A commentary by R. Frank Henn III, MD, and Sean J. Meredith, MD, is linked to the online version of this article at jbjs.org.

Teaching Patients How to Reduce a Shoulder Dislocation

A Randomized Clinical Trial Comparing the Boss-Holzach-Matter Self-Assisted Technique and the Spaso Method

F.A. Marcano-Fernández, MD, MSc, Mariano Balaguer-Castro, MD, MSc, F. Fillat-Gomà, MD, MSc, Ona Ràfols-Perramon, MD, C. Torrens, MD, MSc, PhD, and P. Torner, MD, MSc, PhD

Investigation performed at Parc Taulí Hospital Universitari, Universitat Autònoma de Barcelona, Sabadell, Spain

Background: There are many different techniques for reducing acute anterior dislocations of the shoulder, and their use depends on surgeon preference. The objective of this study was to compare the pain experienced by a patient performing a self-reduction technique with the pain felt during a reduction performed by a trained physician.

Methods: The study was carried out at the emergency department of a tertiary referral center. Patients between 18 and 60 years of age with an acute anterior shoulder dislocation were randomly allocated into 2 groups. In 1 group the emergency doctor actively guided the reduction process with the Spaso technique (Sp group), and in the other group the patient used the Boss-Holzach-Matter (also known as Davos or Aronen) self-reduction technique (BHM group). The pain experienced by the patient during the reduction was recorded by means of a visual analogue scale (VAS) ranging from 0 to 10. Other recorded data included demographic characteristics, reduction time, and success rate.

Results: Of 378 patients assessed for eligibility from May 2015 until February 2017, 197 did not meet the inclusion criteria, 58 met exclusion criteria, 22 declined to participate, and 41 withdrew before randomization. Sixty acute anterior shoulder dislocations were randomized into the Sp group (n = 30) or the BHM group (n = 30). The BHM group experienced significantly less pain during reduction than the Sp group (p = 0.047), with mean pain scores of 3.57 (standard deviation [SD] = 2.1]) and 5.26 (SD = 2.9), respectively. No significant difference between groups was found with respect to reduction time (105 seconds [range, 10 to 660 seconds] in the Sp group and 90 seconds [range, 5 to 600 seconds] in the BHM group; p = 0.6) or success rate (67% and 77%, respectively; p = 0.39).

Conclusions: The self-reduction technique results in less pain than, and is as efficient in achieving reduction of anterior shoulder dislocations as, the Spaso technique. These findings favor the use of the self-assisted method as an effective first-line treatment for shoulder dislocations seen in the emergency department as well as its use by patients with recurrent dislocation.

Level of Evidence: Therapeutic Level I. See Instructions for Authors for a complete description of levels of evidence.

Shoulder dislocation is the most common joint dislocation of the body, accounting for >60% of all dislocations treated in the emergency department[1,2]. Epidemiological studies published in the U.S. have cited an incidence of 11.2 to 23.9 per 100,000 person-years[3]. Multiple techniques for reducing these dislocations have been described in the literature[4-8], mostly in case reports and retrospective studies with very few articles comparing techniques in a randomized manner[9-11].

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Most maneuvers require trained personnel to guide and perform the technique, and their success rate has been fairly high. However, many shoulder dislocations occur in remote areas where the individual is participating in sports or outdoor activities and medical personnel might not be available for initial care and treatment[12]. This is important since it has been observed that a delay before the first attempt at reduction of a shoulder dislocation is associated with a lower chance of that reduction being successful[13]. Moreover, many reduction protocols are resource-intensive in that they require sedation and multiple personnel for reduction and monitoring. Thus, there is a need for a simple and effective reduction technique that can be used as a first-line treatment in the emergency department for anterior shoulder dislocations in order to reduce health-care cost and the time until reduction.

Although an abundance of techniques for the reduction of anterior shoulder dislocations have been described, there are not many descriptions of self-assisted maneuvers[4-16], where the patient guides and performs the reduction.

Given the high rate of recurrence of this type of injury, especially in the young population (overall recurrence rate, 90% in patients <21 years of age and 70% in the 21 to 30-year age group[17]), we believe that teaching a self-assisted reduction technique to patients at risk for recurrence may be appropriate. This technique should be simple to explain and easy to perform and have a high success rate and a low complication rate[18,19]. Furthermore, it is speculated that, because self-assisted techniques allow patients to control the process of reduction, they cause less pain[20].

Our goal in this study was to investigate the effectiveness of a self-assisted reduction maneuver in comparison with one performed by a physician at the emergency department of a tertiary level center. The hypothesis was that the self-assisted maneuver would be less painful and equally effective.

Materials and Methods

We carried out a single-center, observer-blinded, 2-year randomized clinical trial in which all acute anterior shoulder dislocations treated in our emergency department from May 2015 until February 2017 were assessed for eligibility. This time period was needed to achieve our previously estimated sample size of 60 patients (30 per group), which we calculated to be necessary to detect a difference of 2 points on a 0 to 10-point visual analogue scale (VAS) (which we determined to be clinically meaningful) at a 2-tailed α of 0.05 and with a power $(1 - \beta)$ of 0.80.

All acute anterior shoulder dislocations in patients between 18 and 60 years of age treated at our center were considered for inclusion in the study. Patients who had a chronic unreduced or posterior dislocation, had an associated fracture, or were unable to follow instructions were excluded from the study. A CONSORT (Consolidated Standards of Reporting Trials) study flowchart can be seen in Figure 1.

Block randomization was accomplished by means of sequentially numbered sealed opaque envelopes that were kept in the emergency department. There was an allocation ratio of 1:1, and the allocation sequence was generated previously by an analyst not affiliated with our orthopaedic department.

Patients who met the inclusion criteria and agreed to participate were randomly allocated to either the Sp group, in which the emergency department physician performed the reduction process with the Spaso technique[21], or the BHM group, in which self-reduction with the Boss-Holzach-Matter technique[16] (Davos[22] or Aronen method) was performed by the patient under the guidance of the emergency department physician. Oral consent to participate was accepted prior to randomization given the difficulty of obtaining written consent, especially if the dominant arm was affected. Afterward, once reduction was completed and the pain had diminished, written consent was obtained.

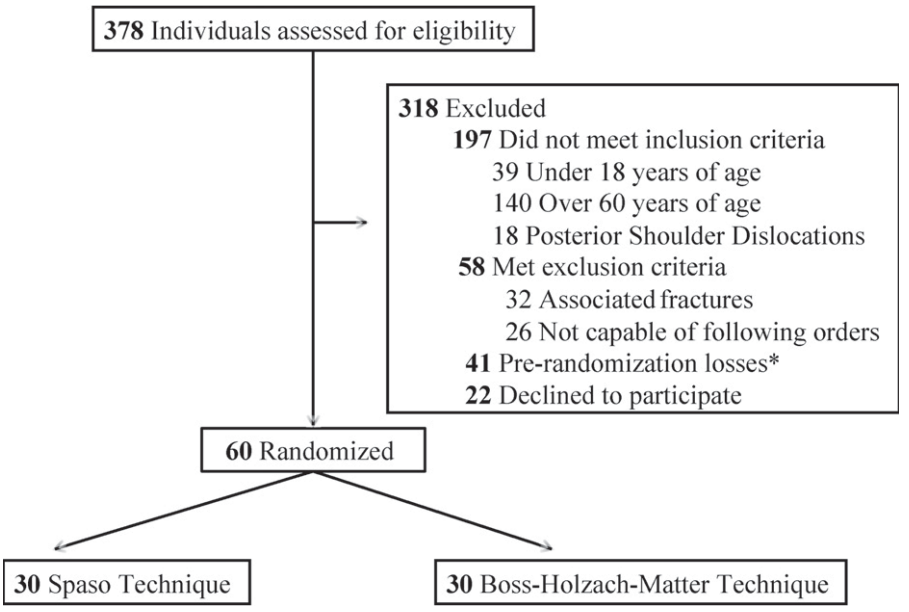

Fig. 1

Study flowchart. *Pre-randomization losses were patients who did not perform the pain assessment or withdrew consent to participate in the study.

The need for intravenous sedation or the use of another technique other than the randomly assigned one was considered a failure of the assigned treatment. These failures were not included in the analysis because a per-protocol model was used.

The primary outcome was the pain experienced by the patient during the reduction technique as recorded on a VAS[23] from 0 to 10 immediately after post-reduction radiographic confirmation. The patients were also asked to rate, on 2 separate VASs, the level of pain experienced at their arrival to the emergency department as well as the maximum level of pain felt at any point throughout the reduction process.

Other recorded data obtained after the reduction procedure included demographic characteristics, side of the dislocation (left or right shoulder), prior dislocations, injury mechanism, any complications, and reduction time.

Radiographic images made before and after reduction were used to confirm the diagnosis and the reduction.

We selected the Spaso method as the physician-guided technique because it is the maneuver primarily used by our emergency department physicians and we wished to ensure homogenization of the series with regard to procedure. First described in 1998, the Spaso technique can be considered a fairly new method about which there are little prospective data[21]. The technique is carried out with the patient supine. The dislocated arm is lifted vertically by grasping the wrist, and gentle traction is applied while the arm is externally rotated gently, as seen in Figure 2. A clunk is felt when reduction is achieved. The reported success rates of this technique have ranged from 67.6% in a prospective study to approximately 85% to 90% in retrospective studies[7,10,11,21,24].

The Boss-Holzach-Matter technique, also known as the Davos or Aronen technique, was selected as the self-reduction method because it was previously described in the literature as being effective and risk-free. First described by Boss, Holzach, and Matter in 1993, this technique is performed by the patient under the guidance of a physician[16]. The patient, seated on the examination table or another hard surface, flexes the ipsilateral knee to 90° and places the foot flat on the table or other surface. With the fingers interlocked about the knee, the patient gently leans backward with the neck hyperextended until the arms are fully extended, producing axial traction. Simultaneously, the patient shrugs the shoulders anteriorly, generating anteversion of the scapula on the axis of traction to facilitate reduction, as shown in Figure 3. Little information concerning the success rate of this reduction technique can be found in the literature, although the original paper reported it to be 60%[16,25]. It was also found to be the most successful technique for reducing subcoracoid anterior dislocations (84.5% success rate) and in patients under 40 years of age (85.3% success rate)[22,25]. However, we are not aware of any prospective randomized study on this procedure.

Recall data were given to an independent analyst, ensuring observer blinding of the results. The information obtained from the study was analyzed using SPSS for Windows (version 16.0; SPSS). Patient characteristics were expressed as the mean and standard deviation or as the number and percentage. The t test and the Mann-Whitney test were used to compare quantitative variables between the 2 groups. The chi-square test was used to analyze categorical data. A p value of <0.05 was considered significant. An intention-to-treat analysis of the data was used.

Fig. 2

During the Spaso technique, the patient lies in a supine position with the arm extended and shoulder flexed to 90°. Longitudinal traction is applied. At the same time, the reduction is initiated by external rotation of the shoulder.

The study received institutional review board approval (CSPTCOT201501), and the protocol was registered at the U.S. National Institutes of Health (ClinicalTrials.gov) with the identifier NCT02527603.

Results

The trial ended and data were analyzed in February 2017, when the previously calculated sample size of 60 patients was accomplished. Of the 60 patients who were allocated to the 2 groups, 53 (88%) were men and 7 (12%) were women; 37 (62%) had a dislocated right shoulder and 23 (38%), a dislocated left shoulder. Thirty-three dislocations (55%) were the patient's first dislocation in that shoulder, while 27 (45%) were recurrent. Of the recurrent cases, 18 (67%) were the second, third, or fourth episode and 9 (33%) were at least the fifth.

Fig. 3

During the Boss-Holzach-Matter technique, the patient sits on the examination table with the lower limb straight. The knee on the same side as the dislocated shoulder is then flexed to 90°, and the patient laces the fingers around this knee. The patient is asked to lean back, while hyperextending the neck, until the arms are fully extended. Simultaneously, the patient shrugs the shoulders anteriorly, generating anteversion of the scapula.

The mean age in the study, in which the age range for inclusion was 18 to 60 years, was 33.4 ± 13.4 years.

Twenty-nine dislocations (48%) were related to sport activities, 9 (15%) were spontaneous low-energy dislocations, 5 (8%) were due to a work-related accident, 1 (2%) was due to a motor-vehicle collision, and 16 (27%) did not fall into any specific category of injury mechanism. A comparison of the baseline characteristics between the 2 treatment groups can be seen in Table I. There were no significant differences between the 2 groups with respect to sex (p = 0.99) or recurrent dislocation (p = 0.607). However, the Sp group was significantly older (p = 0.029), with a mean age of 37.1 ± 15.2 years compared with 29.7 ± 10.1 years in the BHM group. No complications were recorded for either group throughout the study.

Table II presents the results for the main variables. No differences between the groups were found for the success rate,

TABLE I Baseline Characteristics for the Sp and BHM Groups

	Total (N = 60)	Sp Group (N = 30)	BHM Group (N = 30)
Age* *(yr)*	33.4 ± 13.4	37.1 ± 15.2	29.7 ± 10.1
Male†	53 (88%)	26 (87%)	27 (90%)
Female†	7 (12%)	4 (13%)	3 (10%)
First episode†	33 (55%)	15 (50%)	18 (60%)
Recurrent episode†	27 (45%)	15 (50%)	12 (40%)
Mechanism†			
Sports injury	29 (48%)	13 (43%)	16 (53%)
Spontaneous dislocation‡	9 (15%)	5 (17%)	4 (13%)
Work-related	5 (8%)	2 (7%)	3 (10%)
Motor-vehicle collision	1 (2%)	0 (0%)	1 (3%)
Other mechanism§	16 (27%)	10 (33 %)	6 (20%)

*The values are given as the mean and standard deviation. †The values are given as the number of patients with the percentage in parentheses. ‡Low-energy mechanism. §Mechanism not classifiable into any category.

TABLE II Outcomes for the Sp and BHM Groups

	Sp Group (N = 30)	BHM Group (N = 30)	P Value*
VAS score†			
Overall pain	5.26 ± 2.9	3.57 ± 2.1	0.047
Maximum pain	7.12 ± 2.4	5.41 ± 2.6	0.015
Pain on arrival	8.63 ± 1.5	7.97 ± 2.1	0.603
Reduction time† *(sec)*	105 (10-660)	90 (5-600)	0.608
Success rate§	20 (67%)	23 (77%)	0.390

*Mann-Whitney U test, except for success rate, which was analyzed with the chi-square test. †The values are given as the mean and standard deviation. ‡The values are given as the mean with the range in parentheses. §The values are given as the number of patients with the percentage in parentheses.

reduction time, or pain on arrival to the emergency department. However, the patients in the BHM group experienced significantly less overall pain during the reduction procedure, with a mean VAS score of 3.57 ± 2.1 compared with 5.26 ± 2.9 for the Sp group (a difference of 1.69 points [p = 0.047]). Similarly, the mean VAS score for the maximum amount of pain experienced at any point throughout the procedure was significantly lower in the BHM group than in the Sp group (5.41 ± 2.6 compared with 7.12 ± 2.4, a difference of 1.71 points [p = 0.015]).

Discussion

Shoulder dislocation continues to be a common condition in patients presenting to the emergency department[3] and, as was the case in the present series, there is a high prevalence of recurrence.

There is no general agreement on the superiority of any given reduction technique, and its selection normally depends on the physician's preference and previous experience. It is recommended, however, that reduction be done as soon as possible to relieve pain and discomfort as well as to increase the likelihood of the reduction being successful[13].

The most important finding of this study is the high success rate of the self-assisted technique, which was comparable with that of the Spaso technique, performed by a physician. Retrospective studies of the self-assisted Boss-Holzach-Matter technique demonstrated a 60% success rate[16,25], which can be considered fairly low when compared with success rates ranging from 85% to 97% for other techniques[26]. However, the systematic reviews in which the results for the Boss-Holzach-Matter technique were analyzed were based on case series, with a shortage of prospective and randomized data. The results obtained from our randomized sample showed an improvement in the reduction success rate of the self-assisted technique, so that it was equal to that of other techniques that had been deemed more effective[26].

The results confirmed our initial hypothesis. The mean VAS score for pain experienced during the self-assisted technique was almost 2 points lower than that associated with the Spaso technique. The VAS score for the maximum pain experienced at any point in the procedure was also lower, implying a less traumatic experience overall for the patient. This lower pain level may be attributable to the patient's active participation in the process reducing stress and anxiety levels[27] as well as to the level of muscle relaxation that can be achieved by a patient who can control his or her own reduction[20,28]. This technique involves not only traction of the extremity, as many other methods do, but also indirect alignment of the scapula on the reduction axis as the patient relaxes and leans back, which aids in the reduction process as is seen with the scapular-manipulation method[29,30].

There were no short-term complications in our series. Both methods can be done safely for acute dislocation immediately after the patient arrives at the hospital, and the patient can be discharged immediately following the reduction. Furthermore, there is no requirement for intravenous anesthesia in the majority of cases treated with either technique, which decreases the anesthetic hazards.

The characteristics mentioned above make the Boss-Holzach-Matter self-assisted maneuver an excellent health education tool for young patients with a risk of recurrence. These patients can learn the technique and perform it on themselves successfully in case of injury in remote places, decreasing the time to reduction, pain experienced, and anxiety level. Because of its simplicity, it is also useful when the first person to give attention to the dislocation has little experience with other reduction techniques. This technique can reduce the number of emergency department visits with a subsequent reduction in health-care costs.

A limitation of this study was an important number of pre-randomization losses of patients from the study, and a larger number of patients should be enrolled in subsequent studies in order to clarify these findings. Other limitations of this study include the facts that it was performed at a single center and there was a significant age difference between the 2 groups. The younger mean age of the patients performing the self-assisted technique could be a source of error in the final results. Recurrence could also potentially influence the results since recurrent dislocations are often less painful and hence are sometimes considered easier to reduce. We used a multivariate linear regression model with the pain experienced (both overall pain and maximum pain) as the response variable and the technique as the explanatory variable in order to evaluate the confounding effect of both age and recurrence. The results indicated that neither of these variables was significant in the

model, and hence we can conclude that the confounding effect of age and recurrence was negligible.

It can also be argued that the age difference between the 2 groups could be attributed to the fact that failed reduction attempts were not taken into account in the final analysis since a per-protocol model was used. However, this age difference was present before exclusion of the failed reduction attempts, and the failure rate was similar in the 2 groups. We can conclude, therefore, that randomization failed to balance both groups with respect to age, probably because the sample size was small.

It should also be noted that mainly hospital residents performed or supervised the reductions in the study, and learning curves were not taken into account. The influence of Hill-Sachs lesions and osseous Bankart lesions, or of the subtype of anterior dislocation, was not investigated.

In conclusion, the findings of this study support the use of the Boss-Holzach-Matter technique for the reduction of anterior shoulder dislocations. It was found to be an effective, complication-free maneuver that is well tolerated by patients, and we advocate its use as a first-line treatment in the emergency department or in a pre-hospital environment as well as teaching the technique to patients at risk for recurrence. ■

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F.A. Marcano-Fernández, MD, MSc[1]
Mariano Balaguer-Castro, MD, MSc[1]
F. Fillat-Gomà, MD, MSc[1]
Ona Ràfols-Perramon, MD[1]
C. Torrens, MD, MSc, PhD[2]
P. Torner, MD, MSc, PhD[1]

[1]Orthopedic Department, Parc Taulí Hospital Universitari, Institut d'Investigació i Innovació Parc Taulí I3PT, Universitat Autònoma de Barcelona, Sabadell, Spain

[2]Orthopedic Department, Hospital del Mar de Barcelona, Universitat Autònoma de Barcelona, Barcelona, Spain

E-mail address for F.A. Marcano-Fernández: francescmarcano@gmail.com

ORCID iD for F.A. Marcano-Fernández: 0000-0001-5690-631X

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