Clinical Significance of the V-Shaped Space in the Subluxed Shoulder of Hemiplegics

A. Bertrand Arsenault, PhD; Martin Bilodeau, MSc; Elisabeth Dutil, MSc; and Elisabeth Riley, BSc

Recently, it has been proposed that shoulder subluxation in hemiplegia is accompanied by 1) the appearance of a V-shaped articular configuration occurring between the humeral head and glenoid fossa and 2) the presence of chronic pain. The main purpose of this study was to investigate the validity of these statements. We evaluated 40 hemiplegic subjects over 3 months. Radiographs of the affected and nonaffected shoulders were taken at both a frontal plane (0°) and a 45° incidence. From these patients, subluxed (n=19) and nonsubluxed (n=21) groups were formed. Pain was evaluated using the Present Pain Intensity index of the McGill Pain Questionnaire. On these x-ray films, measurements were taken of the V-shaped space, abduction of the arm, and rotation of the scapula. The statistical analysis (analysis of variance for repeated measures) contrasted the results obtained from the nonaffected side with those from the affected side over the 3 months studied. At the 45° angle, which better exposes the articular configuration of the shoulder, the difference in the V angle between the affected and nonaffected shoulders was significant (p<0.01), indicating that such a V-shaped space can be identified. The measures taken also indicate that a downward subluxation of the humeral head occurs relative to the scapula without any systematic abduction of the humerus or downward rotation of the scapula. None of the results obtained from the frontal plane x-ray films was significant. Finally, no significant relation was found between subluxation and shoulder pain. (Stroke 1991;22:867-871)

The literature on hemiplegia suggests that a subluxed shoulder is accompanied by an abduction of the arm and a downward rotation of the scapula.1,2 It has recently been proposed that these clinical observations are accompanied by the appearance of a V-shaped articular configuration occurring between the humeral head and the glenoid fossa.3 The suggestion was made that such a V-shaped configuration could be considered as a clinical sign indicating the development of a shoulder subluxation. Such a sign would obviously be attractive as a clinical tool if it is strongly associated with the presence or development of shoulder subluxation, an important clinical problem in hemiplegia.

Furthermore, it has been suggested that the presence of this V sign is strongly associated with the presence of chronic pain at the level of the subluxed shoulder.3 From the $\chi^2$ value of 8.1 obtained by Shai et al3 while contrasting these two variables, we calculated a $\Phi$ (coefficient of association) of 0.68, a value rather significant.4 Clinically, however, one can argue against this finding since it is well known that a patient can develop a subluxed shoulder without having pain. This issue of shoulder pain in hemiplegia is in itself a topic lacking clear answers based on scientific evidence.

The purpose of this study was to investigate the validity of this V sign. Furthermore, its association with pain was evaluated using one index taken from the McGill Pain Questionnaire.5

Subjects and Methods

Forty hemiplegic subjects (22 men and 18 women with a mean±SD age of 46.5±13.8 years) participated in this study. Nineteen subjects were right hemiplegics. They were evaluated before, during, and after treatment over a period of approximately 3 months.

With the subject seated, arms dependent in a neutral position, radiographs of the affected and nonaffected shoulders were taken in an anteroposterior (A–P) projection as well as with the beams at 45° (i.e., parallel to the glenoid fossa). Two anatomic...
reference points (i.e., the apex of the humeral head and the inferior border of the glenoid fossa) taken on each film were used to evaluate the state of the glenohumeral joint. A perpendicular line was drawn from the apex of the humeral head to a horizontal line passing through the inferior border of the glenoid fossa. A difference of 1 cm between the lines drawn (on the 45° angle films) between the affected and nonaffected shoulders was interpreted as reflecting a subluxed state. Consequently, groups of subluxed \((n=19)\) and nonsubluxed \((n=21)\) subjects were formed. In the subluxed group 12 subjects had their left side affected, while in the nonsubluxed group nine had their left side affected, while in the nonsubluxed group nine had their left side affected. For each group and each angle measured, a one-way analysis of variance (ANOVA) for a repeated-measures design was performed on the data of the nonaffected (one score) and affected (three scores; before, during, and after treatment) shoulders. In this way, a given subject acts as his own control; that is, the affected shoulder is evaluated relative to the nonaffected shoulder.

On these films, the V-shaped angle, the angle of abduction of the arm, and the angle of rotation of the scapula were also measured. Figure 1 represents how these measurements were taken. Since a procedure for measuring the V sign angle had not been described previously, such a procedure had to be developed. The V sign angle is here defined as the angle made by a line passing through the superior and inferior borders of the glenoid fossa and a line passing through the apex of the humeral head and the inferior portion of its anatomic neck. This angle was called \(\theta_1\). These anatomic reference points were chosen on the basis that they are easily identified on most x-ray films. As well, since the two lines forming the angle have no point in common on a given segment, they are independent, thus offering a best estimate of the angle sought. The angle of rotation of the scapula is evaluated as the angle made by a line passing through the superior and inferior borders of the glenoid fossa and the horizontal line already recorded on the film. This angle is identified as \(\theta_2\) and \(\theta_3\). The center of the humeral head \((E\) in Figure 1\) was estimated as being the center of a circle that would best fit the humeral head. It should be noted here that \(\theta_2\) and \(\theta_3\) are made to be independent measures. Thus, the measurement of one is not affected by changes occurring in the other. Finally, another measure, \(\theta_4\), was taken. This angle is defined as being made by a line passing through the inferior and superior borders of the glenoid fossa and a line passing through the inferior border of the glenoid fossa and a point on the head of the humerus on which this line falls tangentially. These two lines have one reference point in common (the inferior border of the glenoid fossa) and in this way may be perceived as being dependent. Thus, \(\theta_4\) is to be contrasted with \(\theta_1\) for their respective sensitivities in measuring the presence of the V-shaped space. The procedures for positioning of the subject and taking of the x-ray film have been reported elsewhere.

The Present Pain Intensity (PPI) index of the McGill Pain Questionnaire was used to evaluate the intensity of pain in this population. Scores on this PPI index range from 0 (no pain) to 5 (severe pain). Subjects who scored 0 to 1 were classified as having no chronic pain. Those scoring 2, 3, 4, or 5 were considered as having chronic pain. In this way a 2 x 2 contingency table of subluxed versus nonsubluxed subjects and chronic versus no pain could be constructed, as had been done previously. All scores were obtained by one or two evaluators trained in the use of the PPI index.

**Results**

Table 1 presents the results obtained with ANOVAs for a given level of significance \((\alpha=0.01)\). None of the results obtained from the A-P films was significant. Because of the superposition of bony structures of the shoulder, it was impossible in most cases to calculate \(\theta_4\) on the A-P film. However, on the 45° angle films the difference in \(\theta_1\) between the affected and nonaffected shoulders was significant for both groups, with an average difference of about 5°. Furthermore, \(\theta_4\) showed significant differences only for the subluxed group, thus showing sensitivity to the subluxed state. Finally, the subluxed group had a significant difference in \(\theta_3\), with an average differ-
Table 1. Summary of Analyses of Variance Performed on $\theta_1$, $\theta_2$, $\theta_3$, and $\theta_4$ for Subluxed and Nonsubluxed Groups

<table>
<thead>
<tr>
<th>Angle</th>
<th>Nonsubluxed (n=21)</th>
<th>Subluxed (n=19)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$R^2$</td>
<td>IC coefficient</td>
</tr>
<tr>
<td>$\theta_1$</td>
<td>0.05</td>
<td>0.85</td>
</tr>
<tr>
<td>$\theta_2$</td>
<td>0.01</td>
<td>0.98</td>
</tr>
<tr>
<td>$\theta_3$</td>
<td>0.00</td>
<td>0.99</td>
</tr>
<tr>
<td>$\theta_4$</td>
<td>...</td>
<td>...</td>
</tr>
</tbody>
</table>

Table 2. Descriptive Statistics Summarizing Data for $\theta_1$, $\theta_2$, $\theta_3$, and $\theta_4$ for Subluxed and Nonsubluxed Groups

<table>
<thead>
<tr>
<th>Angle</th>
<th>Nonsubluxed group (n=21)</th>
<th>Subluxed group (n=19)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td>$\theta_1$</td>
<td>22.7</td>
<td>7.8</td>
</tr>
<tr>
<td>$\theta_2$</td>
<td>84.5</td>
<td>6.9</td>
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<tr>
<td>$\theta_3$</td>
<td>98.3</td>
<td>4.7</td>
</tr>
<tr>
<td>$\theta_4$</td>
<td>0.3</td>
<td>5.7</td>
</tr>
</tbody>
</table>

Table 3. Summary of Results of 2x2 Contingency Table Contrasting Presence/Absence of Pain and Presence/Absence of Shoulder Subluxation

<table>
<thead>
<tr>
<th>Subluxation</th>
<th>Chronic pain</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>9</td>
<td>9</td>
<td>12</td>
</tr>
<tr>
<td>No</td>
<td>8</td>
<td>12</td>
<td>12</td>
</tr>
</tbody>
</table>

Discussion

Even though our results reveal that a radiograph taken at a 45° angle may be more sensitive for evaluating the state of a hemiplegic shoulder, it is clear that the magnitude of the differences found is clinically unimportant. The $R^2$ values of Table 1 and the results of Table 2 disclose this fact for $\theta_1$, $\theta_2$, and $\theta_3$. Moreover, since both the subluxed and nonsubluxed groups presented a significant difference for presence of the V sign as measured by $\theta_1$, the validity of the sign in indicating a subluxation is questionable. Either this measure is not sensitive to this particular state of the shoulder or ANOVA for repeated measures is too sensitive to small differences that clinically are within the range of human error.

However, $\theta_4$ appeared to be more sensitive to presence of the V-shaped space in subluxed shoulders. Let us consider that abduction of the arm can be appropriately measured on an A-P film. As seen in Table 1, no abduction of the arm was observed in the A-P projection. Moreover, let us consider that the possible downward rotation of the scapula that is believed to occur with shoulder subluxation can be best measured on the 45° angle film since we can clearly observe the profile of the glenoid fossa. As seen in Table 1 again, $\theta_2$ did not reach the level of...
significance. Consequently, the downward subluxation was not accompanied by a rotation of the scapula and an abduction of the humerus. This may explain why O1 did not detect the presence of the V-shaped space since the C-D line (Figure 1) was simply shifted downward along the A-B line, keeping its angle more or less constant. However, O4 disclosed this V-shaped space, which is created by a downward movement of the head of the humerus relative to the glenoid fossa, a movement followed by the tangential line G-H (Figure 1). This phenomenon can, according to our experience, be observed only on a 45° angle film and not on an A-P film or radiograph as proposed earlier.

FIGURE 2. Top: Radiograph taken in frontal (anteroposterior) plane of subluxed shoulder. Bottom: Radiograph taken at 45° angle of subluxed shoulder.

Our previous work on this topic disclosed the fact that rotation of the scapula and abduction of the arm are not phenomena systematically related to subluxation of the shoulder in hemiplegia. Even though these are interpreted as being clinically important signs by practitioners, scientific evidence has not yet been presented to support this belief.

The fact that pain is not statistically associated with subluxation is not really surprising (Table 3). Many factors other than subluxation can cause pain.
in hemiplegic shoulders. Furthermore, even patients with an impressive degree of subluxation may have no pain. Previous papers have at times been vague on how pain was quantified.

It is our belief that the PPI index of the McGill Pain Questionnaire is applicable to a good proportion of the hemiplegic population, at least to that proportion that participates on a day-to-day basis in an intensive rehabilitation program. We are thus confident that our way of scoring the intensity of pain felt at the time of evaluation is more than acceptable for the present situation. The literature on shoulder pain in hemiplegia is, however, still awaiting answers and clarifications.

In conclusion, the search for a clinically valid sign and model to describe and understand the appearance and progression of shoulder subluxation is very commendable and necessary. However, any proposed sign and model need to be validated before being used in clinical practice. Our present attempt has been partially successful with regard to validating the previously proposed V sign and is complementary to our previous work on the topic.

The complexity of the hemiplegic condition and the high variability between subjects for variables such as shoulder pain and shoulder subluxation have to be recognized by the clinician and the researcher alike. Thus, standardized evaluation protocols have to be developed, validated, and used by everyone in this field. Only then will our efforts produce progress toward a better understanding of this important clinical problem.

Acknowledgments

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References


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