 12 % of the injuries around the shoulder girdle [22, 23]. These injuries are common especially in males, athletes and high demand professionals (manual labourers) requiring overhead abduction [24, 25]. The injury is commonly seen in the second and third decade of life [24, 25].

Rockwood classified ACJ dislocation injuries into Six grades helps in judging prognosis and treatment [3, 4, 12, 13]. Most of the previous studies agrees on the management of incomplete injuries (grade I and II) should be nonoperative [12, 13]. The nonoperative treatment protocol for these injuries include a period of rest, analgesics, immobilization for brief period (2 to 3 weeks) and return to pre-injury activity after symptoms subsides. Management of grade III injuries is controversial, where various studies documenting no difference between nonoperative and operative methods [12, 13, 14]. However, studies have been presented which advocates surgical intervention in grade III injuries in sports persons and high demand professionals requiring overhead abduction [6, 16, 18]. All the studies agree for operative management of grade IV to VI injuries. The patients having grade III injuries in our study series (n= 4) were symptomatic patients who were either manual labourers (n=3) or persons involve in sport activity (n=1).

Over the years, numerous surgical management techniques has been described for ACJ reconstruction [26]. Numerous new and sophisticated methods and implants have come up recently. However, consensus on the best and affordable management option for ACJ reconstruction is still a matter of debate. In earlier days, K –wires and tension band wiring has been described for the fixation of ACJ reconstruction. However, this technique is associated with complications such as increased incidence of degenerative ACJ disease, breakage of implants and migration of K-wires into the lung, the heart, and even sometimes large vessels and spinal canal [27, 28]. The usage of anatomical hook plate has been commonly used for fixation of ACJ dislocation. However hook plate fixation is also associated with complications such as acromion fractures, ACJ arthritis and a definite second surgery for plate removal [29]. The ACJ stabilization using a screw between clavicle and a coracoid process providing rigid construct which prevents movements between the coracoid process and clavicle is also not left with complications such as fatigue failure of the implant, early joint degeneration and ultimately stiffness of affected shoulder joint along with continuous pain [30, 31].

Weaver-Dunn procedure was first described in 1972 [8]. The procedure utilizes the intact coracoacromial ligament to substitute the torn coracoclavicular ligament. However, this non anatomic reconstruction was found to be only 30 % as strong as native ligament and complications such as anterior displacement of clavicle in post operative follow ups were noted leading to recurrence of deformity [32]. In order to overcome the complications of procedure, several modifications of the Weaver-Dunn procedure have been described. We, in our study have used partial slit of coracoacromial ligament to act as coracoclavicular ligament fixing with bony tunnels in clavicle at its lateral end and also reinforcement of conventional procedure with double loop no. 2 ETHIBOND (Ethicon, Inc., Johnson and Johnson, Somerville, NJ$^{TM)}$ suture which is passed underneath the coracoid process and tied over the clavicle. The main aim of additional reinforcement was to maintain the reduced position of the AC joint and prevents subluxation till the healing of the reconstructed ligament is complete. However, in 5 of our patients, we failed to achieve desired pre-injury status of the patients. 2 out of 5 patients developed ossification around coracoclavicular ligament. It could either be due to micromotion due to instability leading to new bone formation or it may be due to inadequate saline wash of the bone dust which was left after resection of the lateral end of the clavicle. Now we have started adequate copious saline wash to remove bone dust in all our cases.

In recent literatures, the trend is shifting towards more sophisticated arthroscopic fixation of coracoclavicular reconstruction using tendon allograft or autografts using semitendinosus graft, synthetic loops, endo buttons etc. [14, 15]. However, the long learning curve is demanded for arthroscopic fixation technique with higher cost of implants and instruments. Moreover, easy and prompt availability of implants in rural setup are some of the major issue in using arthroscopic management [17]. Moreover, cases of spontaneous detachment and mid substance break of synthetic loops, flip buttons have also been reported [17, 33].

The mean Oxford Shoulder Score in our study was improved form 23.36 (± 5.56) to 44.0 (± 4.1) at the final follow up. 25 patients (83.34%) had satisfactory results, 5 patients (16.67 %) has mild shoulder dysfunction. Rest all 25 patients returned to their pre-injury level of function at a mean of 6 months. The mean Oxford Shoulder Score and results in our study are similar or even better to the recent newer techniques [34, 35]. Moreover surgical management of ACJ dislocation using modified Weaver-Dunn procedure does not require costly and sophisticated instruments and can be done easily in any basic surgical setup even in rural area with limited availability of resources.

The present study has reasonable long follow up period as far as management choice is concerned. However a still longer term follow up is necessary to determine true efficacy of this procedure in order to compare with other modalities of management options.

Conclusion

ACJ reconstruction using modified Weaver-Dunn procedure in ACJ dislocation using native coracoacromial ligament with modifications still remains one of the gold standard and reproducible procedure in all patients in rural setup with limited availability of resources.

Conflicts of interest: Nil

Financial support and sponsorship: Nil

Ethical approval: The Study was approved by the institutional ethics committee.

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