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Evolution of nonoperative treatment of atraumatic sternoclavicular dislocation

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Background: Atraumatic sternoclavicular dislocation (ASCD) is an uncommon pathology that is mainly diagnosed in young adults. The aim of this study is to better describe the clinical picture of ASCD and to describe the results of a ''wait-and-see'' policy in these patients.

Methods: All patients with ASCD who visited our department between 2011 and 2016 were retrospectively analyzed. A standardized clinical examination was used to evaluate the clinical picture. All patients were treated nonoperatively, and at latest follow-up, several parameters and standardized questionnaires (Nottingham Clavicle Score, Oxford Shoulder Score, Constant-Murley Score) were used to evaluate the outcome.

Results: In total, 23 patients (12 male, 11 female) were evaluated. The average age at diagnosis was 18.6 years. There was a significant difference ($P < .001$) in angle of dislocation during forward flexion (mean = 141°) compared with abduction (mean = 101°). At latest follow-up (average 46 months, range 14-113 months; standard deviation [SD] = 27), subluxations still occurred but were less frequent and less prominent relative to presentation at initial diagnosis in 19 of 23 patients. The chance of subjective improvement increased by 27% for each year of follow-up. High outcome scores of Nottingham Clavicle Score (mean score = 80, SD = 11), Oxford Shoulder Score (mean score = 44, SD = 4), and Constant-Murley Score (mean score = 83, SD = 11) were reported.

Conclusion: In patients with ASCD, the clavicle subluxates earlier in abduction than in forward flexion. After a midterm follow-up, a ''wait-and-see'' policy does not resolve the subluxations. However, most patients displayed reduced frequency and severity of subluxations over their recovery period and showed excellent scores on shoulder questionnaires.

Level of evidence: Level IV; Case Series; Treatment Study

Keywords: Atraumatic; sternoclavicular joint; sternoclavicular dislocation; nonoperative treatment; follow-up; outcome

Sternoclavicular (SC) joint dislocation is a very uncommon injury in comparison with other shoulder girdle injuries.[9,17,26] It can be classified as traumatic or atraumatic.[7,17,18,21] Traumatic dislocation of the SC joint is most likely due to an acute injury with high kinetic energy impact, for example, in contact sports or motor vehicle accidents, where there is a fall on the outstretched hand or a

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direct blow to the shoulder causing the clavicle to dislocate from the manubrium sterni.[9,26] In atraumatic (anterior) SC dislocation (ASCD), the medial end of the clavicle subluxates from the manubrium of the sternum without association or history of trauma.[5,10,26] ASCD usually occurs in young adults during forward flexion (FF) and abduction of the affected arm and is associated with a sensation of clicking, snapping, or popping. When the arm is lowered, spontaneous and relatively painless reduction occurs. These patients consult a doctor not only because of the sudden snapping sound, but also because they are worried about the sudden protrusion of the clavicle. In some cases, subluxation can be associated with some degree of discomfort. However, this discomfort or pain is always mild and rarely interferes with the function of the affected shoulder girdle.[10,18,20,26] Currently, little scientific literature is available on ASCD and its treatment. The uncommon nature of the injury, unfamiliar anatomy of the joint, and outdated scientific research have resulted in inconsistent results with no current consensus on the best treatment approach (operative vs. nonoperative). The aim of our study is therefore to evaluate the clinical picture of ASCD and to evaluate our midterm results of nonoperative treatment of ASCD.

Materials and methods

A retrospective analysis was performed in 23 patients with clinical symptoms of pain, swelling, and clicking sense that were diagnosed with unilateral or bilateral atraumatic anterior dislocation of the SC joint (total of 29 pathologic ASCD shoulders) and seen at our department between 2011 and 2016. Exclusion criteria were patients after operative stabilization or with a posttraumatic SC disease.

In all patients, passive glenohumeral range of motion (ROM), active ROM, and hypermobility using the Beighton score (cutoff value of generalized ligamentous laxity $\geq$4/9) were evaluated at initial diagnosis.[23,25] The passive ROM of the shoulder was examined in the supine position: internal rotation (IR) in abduction (ABD), external rotation (ER) in ABD, IR in adduction (ADD), and ER in ADD were tested.[4] During active ROM FF, lateral arm ABD, arm ADD, and scapulothoracic motion/dyskinesis were tested.[24] During this, changes in ROM, subluxation, or pain perception were recorded. Each clinical examination was captured on video. The visual data obtained during the clinical examination were used to determine and check the correct angle of dislocation, relocation, and ROM.

All patients received an explanation of the pathology and a wait-and-see policy (masterly neglect) was initiated. In case of loss of passive ROM, the patient was provided with, and advised to follow, a written manual with stretching exercises (horizontal stretch and sleeper stretch). There were no data available on the adherence of this advice. In the last 3 months of 2017, all patients were contacted and invited to come to our department for a new (follow-up) clinical evaluation to evaluate our results of nonoperative treatment. Several standardized questionnaires and clinical re-examination were used to evaluate the outcome of nonoperative treatment. In case no clinical re-examination could be performed, outcome was evaluated by conducting a telephone questionnaire. The questionnaire consisted of the subjective feeling of improvement, visual analog scale score, the Nottingham Clavicle Score (NCS), Oxford Shoulder Score (OSS), the Constant-Murley Score (CMS), or patient-derived CMS.[14]

Statistical analyses were performed using SPSS-24 (Statistics Package for Social Sciences; IBM, Armonk, NY, USA). A P value $\leq$.05 was considered statistically significant. All tests were 2-tailed. The continuous parametric variables were examined by means of the Student t-test. The Shapiro-Wilk test, Q-Q plots, or histograms were used to determine if the continuous data followed a normal distribution. To test the correlation between categorical variables the χ^2 test was used. When conditions for the χ^2 test were not met, Fisher's exact test was used. A logistic regression analysis was implemented to substantiate the correlation between outcome and continuous variables.

Results

Our study population consisted of 11 female and 12 male patients (29 ASCD shoulders). The mean age at diagnosis was 18.6 years (range, 13-26 years; standard deviation [SD] = 3). A total of 21 patients were right-hand dominant, and 2 were left-hand dominant. A total of 9 (39%) patients reported dislocations of the SC joint at the right side, 8 (35%) at the left side, and 6 (26%) bilateral. In most bilateral cases, both shoulders were affected unequally with the dislocations initially starting at the dominant side. A total of 17 (71%) patients (95% confidence interval [CI]: 0.51-0.85) suffered from dislocations of the SC joint on their dominant-hand side, or, in the case of bilateral ASCD, patients report more burden of the ASCD at the dominant-hand side. The mean Beighton score was 3.6 out of 9 (range: 0-9; SD = 2.4). A total of 10 (44%) patients were diagnosed with generalized ligamentous laxity, accounting for 55% of women and 33% of men.

Concerning the passive glenohumeral ROM, a limitation of IR in ADD (mean limitation = 10°) was noticed in 7 ASCD shoulders; hereby, there was 1 patient with bilateral ASCD, for whom the limitation was noted in both shoulders. Passive glenohumeral IR in ABD, ER in ABD, and ER in ADD were bilaterally equal. Active ROM was investigated and proved to be maximal in the majority of cases. A total of 17 of 23 patients were able to reach 180° of motion during active FF (median = 180, Q_1 = 175, Q_3 = 180) and ABD (median = 180, Q_1 = 165, Q_3 = 180) of the arm. If there was a restriction of active ROM, this was often limited. It is noteworthy that although the SC joint dislocates in some cases during these motions, full ROM remained possible and painless. Dislocations of the SC joint occurred during mean 141° (SD = 30) of FF and during mean 101° (SD = 19) of ABD of the arm.

A statistically significant difference (P < .001) was found between the angle of dislocation during FF compared with ABD. The mean angle of dislocation during FF was 36° higher compared with ABD (95% CI: 19; 53). No

Table I Representation of dislocation and relocation angles of the SC joint during FF and ABD of the arm

Dislocation/relocation during shoulder movement	Mean (SD)	*P* value
Dislocation FF (°)	141 (30.0)	<.001
Dislocation ABD (°)	101 (18.9)	
Relocation FF (°)	96 (42.3)	.124
Relocation ABD (°)	75 (23.5)	

SC, sternoclavicular; *FF*, forward flexion; *ABD*, abduction; *SD*, standard deviation.

correlation was found between the angle of relocation during FF compared with ABD ($P = .124$; 95% CI: −4. 5; 33) (Table I). We did not see any altered scapular resting position or scapular dyskinesis during clinical examination of the patient.

The mean length of follow-up was 46 months (SD = 27). A total of 19 of 23 patients were re-examined at our department at the latest follow-up; the remaining 4 patients were evaluated by telephone questionnaire. None of the nonoperatively treated patients were asymptomatic, meaning that all patients still reported subluxations at follow-up. However, these subluxations were less frequent, less prominent, and less painful and disturbing relative to patient presentation at initial appointment in 19 (83%) cases. These 19 patients described an improvement of complaints and instability and had no or very mild interference from the dislocations. Furthermore, these patients reported increased strength in pathologic shoulder based on their perception compared with presentation at initial diagnosis. An analysis was performed between the patients reporting no improvement and the patients reporting improvement over time. No association was found between the Beighton score ($P = .963$), age at diagnosis ($P = .788$), and possibility of improvement of pathology. A logistic regression analyses showed a positive trend between improvement and length of follow-up (months). However, this result was not statistically significant ($P = .201$). In this study population, the chance of improvement increased by 4% (odds ratio = 1.04) for each month of follow-up (95% CI: 0.98-1.11) (Fig. 1, *A*). In addition, a positive trend was found for age at follow-up and improvement; this result was also not significant ($P = .280$). In this study population, the chance of improvement increased by 27% (odds ratio = 1.27) for each year of age (95% CI: 0.82-1.95) (Fig. 1, *B*).[1]

In 2 of 7 patients, with loss of passive IR, there was no more limitation noted at the latest follow-up. In 3 patients, there was a loss of passive IR that was not seen at the first consultation. During active ROM there was no difference between the angle of subluxation in ABD or FF compared with first consultation.

Follow-up questionnaire reported an average visual analog scale score of the SC joint during normal activities of 1.6 out of 10 (range, 0-6; SD = 1.4). The highest pain score reported by 1 patient was 6. This patient experienced a high number of dislocations per day (≥100).

The mean NCS was 80 (range, 62-100; SD = 11). A total of 12 patients were classified as having good joint function, and 11 patients as excellent joint function. The average score of the items ''sport interference'' and ''movement or clicking of the collarbone'' were clearly lower in comparison with the other items (average 6.5 in comparison with an average 8.4). Nocturnal symptoms or tingling presented rarely within the study population.

The mean OSS was 44 out of 48 (range, 35-48; SD = 4). A total of 3 (13%) patients reported an OSS of <40, indicating mild-to-moderate joint satisfaction.

The mean CMS for 29 pathologic shoulders/23 patients was 83 (range, 60-99; SD = 11). The mean CMS for the 17 normal, nonpathologic shoulders was 92 (range, 62-100; SD = 9). CMS was significantly higher ($P < .001$) in the normal shoulder, with a mean difference of 6 points compared with the pathologic shoulder (95% CI: 3.1; 8.5). The mean strength for the pathologic shoulder was 17 points (SD = 7), and 19 points (SD = 6) for the normal shoulders. No significant difference in strength points between both shoulders was reported ($P = .079$). When comparing these results with the nonpathologic shoulder (ponderated CMS) and the normal data found in the literature, a division for the CMS per gender was used (Table II).[3,27] No significant difference ($P = .614$) was found in the CMS of the ASCD-dominant shoulder compared with the pathologic nondominant shoulder.

Discussion

Atraumatic SC instability remains a rare diagnosis. Our study evaluated the clinical picture and demonstrated that dislocations occurred at a lower angle during ABD compared with FF. We evaluated 2 possible hypotheses for this finding. The first hypothesis was that in ABD, the pectoralis major muscle or anterior deltoid muscle would produce a greater force and pull at a lower angle on the clavicle, causing the SC joint to dislocate earlier when compared with FF. However, electromyography (EMG) studies of Kronberg et al[11] did not find a greater force of these muscles in ABD as compared with FF. Another hypothesis was that there would be a difference in thoracoscapular motion during FF and ABD and that the force applied to the acromioclavicular (AC) joint, which was then transferred to the SC joint, would be pushing the clavicle sooner forward in ABD than FF. However, literature reports of Meskers et al[16] and McClure et al[15] did not find a difference in tilting of the scapula during ABD compared with FF. Likewise, in case of loss of passive IR, thoracoscapular motion may be altered and cause higher loads on the clavicle. This theory may explain why we reported a high percentage of patients with loss of passive IR in ADD

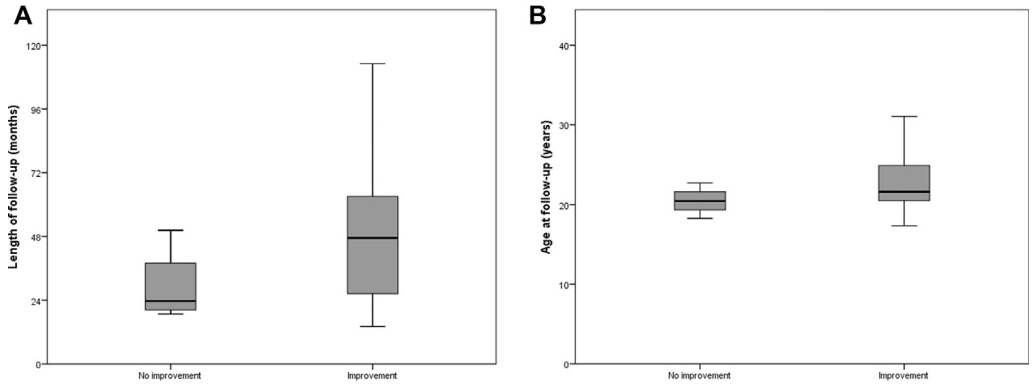

Figure 1 (**A**) Boxplot of the continuous variable: length of follow-up, showing that longer follow-up time is associated with a positive trend for improvement of atraumatic sternoclavicular dislocation (ASCD) pathology. (**B**) Boxplot of the continuous variable: age at follow-up, showing that higher age is associated with a positive trend for improvement of ASCD pathology.

Table II Results of CMS and comparison with normal data, divided by gender

Gender	N	CMS of pathologic shoulder, mean (SD)	Ponderated CMS	Strength (points), mean (SD)	Normal CMS, mean (SD)
Male	15	90 (9)	92	22 (4)	90 (4)-98 (4)
Female	14	77 (10)	95	12 (5)	83 (3)-97 (5)

CMS, Constant-Murley Score;*SD*, standard deviation.

during clinical examination. However, the difference of thoracoscapular motion could not be diagnosed from the clinical point of view, but this may be due to the fact that the difference is too small. Furthermore, no correlation was found between the angle of relocation during FF and ABD. However, it is important to emphasize that the power of this statement (=0.4) is not sufficient because the study population is rather small. Therefore, large-scale, multicentric studies are needed to further investigate the results found in this study.

In our study, patients with ASCD, treated nonoperatively, reported no to very mild pain, good joint functioning, and no discomfort or disability during everyday activities at the latest follow-up. Analyzing the results of the CMS, we conclude that patients reported good active ROM and strength, but a significant difference compared with the normal side. However, Simovitch et al[22] reported that the minimal clinically important difference for the CMS in patients undergoing total shoulder arthroplasty aged <60 years was 8.1 points (95% CI: 7.3-8.9). Likewise, Kukkonen et al[12] reported a minimal clinically important difference in patients undergoing rotator cuff surgery of 10.4 points (95% CI: 9.1-11.7). Correspondingly, the difference of CMS found in our study (average 6 points) is of low clinical significance. Furthermore, it is important to emphasize that in this study more improvement is achieved with longer follow-up time and older age at follow-up for the majority of patients.

Our results confirm the study of Sadr and Swann.[20] In 1979, they investigated 22 patients (mean follow-up length = 8 months) with ASCD. They concluded that no treatment is needed other than simple analgesia and reassurance, as symptoms of discomfort are mild and self-limiting. The main difference is that they reported that this condition seemed to occur predominantly in middle-aged women. This result was not found in our study, nor was this result found in the study of Rockwood and Odor.[18,20] In 1989, Rockwood and Odor[18] investigated 37 patients with ASCD (19 female and 18 male) with the mean length of follow-up of 100 months. A total of 29 patients were treated conservatively. A long-term follow-up study was set up to examine the discomfort, pain, and debilitating side effects of nonoperative treatment. A total of 90% of the patients reported either no limitation of activity, no alteration of lifestyle, or moderate discomfort during the follow-up period. Dislocation at the time of follow-up was usually still notable. A total of 8 patients with operative treatment had unsatisfying results, including noticeable scars, persistent instability, pain, and limitation of activity, eventually resulting in alterations in lifestyle. No statistical data from validated questionnaires or ROM were available. Nevertheless, we can point out some similar and unsimilar findings between the study of Rockwood and Odor and our study. All nonoperatively treated patients of Rockwood and Odor reported that the amount of discomfort that was associated with the initial episodes of dislocations decreased over time and that none reported any limitations of activity or ROM. In our study, only 1 patient reported worse outcome because of hard working conditions, requiring continuous manual labor.

None of our patients reported limitation of main daily activities. However, 7 patients reported the need to stop sporting activities. In both previously mentioned studies, full ROM was possible, even though 90% of patients still reported dislocations at follow-up. The nonoperative treatment of ASCD, consisting of a variety of relative rests, immobilization, nonsteroidal anti-inflammatory drugs (NSAID), or physiotherapy, was also reported in several case reports by Gleason,[8] Di Fabio et al,[5] and Echlin and Michaelson.[6] These case reports reported good results of nonoperative treatment.[5,6,8]

On the other hand, there is a lack of consensus in the literature findings on the operative treatment of ASCD. All patients of Rockwood and Odor who had primary operative treatment reported discomfort and poorer results. The same trend was found in several case reports.[10,17,18,20,26] The outcome of operative treatment has also been described in more recent literature with mixed results. Bae et al[2] presented, in 2006, 15 cases in which either semitendinosus or sternocleidomastoid grafts were passed through the medial clavicle and manubrium in a figure of eight. The medial 2 cm of the clavicle was then resected. Results were very mixed with patients achieving stability, but 40% of patients complained of persistent pain and 85% of patients had to restrict their activities after reconstructive surgery. Overhead throwing, heavy lifting, and sleeping were particularly difficult for many patients.[2] The same was found by Kusnezov et al[13] in 2016, who retrospectively reviewed 14 patients with SC joint dislocations who underwent open-shoulder surgery with ligament reconstruction or figure-of-eight treatment. Kusnezov et al[13] found a total of 6 postoperative complications in 6 patients (35.7%), including recurrent instability, transient scapular winging, and wound problems. Furthermore, Sabatini et al[19] reported that hardware fixation of the SC joint is strongly contraindicated for ASCD, secondary to hardware loosening and migration into mediastinal structures.

When evaluating patients with ASCD, there is currently no standardized questionnaire available in the literature that correctly discusses and measures all aspects of ASCD. When analyzing our results, our research suggests that the NCS is most appropriate to accurately reflect the complaints and the ASCD pathology. The CMS remains important to review general shoulder pathologies, ROM, and strength, which are key features in diagnosis, treatment, and follow-up. However, the lack of an unambiguous, standardized questionnaire for this pathology limits this retrospective study design, because different questionnaires were alternatively used at initial contact. Consequently, questionnaires could not be compared at start and follow-up. In order to compensate this shortfall, we attempted to compose a questionnaire that sought to present this pathology and follow-up as broadly as possible with the aim of reflecting the evolution of pathology based on self-reported outcome and standardized questionnaires.

Conclusion

This study shows acceptable results for the ''wait-and-see'' policy of ASCD. This study suggests the trend of a self-limiting pathology, based on the better outcome reported in patients with longer follow-up and higher age. Most patients who were treated nonoperatively continue to experience dislocations at follow-up. However, for the majority of patients, the number of dislocations and complaints decreased relative to presentation at initial diagnosis. For the moment, no alternative treatment is recommended, because surgical treatment describes poor outcome results.

Disclaimer

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