

## ORIGINAL RESEARCH

# Functional and cosmetic outcomes in Peruvian patients with acromioclavicular joint dislocation: comparison between three surgical techniques

Resultados funcionales y cosméticos en pacientes peruanos con luxación acromioclavicular: comparación entre tres técnicas quirúrgicas

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## Abstract

**Introduction:** Acromioclavicular dislocation (AD) is a frequent and disabling injury. Depending on its type on the Rockwood classification, treatment may be conservative (I-II) or surgical (III-VI), although there is still no gold standard in terms of surgical technique.

**Objectives:** To compare the functional outcomes and the level of patient satisfaction with the cosmetic outcome of three surgical techniques for AD treatment.

**Materials and methods:** Retrospective comparative observational study conducted in 90 adult patients with AD (type III and V), who underwent surgery between January 2013 and August 2023 in four hospitals of Trujillo (Peru) with one of the following techniques: double sutures with bra strap incision (DS; n=30), hook plate (HP; n=30), and modified Phemister (MP; n=30). Questionnaires used to obtain information on functional outcomes and level of satisfaction with the cosmetic outcome were administered starting at the third postoperative month. Bivariate analyses were performed for comparisons between groups (Kruskall-Wallis and Chi-square tests), with a significance level of  $p < 0.05$ .

**Results:** The mean age of the patients was 42.41 years and 74.44% (n=67) were men. The Quick DASH questionnaire score was lower in the DS group (15.23±8.5) than in the other 2 groups (HP=17.64±10.4 and PM=25.96±6.7) ( $p=0.0002$ ). Likewise, disability time (months) was shorter in the DS group (2.1±0.23) than in the other 2 groups (HP=4.66±1.22 and MP=2.93±1.18) ( $p=0.019$ ). Finally, 61.11% of the patients reported being satisfied and totally satisfied with the cosmetic outcome, this proportion being higher with the DS technique (76.67%), followed by MP (60.00%), and HP (46.67%) ( $p < 0.005$ ).

**Conclusion:** Among the three techniques evaluated, the DS technique showed better functional outcomes. Furthermore, the highest proportion of patients satisfied with the cosmetic outcome was found in the DS group.

## Resumen

**Introducción.** La luxación acromioclavicular (LA) es una lesión frecuente e incapacitante. Dependiendo de su tipo según la clasificación de Rockwood, el tratamiento puede ser conservador (I-II) o quirúrgico (III-VI); sin embargo, aún no hay un estándar de oro en términos de la técnica quirúrgica.

**Objetivos.** Comparar los resultados funcionales y el nivel de satisfacción de los pacientes con los resultados cosméticos de tres técnicas quirúrgicas para el tratamiento de la LA.

**Materiales y métodos.** Estudio observacional comparativo retrospectivo realizado en 90 pacientes adultos con LA (tipo III y V) en los que se realizó manejo quirúrgico entre enero de 2013 y agosto de 2023 en cuatro hospitales de Trujillo (Perú) con una de las siguientes técnicas: dos suturas con incisión en correa de sujetador (DS; n=30), placa en gancho (PG; n=30) y Phemister modificada (PM; n=30). Los cuestionarios usados para obtener información sobre los resultados funcionales y el nivel de satisfacción con los resultados cosméticos se administraron a partir del tercer mes posoperatorio. Se realizaron análisis bivariados para realizar comparaciones entre grupos (pruebas de Kruskal-Wallis y Chi Cuadrado), con un nivel de significancia de  $p < 0.05$ .

**Resultados:** La edad promedio de los pacientes fue 42.41 años y 74.44% (n=67) eran hombres. El puntaje en el cuestionario Quick DASH fue más bajo en el grupo DS (15.23±8.5) que en las otras 2 técnicas (PG=17.64±10.4 y PM=25.96±6.7) ( $p=0.0002$ ). Asimismo, el tiempo de discapacidad (meses) fue más corto en el grupo DS (2.1±0.23) que en los otros dos grupos (PG=4.66±1.22 y PM=2.93±1.18) ( $p=0.019$ ). Finalmente, 61.11% de los pacientes refirieron estar satisfechos y totalmente satisfechos con los resultados cosméticos, siendo esta proporción más alta en la técnica DS (76.67%), seguida de PM (60.00%) y PG (46.67%) ( $p < 0.005$ ).

**Conclusión.** De las tres técnicas evaluadas, la técnica DS mostró mejores resultados funcionales. Además, la proporción más alta de pacientes satisfechos con los resultados cosméticos se observó en el grupo DS.

## Introduction

Acromioclavicular dislocation (AD) is a common injury that accounts for 12% of shoulder injuries.<sup>1</sup> Its annual incidence is 2.0 cases per 10 000 people<sup>2</sup> and occurs most frequently in males between the ages of 20 and 40.<sup>3</sup> In addition, in individuals involved in contact sports, it accounts for 40% to 50% of shoulder injuries.<sup>4</sup>

The most common cause of this type of dislocation is direct trauma to the lateral shoulder or acromial process with the arm in adduction. Similarly, falling on an outstretched hand or elbow may result in the separation of the acromioclavicular joint (ACJ).<sup>5</sup>

The Rockwood classification is the standard instrument for categorizing AD.<sup>6</sup> This system classifies injuries into 6 types depending on the displacement of the ACJ on X-rays and the degree of soft tissue involvement (integrity of the acromioclavicular (ACL), anterior deltoid, and trapezius ligaments):<sup>6,7</sup> type I (mild sprain of the ACL and normal coracoclavicular distance [1.1-1.3cm]); type II (ACL tear and coracoclavicular ligament [CCL] sprain with <25% increase in coracoclavicular distance compared to the contralateral shoulder); type III (superior dislocation of the ACJ with rupture of the ACL, the CCL, and joint capsule, and an increase between 25-100% of the coracoclavicular distance compared to the contralateral shoulder); type IV (posterior dislocation of the ACJ with rupture of the ACL, CCL, and joint capsule, and increased coracoclavicular distance compared to the contralateral shoulder); type V (macroscopic superior dislocation of the ACJ with ruptured ACL, CCL, and joint capsule, and an increase in coracoclavicular distance between 100% and 300% compared to the contralateral shoulder); and type VI (inferior dislocation of the ACJ with rupture of the ACL, CCL, and joint capsule, and decreased coracoclavicular distance compared to the contralateral shoulder).<sup>6,7</sup>

AD, besides causing pain, has the potential to cause a long-term abnormal scapulohumeral rhythm, as well as visible deformity in the affected joint.<sup>8</sup> Similarly, these patients may describe pain radiating to the neck or shoulder, which worsens when moving the affected extremity or when attempting to sleep on the affected shoulder. On physical examination, the patient presents with tenderness at the site of injury and, depending on the injury, swelling, bruising, or a deformity of the ACJ may be noted; the piano key sign, with an elevation of the clavicle that rebounds after inferior compression, is also likely to be present.<sup>5</sup>

Regarding the treatment of AD, types I and II, which are the most frequent,<sup>5</sup> only require conservative management with the use of a sling,<sup>4,5</sup> while types IV-VI (high-grade lesions) should always be treated surgically.<sup>4,5,9,10</sup> However, although multiple surgical techniques have been described, there is currently no consensus on the gold standard for the surgical management of these injuries.<sup>4,11</sup> Furthermore, there is controversy regarding the appropriate treatment of type III injuries,<sup>7,9,10</sup> as surgery may be necessary depending on the patient's lifestyle and functional demand, as well as the functionality of the joint. For example, if coracoclavicular displacement is >75%, the patient is an active worker, an elite athlete, or is concerned about cosmetic outcomes, or if no improvement is observed with conservative treatment, surgery may be considered.<sup>5</sup>

Multiple surgical techniques have been developed for the treatment of acute AD (<6 weeks after injury),<sup>10,11</sup> including the Phemister or modified Phemister (MP) technique, Bosworth technique, Weaver-Dunn technique, Wolter plate, conventional hook plate, and locking hook plate fixation.<sup>11</sup> In this sense, Qi *et al.*<sup>12</sup> report in their meta-analysis that the Tight Rope® (TR) technique seems to be associated with better functional recovery and less pain than the hook plate (HP) technique, while Chang *et al.*<sup>13</sup> report that, at

5-year follow-up, the HP and MP techniques with coracoclavicular ligament augmentation using mersilene tape showed adequate and similar functional outcomes, as well as similar pain levels (measured with the Visual Analog Scale).

Although there are several international studies that compare the outcomes of different surgical techniques for the treatment of AD,<sup>10,12,13</sup> according to a review of the relevant literature, there are no studies that make these comparisons in the Peruvian population, being this information of paramount importance to determine the best practices in the management of these patients in the country. Considering the above, the objective of the present study was to compare the functional outcomes and the level of patient satisfaction with the cosmetic outcome of three surgical techniques for AD treatment.

## Materials and methods

### Study type

Multicenter retrospective observational comparative study.

### Study population and sample

The study population comprised adult patients (>18 years) with type III and V AD treated surgically between January 2013 and August 2023 at four hospitals in Trujillo, Peru (Hospital Victor Lazarte Echegaray [tertiary care level], Hospital Belen de Trujillo [tertiary care level], Hospital Regional Docente de Trujillo [tertiary care level], and Hospital de Alta Complejidad Virgen de la Puerta [quaternary care level]) using one of the following techniques: double suture with bra strap incision (DS), HP, or MP (N=135 patients).

For comparison purposes, 30 patients for each surgical technique were included by consecutive sampling. Patients with exposed fractures, uncontrolled comorbidities (diabetes mellitus, heart disease, venous insufficiency, and/or arterial insufficiency), osteoporosis or burns in the upper limbs, as well as those without complete data in the medical records, were not considered.

### Data collection and variables

Based on the review of the medical records of the selected patients, information on the following variables was collected: age at the time of surgery (age groups: 18-30, 31-50, 51-65, >65 years), biological sex, surgical technique used, affected side, functional outcomes, time of disability (time in months until medical discharge or return to daily activities), presence of late morbidity (occurrence of complications one month after surgery), and level of patient satisfaction with the cosmetic outcome of the surgery.

Functional outcomes were measured using the validated Spanish version of the Quick Disabilities of Arm, Shoulder and Hand (Quick DASH) questionnaire.<sup>14</sup> Moreover, the level of satisfaction with the cosmetic outcome of the procedure was measured using a 5-point Likert scale (“mostly dissatisfied”, “dissatisfied”, “somewhat satisfied”, “satisfied”, “completely satisfied”). In accordance with the protocols of the institutions, both questionnaires were administered from the third postoperative month.

Finally, it should be noted that the surgical technique used was the independent variable, while functional outcomes (Quick DASH score and disability time), late morbidity, and level of satisfaction with the cosmetic outcome of the procedure were the dependent variables.

## Surgical techniques

All surgical techniques were performed with the patients in the beach chair position under general anesthesia. In all cases, the extremity to be operated on was prepared and then draped with sterile material, and adequate antibiotic prophylaxis was administered before starting the procedure. Each of the three techniques is described below.

### *Double suture technique with bra strap incision*

A “bra strap” incision is made from 1–2cm medial to the ACJ extending to the coracoid process (Figure 1A). This incision allows identifying and exposing both the clavicle and the ACJ. Next, a “T” incision is made in the clavicle with subperiosteal elevation over the muscle, fascia, and capsule to identify the coracoid process and its medial and lateral borders.<sup>15</sup>

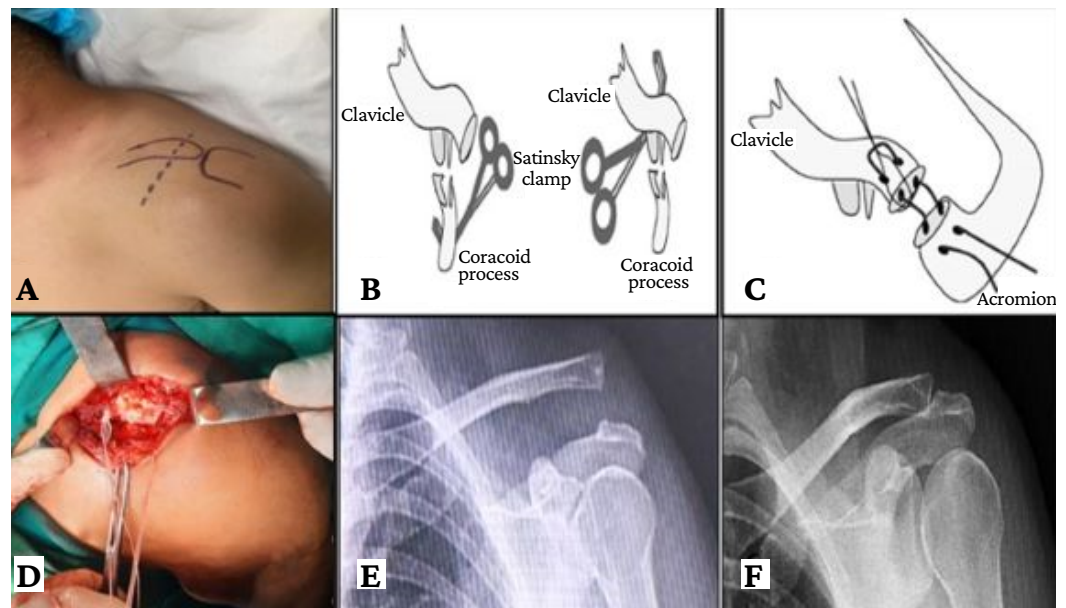
Then, following Bruchmann’s technical recommendation,<sup>16</sup> only two sutures in the bone are used (a suture in the coracoclavicular ligament, followed by a suture in the ACJ). To perform the coracoclavicular suture, while avoiding injury to the trapezius fibers, a Satinsky clamp is used to pass a nonabsorbable suture under the coracoid process to the posterior aspect of the clavicle (Figure 1B); the sutures in the bone are not tightened at this point.

For the suture in the ACJ, 2.0 mm K-wires are used to make 2 holes (1cm apart) in the articular surface of the distal end of the clavicle, in the middle part of the joint. Drilling should be done until the tip of the K-wire exits on the upper surface of the clavicle, thus creating the opposite ends of both holes, which, in addition to being 1cm from each other, should be 1cm from the edge of the clavicle; this same procedure is done on the acromion, observing the distances of 1cm between tips (Figure 1C).

After this, two non-absorbable sutures are used: the first suture is passed through one of the holes created in the superior or dorsal face of the acromion towards the parallel hole created in the articular surface of the clavicle until it exits through the other end of the latter hole, i.e., in the superior face of the clavicle, where the suture is passed through the other entry point created in said surface of the clavicle towards the parallel entry point created in the articular surface of the acromion until it exits through the other end of said entry point (i.e., in the superior face of the acromion), so that a knot can be made to complete the suture. However, before tying the knot, the second non-absorbable suture (e.g., a linen suture) is passed on the superior surface of the clavicle in an inferior-superior direction in order to capture or hook one of the ends of the first suture (Figure 1C).

Thus, once the first suture is tightened after the knot is tied, the second suture is used to “catch” one of the ends of the first suture; a second knot is tied over the ACJ with the ends of the second suture (Figure 1C). In this step, the bone suture is not yet tightened.<sup>16</sup>

Next, the bone sutures are tightened, first the coracoclavicular and then the acromioclavicular (Figure 1D and 1E), reducing and stabilizing the ACJ in the vertical (Figure 1E and 1F) and anteroposterior planes, respectively. Finally, a layered closure of the surgical wound is performed.



**Figure 1.** Double-suture technique in bra strap. A) Incision; B) Suture passage in subcoracoid to supraclavicular direction; C) Acromioclavicular suture passage; D) Knotting of coracoclavicular and acromioclavicular sutures; E) Acromioclavicular dislocation; F) Acromioclavicular reduction and stability.

#### Modified Phemister

An anterior curved or italic “S” shape incision is made to expose the ACJ. Then, in order not to interfere with the reduction of the joint, the articular disc is removed, considering that in many cases it is ruptured and/or blocked, preventing reduction.

Next, to perform ACJ reduction and stabilization, two 2.0mm K-wires are inserted from the lateral border of the acromion, penetrating the clavicle between 2.5 and 4cm; the external end of the needles is bent to prevent their migration. The joint capsule and the acromioclavicular and coracoclavicular ligaments are then repaired and cerclage wiring is placed for additional stability.<sup>17,18</sup> Once the surgical procedure is completed, the limb is immobilized with a sling (4-6 weeks). Finally, the osteosynthesis material must be surgically removed three or four weeks after the procedure.<sup>18</sup>

#### Hook plate

An incision of approximately 6cm is made at the upper end of the ACJ. The soft tissues are then dissected until the ACJ is visible. The anterior and posterior edges of the acromion are located and their midpoint is marked to guide plate placement. The AD is reduced and an HP is placed over the ACJ. The hook is placed under the acromion as posterior as possible to ensure complete attachment to the acromion and avoid subacromial impingement (on the supraspinatus bursa or rotator cuff).<sup>19</sup>

#### Statistical analysis

The data were entered into a database created in Microsoft Excel for subsequent analysis in the IBM SPSS V24.0 statistical software. Data were described using absolute and relative frequencies for qualitative variables and means and standard deviations for quantitative variables. Bivariate analyses were performed to evaluate the differences

between groups (Kruskal-Wallis and Chi-square tests), with a statistical significance level of  $p < 0.05$ .

### Ethical considerations

This research followed the ethical principles for the conduct of biomedical studies involving human subjects established in the Declaration of Helsinki.<sup>20</sup> Likewise, the provisions on the anonymity of patient data established in article 25, paragraph C, of the Peruvian General Health Law (Law No. 26842) were taken into account.<sup>21</sup> The study was approved by the research committee of the Faculty of Human Medicine of the Universidad Privada Antenor Orrego by means of Minutes 0684 of September 17, 2023.

### Results

The mean age of the patients was 42.41 years ( $\pm 13.3$ ), and the 31–50-year-old age group was the most frequent in the three groups (DS: 46.67%,  $n=14$ ; HP: 36.67%,  $n=11$ ; MP: 56.67%,  $n=17$ ). Regarding the distribution by sex, there was a higher proportion of men (85.55% in total and 93.33%, 86.87%, and 76.67% in the DS, HP, and MP groups, respectively), the difference being statistically significant ( $p < 0.05$ ). Concerning the affected side, AD occurred more frequently in the right shoulder in the HP and MP groups (56.67% and 53.33%), while in the DS group, the laterality of the affected shoulder was similar (50%) (Table 1).

**Table 1.** General characteristics of patients according to the surgical technique used for the treatment of acromioclavicular dislocation.

| Characteristics      | Group 1<br>Double suture with<br>bra strap incision |       | Group 2<br>Hook plate |       | Group 3<br>Modified Phemister |       | <i>p</i> -value |
|----------------------|---|-------|-----------------------|-------|-------------------------------|-------|-----------------|
|                      | <i>n</i> =30  | %     | <i>n</i> =30          | %     | <i>n</i> =30                  | %     |                 |
| <b>Age group</b>     |   |       |                       |       |                               |       |                 |
| 18 – 30              | 5   | 16.67 | 9                     | 30.00 | 5                             | 16.67 | 0.069 *         |
| 31 – 50              | 14  | 46.67 | 11                    | 36.67 | 17                            | 56.67 |                 |
| 51 – 65              | 10  | 33.33 | 8                     | 26.67 | 6                             | 20.00 |                 |
| > 65                 | 1   | 3.33  | 2                     | 6.67  | 2                             | 6.67  |                 |
| <b>Sex</b>           |   |       |                       |       |                               |       |                 |
| Female               | 2   | 6.67  | 4                     | 13.33 | 7                             | 23.33 | 0.023 *         |
| Male                 | 28  | 93.33 | 26                    | 86.67 | 23                            | 76.67 |                 |
| <b>Affected side</b> |   |       |                       |       |                               |       |                 |
| Right                | 15  | 50.00 | 17                    | 56.67 | 16                            | 53.33 | 0.267 *         |
| Left                 | 15  | 50.00 | 13                    | 43.33 | 14                            | 46.67 |                 |

\* Chi-square

With respect to functional outcomes (Table 2), the mean score on the Quick DASH questionnaire was lower in the DS group ( $15.23 \pm 8.5$ ) than in the other groups (HP= $17.64 \pm 10.4$  and MP= $25.96 \pm 6.7$ ), ( $p=0.0002$ ). Likewise, the disability time was shorter with the DS technique ( $2.1 \pm 0.23$ ) than with the HP ( $4.66 \pm 1.22$ ) and MP ( $2.93 \pm 1.18$ ) techniques, ( $p=0.019$ ).

**Table 2.** Functional outcomes according to the surgical technique used for the treatment of acromioclavicular dislocation.

|   | <b>Group 1<br/>Double suture with bra<br/>strap incision</b> | <b>Group 2<br/>Hook plate</b> | <b>Group 3<br/>Modified<br/>Phemister</b> | <b>p-value</b> |
|---|--|-------------------------------|---|----------------|
| <b>Functional outcomes<br/>(Quick DASH<br/>Questionnaire)</b> | 15.23±8.5  | 17.64±10.4                    | 25.96±6.7                                 | 0.0002*        |
| <b>Length of disability<br/>(months)</b>                      | 2.1 ±0.23  | 4.66±1.22                     | 2.93±1.18                                 | 0.019*         |

\* Kruskal-Wallis.

Table 3 describes the results in terms of the presence of late morbidity. In this regard, it was observed that most patients in the 3 groups presented late morbidity (BS 1=63.33%, HP=76.67%, MP=80%); there were no significant differences between groups.

**Table 3.** Late morbidity according to the surgical technique used for the treatment of acromioclavicular dislocation.

|                       | <b>Group 1<br/>Double suture with bra<br/>strap incision</b> |       | <b>Group 2<br/>Hook plate</b> |       | <b>Group 3<br/>Modified<br/>Phemister</b> |       | <b>p-value</b> |
|-----------------------|--|-------|-------------------------------|-------|---|-------|----------------|
|                       | n  | %     | n                             | %     | n   | %     |                |
| <b>Late morbidity</b> |  |       |                               |       |   |       |                |
| Yes                   | 19   | 63.33 | 23                            | 76.67 | 24  | 80.00 | 0.128*         |
| No                    | 11   | 36.67 | 7                             | 23.33 | 6   | 20.00 |                |

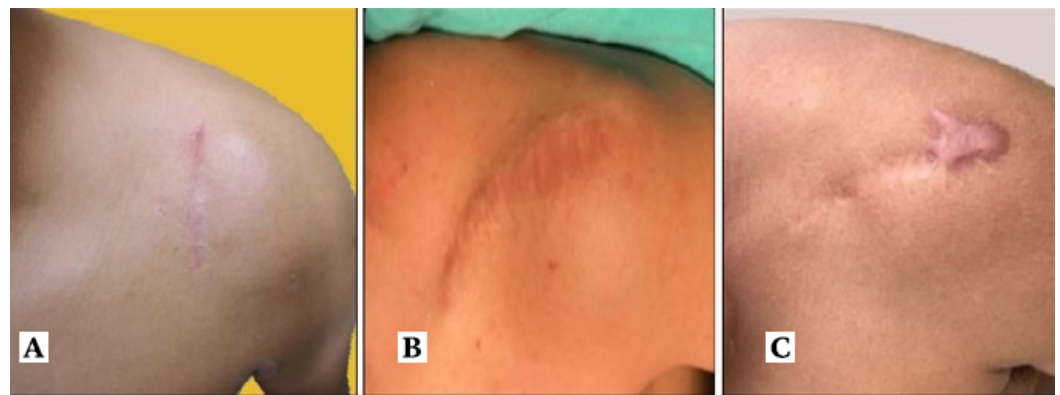
\* Chi-square

Finally, regarding patient satisfaction with the cosmetic outcome of the surgical technique (Table 4), 61.11% reported being satisfied (satisfied and totally satisfied), this proportion being higher with the DS technique (76.67%), followed by MP (60.00%), and HP (46.67%) ( $p < 0.005$ ). Figure 2 (A, B, and C) shows examples of the scars of the procedure in patients of the DS, HP, and MP groups, respectively.

**Table 4.** Patient satisfaction with the cosmetic outcome according to the surgical technique used for the treatment of acromioclavicular dislocation.

| <b>Patient satisfaction with<br/>cosmetic outcome</b> |                    | <b>Group 1<br/>Double suture with bra<br/>strap incision</b> |          | <b>Group 2<br/>Hook plate</b> |          | <b>Group 3<br/>Modified Phemister</b> |          |
|---|--------------------|--|----------|-------------------------------|----------|---------------------------------------|----------|
|   |                    | <b>n</b>   | <b>%</b> | <b>n</b>                      | <b>%</b> | <b>n</b>                              | <b>%</b> |
| Not<br>satisfied                                      | Very dissatisfied  | 0  | 0.00     | 0                             | 0.00     | 0                                     | 0.00     |
|   | Dissatisfied       | 3  | 10.00    | 6                             | 20.00    | 5                                     | 16.67    |
|   | Somewhat satisfied | 4  | 13.33    | 10                            | 33.33    | 7                                     | 23.33    |
| Satisfied   | Satisfied          | 17   | 56.67    | 10                            | 33.33    | 14                                    | 46.67    |
|   | Fully satisfied    | 6  | 20.00    | 4                             | 13.33    | 4                                     | 13.33    |

Chi-square,  $p < 0.005$ .



**Figure 2.** Cosmetic outcome according to the surgical technique used: A) Double suture with bra strap incision; B) Hook plate; C) Modified Phemister.

## Discussion

Multiple surgical techniques are available for the treatment of AD. Although each technique has advantages and disadvantages, none is currently accepted as the gold standard.<sup>4,9,10,22-24</sup> With this in mind, the present study compared the functional outcomes and the level of satisfaction with the cosmetic outcome of the DS (group 1), HP (group 2), and MP (group 3) techniques in patients with type III and V AD.

In our study, the mean age of the participants was 42.41 years, with 31-50 years being the most frequent age group (46.67%); furthermore, there was a predominance of males (85.55%; n= 77 patients). These findings are similar to those described by Chang *et al.*<sup>13</sup> in a study conducted in 35 patients with acute AD treated with the HP (17 shoulders) and MP (18 shoulders) fixation techniques, in which the average age was 43.54 years and men predominated (65.71%). They are also in agreement with the systematic review and meta-analysis by Qui *et al.*<sup>12</sup> (11 studies) that compared the efficacy of the TR and HP techniques for the treatment of acute AD, in which the age of the patients varied between 32.3 and 44.8 years and men were always in the majority in the included studies; furthermore, according to these authors, the TR technique is associated with better functional recovery and less pain than the HP technique.<sup>12</sup>

Regarding the predominance of males, it has been described that they are 8.5 times more likely to suffer this type of injury,<sup>23,25</sup> probably because of differences in lifestyle and the fact that they are more likely to participate in high-risk activities, such as contact sports.<sup>23</sup>

Concerning the laterality of the AD, in our study the right shoulder was the most affected, without the difference being statistically significant (53.33% vs. 46.67%;  $p=0.267$ ). This may be due to the fact that in most patients the right hand was the dominant hand (80%).

As for functional outcomes, the mean score on the Quick DASH questionnaire was lower in patients in whom the DS technique was used ( $15.23\pm 8.5$ ) compared to those operated on using the HP ( $17.64\pm 10.4$ ) and MP ( $25.96\pm 6.7$ ) techniques, the difference being statistically significant ( $p=0.0002$ ). In addition, the disability time was shorter in the DS technique ( $2.1\pm 0.23$ ) compared to the HP and MP techniques ( $4.66\pm 1.22$  and  $2.93\pm 1.18$ ), the difference between groups being statistically significant ( $p=0.019$ ).

Taking into account that the lower the score on the Quick DASH questionnaire, the lower the functional limitation and that the disability time was shorter in the DS technique, it could be stated that the performance of this technique was superior to the other two in terms of functional outcomes. This may be explained by the fact that this technique is dynamic and respects the native anatomy and biomechanics of the ACJ, which allows a better functional outcome to be achieved.



In this respect, Fosser & Camporese<sup>22</sup> in a study performed in 66 patients with AD (types III-V) operated on using three surgical techniques (TR, HP, and tension band wiring; 22 patients per technique), reported that, regardless of the technique, all patients showed a satisfactory functional outcome. They found that, depending on the scores on the DASH and Constant scales, there were no significant differences between the HP technique and tension band wiring, and also that, depending on the DASH scale score, a significant difference was observed ( $p < 0.005$ ) in favor of the TR technique compared to the other two techniques. It should be noted at this point that we did not find studies that compared, in terms of functional outcomes, the DS technique with the other two techniques considered in our study (HP and MP).

About the level of satisfaction with the cosmetic outcome of the procedure, 61.11% of the patients claimed to be satisfied (satisfied or totally satisfied). Moreover, in the DS group this proportion was higher (76.67%) than in the other two groups (MP= 60.00% and HP=46.66%), the difference being statistically significant ( $p < 0.005$ ), probably because the vertical incision of this technique is more acceptable to the patients, particularly for women, since they can hide it under the bra straps. Concerning this, Fosser & Camporese<sup>22</sup> reported in their study that 40.2% of patients operated on with the HP technique are dissatisfied with the cosmetic outcome; furthermore, according to these authors, the cosmetic aspect also plays an important role in the treatment of these patients, since better cosmetic outcomes result in less social and psychological pressure for the patient when returning to their regular activities.<sup>22</sup> As with the functional outcomes, it is important to mention that we found no studies that made comparisons in terms of satisfaction with cosmetic outcomes between the DS technique and the other two techniques considered in the present study (HP and MP).

Due to its retrospective nature, the present study has limitations related to the quality of the information collected, as it was obtained from medical records, which may introduce information biases due to suboptimal record quality and potential discrepancies in data measurement compared to the study's objectives. Nevertheless, unlike a prospective cohort, this type of study involves less time and costs, and also provides information on the outcomes over time of these three surgical techniques for the treatment of AD, including the presence of late morbidity.

## Conclusion

Compared with the HP and MP techniques, the DS technique showed better functional outcomes in terms of Quick DASH score and disability time. In addition, the proportion of patients satisfied with the cosmetic outcome of the procedure was higher in those operated on with the DS technique.

Note: This article is derived from the thesis *Resultado funcional y cosmético en pacientes con luxación acromioclavicular según técnicas de tratamiento* (Functional and cosmetic outcomes in patients with acromioclavicular dislocation according to treatment techniques) authored by KSPA and directed by REVM, which was written to obtain the degree of surgeon.<sup>26</sup>

## Conflicts of interest

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