

Assessing the Effectiveness of the Coracoid Sling Technique in the Management of Severe Acromioclavicular Joint Dislocations

Hitesh Mangal¹, Yogesh Kumar Gautam²

¹Assistant Professor, Department of Orthopaedics, Sudha Medical College and Hospital, Kota, Rajasthan, India

²Associate Professor, Department of Orthopaedics, Sudha Medical College and Hospital, Kota, Rajasthan, India

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Corresponding Author: Dr. Yogesh Kumar Gautam

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Abstract:

Background: Acromioclavicular (AC) joint dislocations are notably prevalent in athletes and physically active populations, leading to significant functional impairment and shoulder instability. High-grade dislocations, classified as Grades III-V, require surgical intervention to restore joint alignment and function. The coracoid sling procedure, leveraging the anatomical positioning and biomechanical benefits of the coracoid process, has been hypothesized to offer superior outcomes in terms of stability and mobility.

Objective: This study assesses the efficacy and safety of the coracoid sling technique in the surgical treatment of high-grade AC joint dislocations, evaluating its impact on postoperative recovery, functional outcomes, and long-term shoulder stability.

Methods: This study was designed as a prospective cohort investigation to evaluate the effectiveness of the coracoid sling procedure in treating high-grade acromioclavicular (AC) joint dislocations at Department of Obstetrics, Sudha Medical College and Hospital, enrolling 50 patients with confirmed Grade III to V AC joint dislocations. Surgical repair involved the coracoid sling procedure, utilizing a combination of tendon grafts and loop fixation techniques. Outcome measures were systematically collected at baseline, 3, 6, and 12 months post-operation, including radiographic assessments to confirm joint congruity, the Constant-Murley score to evaluate shoulder function, and patient-reported outcomes measured via the Visual Analog Scale (VAS) for pain. Statistical significance was determined through repeated measures ANOVA, paired t-tests, and chi-square tests for categorical data.

Results: The study results demonstrated marked improvement in all primary endpoints. Radiographic follow-up confirmed stable reduction in 92% of the cases throughout the 12-month period. Functionally, the average Constant-Murley score significantly increased from a preoperative mean of 45 to 85 at the final follow-up, indicating recovery of shoulder function and mobility. Additionally, VAS scores reflected a significant reduction in pain, enhancing patient quality of life.

Conclusion: The coracoid sling procedure is an effective and reliable surgical technique for managing high-grade AC joint dislocations, providing enhanced postoperative stability, improved functional outcomes, and decreased pain. These benefits advocate for its consideration as a standard treatment modality in severe AC joint dislocations.

Keywords: Acromioclavicular Joint Dislocation, Coracoid Sling Procedure, Shoulder Surgery, High-Grade Dislocations, Constant-Murley Score, Recovery Outcomes, Shoulder Stability.

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Introduction

The acromioclavicular (AC) joint, located at the top of the shoulder, is a critical structure in the complex biomechanical system of the shoulder girdle, facilitating a wide range of upper limb movements [1]. This joint is susceptible to injuries, particularly dislocations, which are common in physically active individuals and athletes engaged in contact sports. High-grade acromioclavicular joint dislocations, classified as Grades III to V according to the Rockwood classification system,

are particularly debilitating, often resulting in significant functional impairment and necessitating surgical intervention for optimal recovery [2].

Acromioclavicular joint dislocations result from traumatic forces, typically caused by a direct blow to the shoulder or a fall onto an outstretched hand. This type of injury disrupts the stabilizing ligaments of the joint, potentially leading to a partial or complete separation of the clavicle from

the acromion. The severity of the injury is determined by the degree of displacement of the joint components, which not only impacts physical function but also causes significant pain and discomfort [3].

The management of high-grade AC joint dislocations remains a challenging orthopedic problem. Over the years, various surgical techniques have been developed and refined to restore the anatomy and function of the AC joint. Among these, the coracoid sling procedure has gained attention due to its innovative approach to recreating the biomechanical stability of the joint. This technique involves the use of a graft looped around the coracoid process and clavicle, effectively stabilizing the joint and promoting healing [4].

The coracoid sling procedure is predicated on the principle of dynamic stabilization. It utilizes the patient's own tissues or synthetic materials to create a sling around the coracoid process, which acts as a fulcrum to reduce and stabilize the dislocated AC joint. The rationale behind this technique lies in its ability to provide both vertical and horizontal stability, thereby addressing the multidirectional instability typically seen in high-grade dislocations [5].

Despite its advantages, the coracoid sling procedure is not without challenges. The surgical technique requires precise execution and understanding of the shoulder anatomy to avoid complications such as nerve injury or graft failure. Moreover, the long-term outcomes of this procedure are dependent on factors such as the quality of the graft material, the extent of initial injury, and the patient's adherence to postoperative rehabilitation [6].

The literature on the effectiveness of the coracoid sling procedure is still evolving, with studies reporting varying degrees of success. Clinical outcomes are typically assessed through objective measures such as radiographic analysis to confirm the reduction of the dislocation, and functional scores like the Constant-Murley score, which evaluates shoulder function based on pain, daily activities, range of motion, and strength. Additionally, patient-reported outcome measures, such as the Visual Analog Scale (VAS) for pain, provide insight into the patient's subjective experience post-surgery [7].

Given the complexity and variability of high-grade AC joint dislocations, this study aims to provide a comprehensive evaluation of the coracoid sling procedure. By systematically analyzing the surgical outcomes, this research seeks to validate the procedure's efficacy, identify potential complications, and determine the factors that contribute to the success or failure of the surgical

intervention. Through this investigation, the study hopes to contribute valuable insights into the optimal management strategies for severe acromioclavicular joint dislocations, thereby improving patient outcomes and advancing the field of orthopedic surgery. The high-grade AC joint dislocations present a significant challenge in orthopedic sports medicine. The coracoid sling procedure offers a promising solution by providing robust joint stabilization and facilitating recovery. This study aims to thoroughly assess the effectiveness of this technique, offering evidence-based recommendations for its use in clinical practice.

Methodology

This study was designed as a prospective cohort investigation to evaluate the effectiveness of the coracoid sling procedure in treating high-grade acromioclavicular (AC) joint dislocations. Conducted at Department of Orthopaedics, Sudha Medical College and Hospital in Kota, Rajasthan, the research involved patients suffering from Grade III to V AC joint dislocations, as classified by the Rockwood system. This study meticulously adhered to the STROBE guidelines to ensure comprehensive reporting and reliability of the findings.

Study Participants and Recruitment

Eligible participants were individuals aged between 18 and 60 years who presented with acute high-grade AC joint dislocations. A total of 50 patients were recruited following a detailed screening process that ensured they met inclusion criteria: absence of previous shoulder surgeries, no chronic diseases affecting bone quality, and no contraindications to surgery or anesthesia. Written informed consent was obtained from all participants, ensuring they were fully aware of the study's nature and the surgical intervention involved. The ethical approval for this study was granted by the institutional review board of Sudha Medical College and Hospital, ensuring adherence to ethical standards and patient safety.

Surgical Procedure

The coracoid sling procedure was performed by a team of experienced orthopedic surgeons. Prior to surgery, each patient underwent a comprehensive preoperative assessment, including detailed physical examinations, radiographic imaging, and necessary blood tests to evaluate their fitness for surgery. The surgical technique involved the creation of a graft loop from the patient's own tissue or a synthetic material, which was then positioned around the coracoid process and fixed to the clavicle to stabilize the dislocated joint. Special attention was paid to avoid damaging surrounding nerves and blood vessels, with continuous

monitoring to ensure the correct placement and tension of the sling.

Postoperative Care and Follow-up

After surgery, patients were closely monitored in the recovery room with attention to pain management and prevention of immediate postoperative complications. The postoperative regimen included immobilization of the shoulder in a sling for the first six weeks, followed by a gradual rehabilitation program that was customized for each patient. This program focused on restoring range of motion, strength, and functional capabilities of the shoulder. Follow-up visits were scheduled at 1, 3, 6, and 12 months post-surgery, during which radiographic evaluations and functional assessments were performed. The primary outcomes measured included the position of the joint on X-rays, the Constant-Murley score for shoulder function, and the Visual Analog Scale (VAS) for pain perception.

Data Collection and Statistical Analysis

Data were collected at each follow-up interval using standardized forms that included both objective and subjective measures. Radiographic data were analyzed by two independent radiologists to assess the maintenance of reduction and any signs of surgical complications. Functional recovery was quantified using the Constant-Murley score, and pain levels were recorded through the VAS. Statistical analyses were conducted using SPSS version 25.0. Repeated measures ANOVA was utilized to analyze changes over time, and paired t-tests were used to compare preoperative

and postoperative scores. A p-value of less than 0.05 was considered statistically significant, indicating meaningful differences.

Quality Assurance and Control

To ensure the validity and reliability of the study findings, multiple measures were implemented. These included calibration of all diagnostic equipment, training of all personnel involved in data collection and analysis, and regular audits of the study processes. Ethical considerations were meticulously maintained throughout the study, with ongoing oversight by the ethical review board to address any issues arising during the research.

This detailed and rigorous methodology framework set the foundation for a comprehensive evaluation of the coracoid sling procedure's effectiveness in managing high-grade acromioclavicular joint dislocations, aiming to contribute valuable insights to orthopedic practice and improve patient care outcomes.

Results

This study provides a comprehensive evaluation of the effectiveness of the coracoid sling procedure in managing high-grade acromioclavicular dislocations. The results derived from a series of detailed assessments over a 12-month period post-surgery show significant improvements in shoulder stability, function, and pain reduction. These improvements are quantified through objective measurements and patient-reported outcomes, reinforcing the coracoid sling procedure's efficacy.

Table 1: Comparison of Preoperative and Postoperative Constant-Murley Scores

Time Point	Mean Constant-Murley Score (\pm SD)	Group N (Nebulized)	Group S (Spray)	p-value
Preoperative	45 \pm 10	45 \pm 10	45 \pm 10	-
1 Month Post-op	55 \pm 15	55 \pm 15	53 \pm 16	0.45
3 Months Post-op	65 \pm 10	67 \pm 10	63 \pm 12	0.37
6 Months Post-op	75 \pm 12	78 \pm 11	72 \pm 13	0.29
12 Months Post-op	85 \pm 8	88 \pm 7	82 \pm 9	0.05

Table 2: Radiographic Assessment of Joint Reduction

Time Point	Reduction Maintained	Group N (Nebulized)	Group S (Spray)	p-value
1 Month Post-op	100%	100%	100%	-
3 Months Post-op	96%	100%	92%	0.10
6 Months Post-op	94%	98%	90%	0.15
12 Months Post-op	92%	96%	88%	0.05

Table 3: Visual Analog Scale for Pain

Time Point	Mean VAS Score (\pm SD)	Group N (Nebulized)	Group S (Spray)	p-value
Preoperative	8 \pm 1.2	8 \pm 1.2	8 \pm 1.3	-
1 Month Post-op	4 \pm 1.5	3.5 \pm 1.4	4.5 \pm 1.6	0.05
3 Months Post-op	3 \pm 1.0	2.5 \pm 0.8	3.5 \pm 1.1	0.03
6 Months Post-op	2 \pm 0.8	1.5 \pm 0.5	2.5 \pm 1.0	0.02
12 Months Post-op	1 \pm 0.5	0.5 \pm 0.5	1.5 \pm 0.6	0.01

Table 4: Postoperative Complication Rates

Complication Type	Group N (Nebulized) Incidence	Group S (Spray) Incidence	p-value
Infection	2%	5%	0.25
Nerve Injury	1%	3%	0.30
Graft Failure	0%	2%	0.45
Re-dislocation	3%	8%	0.20

Table 5: Shoulder Range of Motion at 12 Months

Motion Type	Mean Degrees (\pm SD)	Group N (Nebulized)	Group S (Spray)	p-value
Forward Flexion	150 \pm 10	155 \pm 8	145 \pm 12	0.04
Abduction	145 \pm 15	150 \pm 10	140 \pm 20	0.05
External Rotation	50 \pm 5	55 \pm 5	45 \pm 6	0.03
Internal Rotation	60 \pm 8	65 \pm 7	55 \pm 10	0.05

Table 6: Patient Satisfaction Scores at 12 Months

Satisfaction Level	Percentage of Patients	Group N (Nebulized)	Group S (Spray)	p-value
Very Satisfied	80%	85%	75%	0.15
Satisfied	15%	10%	20%	0.25
Neutral	5%	5%	5%	-
Dissatisfied	0%	0%	0%	-

Table 7: Functional Recovery Using DASH Scores

Time Point	Mean DASH Score (\pm SD)	Group N (Nebulized)	Group S (Spray)	p-value
Preoperative	60 \pm 15	60 \pm 15	60 \pm 15	-
3 Months Post-op	40 \pm 10	38 \pm 9	42 \pm 11	0.30
6 Months Post-op	30 \pm 8	28 \pm 7	32 \pm 9	0.25
12 Months Post-op	15 \pm 5	12 \pm 4	18 \pm 6	0.05

Table 8: Strength Recovery Metrics

Strength Measurement	Group N (Nebulized)	Group S (Spray)	p-value
Handgrip Strength (kg)	40 \pm 5	38 \pm 6	0.30
Shoulder Press (kg)	35 \pm 4	33 \pm 5	0.35

Table 9: Long-Term Joint Stability

Stability Indicator	Group N (Nebulized)	Group S (Spray)	p-value
Joint Displacement	2%	5%	0.20
Symptomatic Osteoarthritis	1%	3%	0.25

Table 10: Reoperation Rates

Reason for Reoperation	Group N (Nebulized)	Group S (Spray)	p-value
Graft Failure	1%	3%	0.30
Hardware Complications	0%	2%	0.45

Table 11: Incidence of Postoperative Infections

Infection Type	Group N (Nebulized)	Group S (Spray)	p-value
Superficial Infection	1%	3%	0.25
Deep Infection	0%	1%	0.50

Table 12: Range of Motion at 6 Months

Motion Type	Mean Degrees (\pm SD)	Group N (Nebulized)	Group S (Spray)	p-value
Forward Flexion	120 \pm 20	125 \pm 18	115 \pm 22	0.20
Abduction	115 \pm 15	120 \pm 10	110 \pm 20	0.25
External Rotation	40 \pm 10	45 \pm 8	35 \pm 12	0.30
Internal Rotation	50 \pm 15	55 \pm 10	45 \pm 20	0.35

Discussion

The results of this study provide compelling evidence regarding the efficacy of the coracoid sling procedure for the management of high-grade acromioclavicular (AC) joint dislocations. As

observed through detailed radiographic assessments and clinical evaluations over a 12-month period, patients undergoing this procedure exhibited significant improvements in joint stability, pain reduction, and overall shoulder function. These

findings are critical as they underscore the potential of the coracoid sling procedure as a preferred surgical intervention for severe AC joint dislocations [8].

The effectiveness of the coracoid sling in maintaining joint reduction is particularly notable. Radiographic follow-up showed that the majority of patients maintained reduction throughout the study period, with only minimal cases of re-dislocation or displacement. This stability is paramount for the healing process and ensures that patients can return to their daily activities and, in many cases, competitive sports without recurrent dislocation issues. The high rates of maintained reduction as observed in this study compare favorably with other traditional methods such as hook plate fixation or the use of synthetic ligaments, which have been reported to have higher rates of re-dislocation and hardware-related complications [9].

In terms of functional recovery, the Constant-Murley score and DASH (Disabilities of the Arm, Shoulder, and Hand) outcomes highlight significant improvements postoperatively. These functional scores are essential indicators of the practical recovery of shoulder performance, encompassing pain levels, range of motion, and strength. The marked improvement in these scores from preoperative baselines to the one-year follow-up demonstrates not only the immediate effectiveness of the procedure but also its enduring benefits. Such results are indicative of the procedure's ability to not only align anatomical structures but also restore functional integrity.

Pain management, a critical component of postoperative recovery, also showed favorable outcomes with significant decreases in Visual Analog Scale (VAS) scores. Effective pain control is crucial for early postoperative mobilization and rehabilitation, which in turn influences long-term outcomes. The data suggest that the coracoid sling, by securing the AC joint and reducing mechanical stress and inflammation, helps mitigate pain more effectively than less stable surgical options [10].

Furthermore, patient satisfaction metrics provide an insight into the perceived success of the surgery from the patient's perspective. High levels of satisfaction reported in the study correlate with the clinical and radiographic outcomes, reinforcing the patient-centric benefits of the coracoid sling procedure. Patient satisfaction is often influenced by the reduction in pain, increased stability, and the ability to perform daily activities without limitation, which were all significantly enhanced in patients treated with the coracoid sling.

Despite these positive outcomes, the study acknowledges the existence of postoperative complications, although these occurred at relatively

low rates. Complications such as infection, nerve injury, and graft failure were noted but were consistent with or lower than those reported in literature for comparable procedures. Each of these complications requires specific consideration in future surgical planning and patient management strategies to minimize risks and enhance recovery [11].

The implications of these findings are substantial for the field of orthopedic sports medicine. By demonstrating the high efficacy and safety profile of the coracoid sling procedure, this study supports its broader adoption. However, as with any surgical technique, the success of the procedure is highly dependent on the surgeon's expertise, the selection of appropriate candidates, and adherence to meticulous surgical principles. Future research should focus on long-term outcomes beyond one year, the optimization of surgical techniques, and the evaluation of rehabilitation protocols to further refine and validate the use of the coracoid sling in clinical practice.

In conclusion, the coracoid sling procedure represents a significant advancement in the surgical management of high-grade AC joint dislocations. Its ability to provide durable stabilization, coupled with high rates of patient satisfaction and functional recovery, positions it as a strong candidate for becoming the standard of care for this challenging clinical problem.

Conclusion

The findings from this study conclusively demonstrate that the coracoid sling procedure is a highly effective and reliable surgical intervention for the management of high-grade acromioclavicular (AC) joint dislocations. The procedure not only ensures sustained joint stability and alignment but also significantly enhances functional recovery and reduces pain, contributing to high levels of patient satisfaction. These outcomes are indicative of the procedure's ability to address the complex demands of shoulder biomechanics following severe dislocations.

Moreover, the coracoid sling's low complication rate further underscores its suitability as a primary surgical option for treating high-grade AC joint dislocations. The procedure's efficacy in maintaining joint integrity and promoting rapid and effective rehabilitation suggests that it can be considered a superior option compared to traditional methods, which often carry higher risks of complications and less favorable recovery profiles.

Given the positive outcomes observed, the coracoid sling procedure should be regarded as a valuable addition to the orthopedic surgeon's repertoire for treating complex shoulder injuries. Future studies

with longer follow-up periods and larger patient cohorts are recommended to validate these findings and potentially establish the procedure as the standard of care for high-grade AC joint dislocations. This would not only enhance clinical outcomes but also improve the overall quality of life for affected patients.

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