Sternoclavicular joint dislocations are relatively rare injuries and account for 3% of all injuries to the shoulder girdle. Although the majority of these injuries result in an anteriorly directed dislocation, it is the less common posterior sternoclavicular joint dislocation that carries the greatest risk to the patient and at times is life threatening. Anterior dislocations are often treated nonoperatively with a sling or figure-of-eight bandage, but the standard of treatment for posterior dislocations is closed or open reduction. A variety of operative procedures exist to treat sternoclavicular dislocations, including resection of the medial clavicle, suture fixation, stabilization with wires, pins, or plates, and reconstruction with allograft tendon or tenodesis.

The goal of this systematic review was to present all the available data reported in the literature to provide some guidance for the management of this relatively rare and infrequently reported injury. Functional outcomes were compared between anterior and posterior dislocations, between acute and chronic dislocations, and between nonoperative, closed reduction, and open reduction treatment options.

MATERIALS AND METHODS

Eligibility Criteria

Studies that reported the functional outcomes of at least four sternoclavicular joint dislocations were eligible for this systematic review. If a case series included patients who were lost to follow-up, who were presented with an associated clavicle fracture or acromioclavicular joint injury, who underwent a failed previous open reduction, or who had only a sternoclavicular joint subluxation, the data for those specific patients were extracted and excluded from this review.

Study Identification (Search Date: March 2010)

A search of the Cochrane Database, PubMed, Medline, and the OTA online abstracts database using the search terms “sternoclavicular AND joint AND dislocation” generated 1,344, 149, and 1 hits, respectively. Nineteen relevant articles were identified from PubMed, two relevant but redundant articles were identified from Medline, and five relevant articles were found in a review of bibliographies of identified articles. A total of 24 case studies (19 English and 5 French) were included in this systematic review.

Available Evidence

All 24 case studies included in this review were retrospective case series (EBM-Level IV). Eight case series included both anterior and posterior dislocations. Six included only anterior dislocations, and 10 included only posterior dislocations. Only one case series reported patients treated nonoperatively, and six case series reported patients treated by open reduction.

Data Abstraction

The following variables were extracted from the articles whenever possible: number of patients, average age of patients, male to female ratio, type of treatment (nonoperative, closed reduction, or open reduction), direction of dislocation (anterior or posterior), time between injury and treatment (acute or chronic), and functional outcome results on a categorical scale (excellent/good or fair/poor). The minimal reported follow-up was used if no average or individual follow-up data were included. For patients treated by open reduction, the specific surgical procedures, associated complications, and whether there was a previously attempted closed reduction were recorded if documented in the literature.

Data Analysis

Functional outcomes were stratified by type of treatment, direction of dislocation, and time between injury and treatment. Many of these categories have small sample sizes, because sternoclavicular joint dislocation is a relatively rare injury. Therefore, it was not possible to make statistical comparisons between certain categories. For categories consisting of <30 dislocations, 95% confidence intervals (CI) were not calculated and only frequencies were reported. The Fisher exact test was used to make comparisons between categorical results.
Methods of Categorization

A variety of different scoring systems, outcome scales, and follow-up descriptions were used across all case series: DASH and Constant scores,13,15 original outcome scales according to Eskola et al.,7,8 and Rockwood et al.,19 a categorical result reported as excellent, good, fair, or poor,6,12,18,25,26 and the surgeon’s description of follow-up outcome based on pain, range of motion, ability to return to normal activities, and/or recurrence of symptoms.3–5,9–11,14,16–18,20–24

The functional results were categorized as either excellent/good or fair/poor. The following results were placed into the excellent/good category: excellent, good, satisfactory, minimal or no recurrence of symptoms, mild or no impairment of daily activities, restored shoulder mobility with mild or no pain, successful reduction and discharged without further intervention, no functional loss, and no disability or abnormality. The following results were placed into the fair/poor category: fair, poor, average, unsatisfactory, moderate or severe limitation of shoulder mobility, moderate or severe impairment of daily activities, significant pain, failure of reduction, and the presence of a debilitating complication. Patients with a DASH score >35 or a Constant score <80 were classified as fair/poor; otherwise, they were classified as excellent/good. The original outcome scales created by Eskola et al. and Rockwood et al. were already categorized as excellent, good, fair, or poor in the results sections of their case series.

Dislocations were categorized as either acute or chronic. Dislocations were placed into the acute category if described as acute, recent, fresh, or <6 weeks old. Dislocations were categorized as chronic if described as chronic, old, recurrent, or >6 weeks old.

A wide variety of open reduction procedures have been described in these case series. The procedures have been categorized into six groups. The open reduction and internal fixation (ORIF) category includes Balser plate stabilization13 and stabilization by anterior plating.3 Resection of medial clavicle describes procedures in which 1 to 1.5 inches of the medial clavicle was resected.8,12,17–19,25 Tendon graft includes tendon grafts8 and fascia lata grafts.8,18 Tenodesis includes Jackson Burrow’s technique (subclavian tenodesis)4,12,15,26 and sternomastoid tenodesis.5,15 all without the use of wires or pins. K-wire/pin fixation includes all procedures involving Kirchner wires.9,15,16,18,23 pins,12,18,24,26 nails (Brown’s method),4 or cerclage wiring.12 Suture fixation includes costoclavicular ligament suture reconstruction15 and all suture stabilization techniques that do not apply to the previous categories.17,18,21,22 all without the use of wires or pins.

**TABLE 1. Functional Results by Treatment for Anterior and Posterior Dislocations**

<table>
<thead>
<tr>
<th></th>
<th>Nonoperative: Excellent/Good</th>
<th>Closed Reduction: Excellent/Good</th>
<th>Open Reduction After Failed Closed Reduction: Excellent/Good</th>
<th>Open Reduction: Excellent/Good</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anterior</td>
<td>69% (36/52; 95% CI, 55–81)</td>
<td>85% (17/20)</td>
<td>80% (4/5)</td>
<td>75% (30/40; 95% CI, 59–87)</td>
</tr>
<tr>
<td>Posterior</td>
<td>N/A (0/0)</td>
<td>100% (41/41; 95% CI, 91–100)</td>
<td>88% (14/16)</td>
<td>91% (21/23)</td>
</tr>
</tbody>
</table>

N/A, not applicable.

**RESULTS**

**Overall Outcomes**

A total of 251 dislocations were identified from 24 studies.3–26 The average age of the patients was 29 years (based on 218 patients in 20 case series), and 67% of the patients were male (based on 217 patients in 20 case series). The average reported follow-up was 45 months (based on 150 patients in 19 case series). Overall, 80% of patients (200 of 251; 95% CI, 74–84) had an excellent/good result, and 20% (51 of 251; 95% CI, 16–26) had a fair/poor result.

**Anterior Versus Posterior**

The functional outcomes were not separated by direction of dislocation in the operative results section of one case series,18 and in the entire results section of another.12 Therefore, these data could not be extracted for comparisons between anterior and posterior dislocations, which is why the total patient number totals 197 in this section.

Of 117 total anterior dislocations, 52 (44%) were treated nonoperatively, 25 (21%) by closed reduction, and 45 (38%) by open reduction. Five (4%) of the open reductions had a reported failed closed reduction before the open reduction and were therefore counted in both categories. Of 80 total posterior dislocations, zero were treated nonoperatively, 57 (71%) by closed reduction, and 39 (49%) by open reduction. Sixteen (20%) of the open reductions had a reported failed closed reduction before the open reduction.

Although 80 of 197 patients in this review suffered a posterior dislocation, this ratio is not representative of this injury’s true prevalence. The inclusion of 10 case series that reported posterior dislocations exclusively resulted in a disproportionately high number of posterior dislocations in this review. More accurate percentages of posterior dislocations have been reported as 5%,18 16%,12 and 27%.2

Results of each treatment are presented in Table 1. All patients in the closed reduction category either had a successful reduction or refused to have surgery after a failed treatment (3 anterior dislocations18). All other unsuccessful closed reductions underwent an open reduction procedure; hence, a separate category was created to account for these overlapping patients.

It is also important to note that posterior dislocations can be associated with the compression of adjacent mediastinal structures and great vessels such as the innominate vein or subclavian artery.17,27 If left untreated, prolonged pressure on the superior mediastinum can cause erosion of the great vessels,28 tracheoesophageal fistulas, brachial plexopathy,29 and thoracic outlet syndrome.30 Of the 80 documented...
posterior dislocations, 24 patients (30%) presented with symptoms indicative of mediastinal compression such as dysphagia, dyspnea, paresthesia, and venous compression.3,6,9,15–17,20–24 Favorable results were achieved for patients treated by closed reduction (7/7 excellent/good) and open reduction (16/17 excellent/good).

### Open Reduction Procedures

Functional results and all reported complications of the various open reduction procedures are presented in Table 2 and stratified by direction of dislocation. Although not all of the studies described associated complications to the same extent, the complications did not always negatively affect the functional outcome of the patient, and the excellent/good category was often still appropriate. Although the complications from these case series did not have severe consequences, it should be noted that complications from the use of K-wires and pins have the potential to be life threatening. Wires and pins have been reported to migrate into the heart, pulmonary artery, aorta, innominate artery, and spinal cord.31

| TABLE 2. Functional Results and Complications for Open Reduction Procedures |
|-----------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|
|                             | ORIF                        | Resection of Medial Clavicle | Tenodesis                   | K-Wire/Pin Fixation         |
| Overall excellent/good results | 92% (11/12)                  | 55% (6/11)                   | 64% (9/14)                  | 94% (15/16)                 |
| Anterior excellent/good results | 80% (4/5)                   | 33% (2/6)                    | 50% (4/8)                   | 100% (10/10)                |
| Anterior complications       | 1 postoperative seroma13     | None reported                | 1 restriction of movement due to tightly wrapped fascial loops8 | 1 small postoperative pneumothorax4 |
| Anterior complications       | 1 osteoarthritis of the acromio-clavicular joint6 | None reported | 1 superficial wound dehiscence5 | 1 superficial sepsis26 |
| Posterior excellent/good results | 100% (7/7)                  | 67% (2/3)                    | N/A (0/0)                   | 83% (5/6)                   |
| Posterior complications      | 1 plate breakage3            | 1 intermittent compression of subclavian artery17 | None reported                | 91% (12/13)                |
| Posterior complications      | None reported                | None reported                | 2 migrations of wires9       | 88% (7/8)                   |
|                             |                             |                             |                             |                             |
| The “overall excellent/good results” row includes data from two articles12,18 that did not report the direction of dislocation; thus, this row is not always equal to the sum of the anterior and posterior data. Complications from these articles included only 1 wire breakage18 and 1 pin breakage18 for K-wire/pin fixation. | 

<table>
<thead>
<tr>
<th>TABLE 3. Functional Results for Acute and Chronic Dislocations</th>
</tr>
</thead>
<tbody>
<tr>
<td>#</td>
</tr>
<tr>
<td>---</td>
</tr>
<tr>
<td>Acute</td>
</tr>
<tr>
<td>Chronic</td>
</tr>
</tbody>
</table>

### Acute Versus Chronic

Sixteen case series reported information on 151 patients concerning the duration of time between injury and treatment.4–6,8–11,14,15,17–19,21,23,24,26 The overall outcome results for acute and chronic dislocations are presented in Table 3. 87.5% of acute dislocations were treated with excellent or good results, whereas only 73% of chronic dislocations had excellent/good results (p = 0.038). The functional outcomes and percentages of patients treated nonoperatively, by closed reduction, and by open reduction are presented in Table 4. Of the 151 patients with documented time between injury and treatment, 136 reported the direction of dislocation, and these stratified results are also included in Table 4.

| TABLE 4. Treatment Distribution and Functional Outcomes for Acute and Chronic Dislocations |
|-----------------------------------------------|--|--|--|--|
| Percent Treated Nonoperatively | Percent Treated by Closed Reduction | Percent Treated by Open Reduction After Failed Closed | Percent Treated by Open Reduction |
| Acute | 4 (3 e/g, 0 f/p) | 57.5 (43 e/g, 3 f/p) | 7.5 (5 e/g, 1 f/p) | 31 (19 e/g, 6 f/p) |
| Chronic | 38 (19 e/g, 8 f/p) | 0 (0 e/g, 0 f/p) | 1 (1 e/g, 0 f/p) | 61 (32 e/g, 11 f/p) |
| Anterior acute | 10 (3 e/g, 0 f/p) | 57 (14 e/g, 3 f/p) | 0 (0 e/g, 0 f/p) | 33 (8 e/g, 2 f/p) |
| Anterior chronic | 53 (19 e/g, 8 f/p) | 0 (0 e/g, 0 f/p) | 0 (0 e/g, 0 f/p) | 47 (16 e/g, 8 f/p) |
| Posterior acute | 0 (0 e/g, 0 f/p) | 60 (29 e/g, 0 f/p) | 13 (5 e/g, 1 f/p) | 27 (11 e/g, 2 f/p) |
| Posterior chronic | 0 (0 e/g, 0 f/p) | 0 (0 e/g, 0 f/p) | 14 (1 e/g, 0 f/p) | 86 (6 e/g, 0 f/p) |

e/g, excellent/good; f/p, fair/poor.

Because some of the literature12,18 did stratify by direction of dislocation, not all of the 151 patients stratified as acute/chronic could be further stratified into anterior/posterior.
Table 4 shows that the main treatment options for acute dislocations (either anterior or posterior) are closed and open reduction. For acute dislocations, 48 of 52 patients (92%; 95% CI, 81–98) treated initially by closed reduction, even if a subsequent open reduction was required, achieved excellent or good results. This excellent/good outcome rate trended higher than the results for patients treated solely by open reduction, of which 19 of 25 patients (76%) achieved excellent or good results. However, this difference was not statistically significant (p = 0.069).

The main treatment options for chronic dislocations are nonoperative and open reduction; however, all chronic posterior dislocations were treated by open reduction (7/7 patients, 1 after a previous failed closed reduction). For chronic anterior dislocations, 19 of 27 patients (70%) treated nonoperatively achieved excellent or good results. Twenty-six of 37 patients (70%; 95% CI, 53–84) treated by open reduction achieved excellent or good results; thus, neither treatment achieved significantly better functional outcomes (p > 0.999).

**DISCUSSION**

**Are the Results of These Studies Valid?**

The identified studies were all retrospective case series. The available literature does not include prospective randomized clinical trials or comparative studies. The conclusions that can be drawn from these results are limited by the lack of a control group, the potentially biased comparisons between treatment groups because of the lack of randomization, and the potentially biased functional outcomes because of lack of blinding. The reported functional outcomes were categorized based on various outcome scores, nonvalidated scales, and descriptions used in the different case studies. Because no standardized outcome score was used universally, the comparison and categorization of these results may not be entirely accurate. Comparisons between treatment groups are also potentially biased because of different indications for the available treatment options such as severity of dislocation and time between injury and treatment.

Another limiting factor of this study is the possibility of misdiagnosing an epiphysial fracture of the medial clavicule as a sternoclavicular dislocation. Although the clavicle is one of the earliest bones to ossify, the medial epiphysis only begins ossification during the 18th or 20th year, fusing with the clavicular shaft by the 23rd to 25th year. A Salter-Harris Type I or II injury to the medial epiphysis of the clavicle usually occurs before a dislocation of the comparatively stronger sternoclavicular joint in patients younger than 25 years. It is often difficult to distinguish between the two injuries using X-rays or physical examination. Because of the high osteogenic potential of the two raw bone surfaces of an epiphysial separation, patients are expected to heal more rapidly with better results as the bone is remodeled. Therefore, study results of excellent/good in patients younger than 25 years could stem from the fact that many so-called dislocations were actually fractures through the physial plate. Only acute injuries that reported a specific age for the patient were considered as a potential misdiagnosis. The study also assumed that patients treated by ORIF were most likely not candidates for a misdiagnosed epiphysial separation. Of the 124 acute injures treated with nonoperative means or closed reductions, 27 cases (22%) occurred in patients younger than 25 years, of which 14 were anterior dislocations (23% of all anterior dislocations) and 13 were posterior dislocations (25%).

**Evidence-Based Bottom Line**

Based on the current available evidence, we report the following:

**Anterior Versus Posterior**

- The most common treatment for anterior dislocations was nonoperative (44% of reported patients). Excellent or good results were achieved with nonoperative treatment in 69% (36/52; 95% CI, 55–81) of patients with anterior dislocations.
- The most common treatment for posterior dislocations was attempted closed reduction (71% of reported patients). Excellent or good results were achieved in 96% (55/57; 95% CI, 88–99) of patients with posterior dislocations treated by closed reduction or open reduction after a failed closed reduction.
- Symptoms of mediastinal compression accompanied posterior dislocations 30% of the time (24/80), although 23 of 24 patients still achieved excellent/good good results regardless of the choice of treatment. Prompt surgical reduction is crucial in the rare circumstance of laceration of the superior mediastinal organs.

**Open Reduction Treatment**

- For patients treated by open reduction, the failure of an initial closed reduction resulted in functional outcomes no worse than for patients treated without an attempted closed reduction (86% vs. 81%; 95% CI, 69–90). It can be reported with 95% CI that for treatment after a failed closed reduction, the proportion of patients achieving excellent/good results is no more than 14% worse than for treatment without a previous closed reduction.
- Based on the low number of reported open reduction cases in the literature, tenodesis, suture fixation, and ORIF have the largest proportions of excellent/good results without frequently associated high-risk complications. Resection of the medial clavicle and tendon graft has the smallest proportions of excellent/good results, and K-wire/pin fixation is associated with dangerous complications including wire and pin migrations or breakages.

**Acute Versus Chronic**

- Patients with acute dislocations achieved better functional outcomes than patients with chronic dislocations (87.5% [95% CI, 78–94] vs. 73% [95% CI, 61–83] excellent/good results; p = 0.038).
- Acute dislocations treated initially by closed reduction achieved better functional outcomes than if treated...
solely by open reduction (92% vs. 76% excellent/good results, p = 0.069).
• Chronic anterior dislocations treated by open reduction achieved functional outcomes that were not significantly different from dislocations treated nonoperatively (70% vs. 70% excellent/good results, p > 0.999).
• All chronic posterior dislocations were treated by open reduction (7/7 patients, 1 after a previous failed closed reduction).

CONCLUSIONS

Treatments by closed reduction for anterior and posterior dislocations and nonoperative treatment for anterior dislocations are excellent initial treatment options because they are effective and conservative. The option for open reduction is always available should closed reduction fail, and the data have shown that its effectiveness is not negatively affected by a failed closed reduction. If a patient does require an open reduction, tenodesis, suture fixation, and ORIF are all effective and are the recommended open reduction treatments. Although fixation using pins or K-wires often provides excellent/good results in the study, the procedure cannot be recommended as the first choice of open reduction because of the potentially catastrophic complications involving wire or pin migration.

Possibly the most important factor that affects the success of treatment is the duration of time elapsed after the injury. The functional outcomes for patients with acute dislocations are significantly better than for those with chronic dislocations. Therefore, once the diagnosis of sternoclavicular dislocation is made, prompt treatment is optimal. Posterior dislocations accompanied with symptoms of mediastinal compression can achieve satisfactory results with both closed and open procedures if the dislocation is reduced as close to the time of injury as possible.

The data presented in this systematic review provide a wide variety of information useful for determining recommendations for the wide variety of available treatment options. However, the only available articles in the literature were retrospective case series (EBM Level IV). A prospective multicenter randomized clinical trial will be necessary to more accurately define the most appropriate and successful treatment options.

REFERENCES