ORIGINAL ARTICLE

Anterior shoulder instability arthroscopic treatment outcomes measures: The WOSI correlates with the Walch-Duplay score

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Summary
Purpose: New techniques and instrumentation for arthroscopic management of shoulder instability require accurate measurement tools to investigate possible clinical improvements. The aim of the study was to assess the self-administered Western Ontario Shoulder Instability Index (WOSI), which is a subjective quality of life measurement tool specific to shoulder instability, and also to validate this score by comparison with the Walch-Duplay score, which is the gold standard score used in Europe. These two scores had never been compared.

Methods: Forty-eight patients, who underwent arthroscopic surgery for anterior shoulder instability, were evaluated using the WOSI and the Walch-Duplay score at 42.7 months’ follow-up. The correlation between these two scores was investigated.

Results: The WOSI significantly correlated with the Walch-Duplay score (global score, and specific items of pain, stability, return to activity). The standard correlation coefficient was 0.8 and the Lin correlation coefficient was 0.65. The WOSI did not correlate with the mobility item of the Walch-Duplay score.

Discussion: The WOSI was found to correlate with the Walch-Duplay score. However, the WOSI was more sensitive than the Walch-Duplay score for the assessment of patient satisfaction. It is likely that both self-administered questionnaires and physical examinations are complementary for an accurate investigation of the functional objective and subjective outcome after shoulder stabilization surgery.

Type of study: Retrospective. Level IV.
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Introduction

The risk of traumatic dislocation of the shoulder has been estimated at 1–2% in a lifetime [1–3]. The growing interest for this pathology and the improvement of arthroscopic techniques stimulated the multiplication of innovative procedures. Slight changes in the techniques and instrumentation require accurate evaluation tools in order to demonstrate clinical improvements [4].

The European Society of Shoulder and Elbow Surgery recommended using the Walch-Duplay score [5] which was inspired by the Rowe rating scale [6] and takes into account both subjective and objective data (stability, pain, sport level recovery, mobility) to assess clinical outcome. However, the observer’s interpretation remains a source of potential bias, since it is not self-administered [7]. Indeed, many authors [8,9] proved that subjective evaluation using self-administered questionnaire was mandatory to assess patient satisfaction.

The self-administrated Western Ontario Shoulder Instability Index (WOSI) is a quality of life measurement tool specific to shoulder instability. It was developed by A. Kirkey in 1998 [10] and is widely used [11–13]. The 21 most informative questions out of the 300 that were tested have been kept in the definitive version. The WOSI was successfully compared with the Rowe rating scale, the UCLA shoulder rating scale, the Constant score, the SF-12, the Disability of the Arm, Shoulder and Hand scale (DASH), and the American Shoulder and Elbow Surgeons Standardized Shoulder Assessment Form. The Walch-Duplay score is the most currently used score in Europe for the assessment of the patient undergoing shoulder stabilization surgery [14–16]. However, it is not a self-administrated questionnaire. To our best knowledge, no series investigated the relationships between the WOSI and the Walch-Duplay score. The aim of this study was to compare the WOSI and the Walch-Duplay score in a group of patients undergoing an arthroscopic surgery treatment for anterior shoulder instability. The correlation between these two scores was analyzed. The results may help optimize the functional evaluation of patients in daily surgical activity, by including subjective self-evaluation in objective scores.

Methods

Cohort description

Forty-eight consecutive patients (36 men and 12 women), who had arthroscopic surgery for anterior shoulder instability between May 1997 and December 2000, were reviewed retrospectively. The number of patients available for follow-up was 79% (37 patients). The average age at the time of surgery was 30.7 years (16 to 57). The operated shoulder was on the dominant side in 41 cases. Thirty-five patients practiced a sport, 25 of them throwing. The medical history began with an effective shoulder dislocation in 24 cases, subluxation and painful unstable shoulders in 24 patients. Thirty-three patients had a Hill-Sachs lesion, including 16 cases that had a lesion depth above 15% of the humeral head diameter. There was a bony lesion of the glenoid fossa in 28 cases. The average duration between the initial event and the surgical treatment was 51.8 months (range 0 to 288).

Methods

The patients were reviewed by an independent observer. The average follow-up was 42.7±24 months (range 27 to 71). The Walch-Duplay score (0 to 100 points) and the WOSI [17] (0 to 2100 points) (Appendix A) were recorded at the last follow-up. The Walch-Duplay score is composed of four items: activity, stability, pain and mobility. According to the Walch-Duplay score, results were classified as excellent (91 and 100 points), good (76 and 90 points), fair (51–75 points) or poor (under 50). The WOSI consists of four subscales: physical symptoms and pain; sport, recreation, and work function; lifestyle and social functioning; and emotional well-being. Twenty-one items are scored using a visual analogue scale measuring 100 mm horizontally placed under each question. This questionnaire requires a minimum of explanations to the patient for the filling of scales. The best possible score indicating the highest possible shoulder-related quality of life is 0 and the worst possible score indicating the poorest quality of life is 2100.

There were four recurrent dislocations and six recurrent subluxations. The average time between surgery and recurrence was 17.7± months (4 to 36). Four patients underwent a surgical revision using an open conventional technique. The Walch-Duplay score and the WOSI were not recorded at the last follow-up for these patients. The average Walch-Duplay score was 74.8 (5 to 100). The average WOSI was 335 (7 to 1338). At the last follow-up, 37 patients (77%) declared being satisfied with surgery.

Statistical analysis

The statistical analysis was performed at the biostatistics department of Paris VI University. For quantitative parameters, the correlation between Walch-Duplay score and the WOSI was investigated using the standard correlation test (linear regression), the Lin concordance method [18] and the Bland and Altman method for assessing agreement between two methods of clinical measurement [19,20]. Concerning qualitative parameters, the non-parametric Kruskal-Wallis test was used in order to compare the WOSI between the four groups corresponding to the Walch-Duplay stratification (excellent, good, fair, poor). A P-value of 0.05 was used for significance.

Results

The statistical analysis of correlation of these two scores is multiple. The values of WOSI, expressed in % by the formula [(1−WOSI/2100)*100], were correlated in the values of Walch-Duplay with a correlation coefficient of 0.79 (r² = 0.63; 0.41 to 0.78). On the Fig. 1 are indicated the values of the WOSI and Walch-Duplay scores and the identity line (WOSI = Duplay). The correlation line should get closer to this identity line if the Walch-Duplay and WOSI scores were two different instruments to measure the same quantity. The concordance correlation coefficient of Lin Li [18]
was 0.648 (0.505–0.792 P < 0.0001) and was statistically different from 0. It thus indicates that there was a certain concordance between both measures, but not total, in which case would be close to 1.

The method of Bland and Altman [20] consists in comparing for every measure the difference between the obtained values and the average of two values. If two values are identical, the graph of values differences according to the average of the values is a line parallel to the x-axis and the value on the y-axis is 0 (Fig. 2). As regards the WOSI and Walch-Duplay scores, the average of the differences was 9.7 ± 32. We can consider that indistinctness tended to be small. The intraclass correlation coefficient was 0.65 (0.389–0.911) which can be considered as good agreement Table 1 [20].

The Walch-Duplay score was graded as excellent in 11 cases, good in 16 cases, fair in eight cases, and poor in nine cases. The corresponding WOSI was respectively 85 ± 66, 183 ± 162, 528 ± 405, and 740 ± 176 (Table 2). There was a significant correlation between the Walch-Duplay score stratification and the WOSI (P < 0.001). For every specific item of the Walch-Duplay score (stability, pain, mobility and return to activity), the WOSI was calculated for each functional result of these items (Table 3). WOSI significantly correlated with the subjective items of the Walch-Duplay score (stability, pain, and return to activity), but not with the objective item of mobility (Table 3). Subjective evaluation was correlated with the Walch-Duplay score (81 ± 22 in the satisfied group vs 41 ± 20 in the disappointed group) and the WOSI (263 ± 296 in the satisfied group vs 715 ± 336 in the disappointed group) (P = 0.02) (Table 4).

Replacing the global value of the WOSI (2100 points) by four identical classes (0–525/526–1050/1051–1575/1576–2100) to verify the correlation with the Walch-Duplay score, which is used with four classes, the value of kappa was 0.19, certainly statistically different from 0, but tenuous (Table 5).

**Discussion**

Recurrence is not the only indicator for success/failure after arthroscopic shoulder stabilization [12]. While the basic evaluation of satisfaction/disappointment may summarize the proper opinion of the patient, the wide distribution of data in terms of the Walch-Duplay score or the WOSI demonstrates that results are not clear-cut. Therefore, accurate grading systems are necessary to quote the benefits of the surgical procedure precisely. This may particularly be difficult concerning shoulder instability, with the main complaint leading to surgery being subjective. In addition, the accuracy of patients’ status grading may particularly be important, since various technical details in the arthroscopic procedure and the instrumentation (limits of dissection and

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**Table 1** Standard intraclass correlation coefficient interpretation.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Correlation Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>&gt; 0.81</td>
</tr>
<tr>
<td>Good</td>
<td>0.80–0.61</td>
</tr>
<tr>
<td>Fair</td>
<td>0.60–0.41</td>
</tr>
<tr>
<td>Poor</td>
<td>&lt; 0.40</td>
</tr>
</tbody>
</table>

**Table 2** Global Walch-Duplay and Western Ontario Shoulder Instability Index (WOSI) scores.

<table>
<thead>
<tr>
<th>Group</th>
<th>WOSI ± 95% CI</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>11 (25%)</td>
<td>85 ± 66</td>
</tr>
<tr>
<td>Good</td>
<td>16 (37%)</td>
<td>183 ± 162</td>
</tr>
<tr>
<td>Fair</td>
<td>8 (18%)</td>
<td>528 ± 405</td>
</tr>
<tr>
<td>Poor</td>
<td>9 (20%)</td>
<td>740 ± 176</td>
</tr>
</tbody>
</table>

* N = 44 (100%)
Anterior shoulder instability arthroscopic treatment outcomes measures

**Table 3** Specific Walch-Duplay score items and the Western Ontario Shoulder Instability Index (WOSI). For every specific item of the Walch-Duplay score (stability, pain, mobility and return to activity), the WOSI was calculated for each functional result of these items.

<table>
<thead>
<tr>
<th>Stability</th>
<th>Western Ontario Shoulder Instability Index (WOSI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>$143 \pm 137$</td>
</tr>
<tr>
<td>Good</td>
<td>$533 \pm 382$</td>
</tr>
<tr>
<td>Fair</td>
<td>$732 \pm 341$</td>
</tr>
<tr>
<td>Poor</td>
<td>$768 \pm 305$</td>
</tr>
<tr>
<td>Pain</td>
<td></td>
</tr>
<tr>
<td>No pain</td>
<td>$227 \pm 271$</td>
</tr>
<tr>
<td>Pain for extreme mobility</td>
<td>$453 \pm 377$</td>
</tr>
<tr>
<td>Daily pain</td>
<td>/</td>
</tr>
<tr>
<td>Mobility</td>
<td></td>
</tr>
<tr>
<td>Excellent</td>
<td>$264 \pm 253$</td>
</tr>
<tr>
<td>Good</td>
<td>$434 \pm 427$</td>
</tr>
<tr>
<td>Fair</td>
<td>$534 \pm 539$</td>
</tr>
<tr>
<td>Poor</td>
<td>/</td>
</tr>
<tr>
<td>Activities recovery</td>
<td></td>
</tr>
<tr>
<td>Excellent</td>
<td>$146 \pm 160$</td>
</tr>
<tr>
<td>Good</td>
<td>$489 \pm 353$</td>
</tr>
<tr>
<td>Fair</td>
<td>$736 \pm 420$</td>
</tr>
<tr>
<td>Poor</td>
<td>$715 \pm 230$</td>
</tr>
</tbody>
</table>

reinsertion, choice of anchors, types of suture wires) can dramatically influence the outcomes. Objective evaluation by the surgeon can reveal huge complications of the treatment, such as a neurological deficit and limitation of passive range of motion. However, subjective items are more relevant for assessing the actual benefits of surgery on the initial complaints of instability and pain. In this purpose, the WOSI has been developed as a disease-specific quality of life questionnaire, promoted by A. Kirkley [10]. The WOSI is a rigorously designed and evaluated measurement tool for patients with shoulder instability. It has been shown to be highly reliable, has been validated in this population, and has shown excellent responsiveness in patients with anterior and posterior instability. Since the form is self-administrated, no bias of interpretation by the physician (mainly overestimation of the good results) is theoretically possible. The WOSI shows more sensitivity than the ASES and DASH scales to assess functional results after surgical stabilization of the shoulder [21]. Detractors suggest using the WOSI for non-sporty people and amateur sportsmen only [22], since return to the initial sport level, which would be the best outcome measure in athletes, was taken into account in the DASH Outcome Measure, but not in the WOSI.

The benefit of the WOSI is very important and its translation is authorized in Swedish and German [13,23]. The Walch-Duplays score, both objective and subjective, is the reference score in Europe to evaluate shoulder instability. It had never been compared with the WOSI.

The correlation between the Walch-Duplay score and the WOSI is strong. The better the Walch-Duplay score is, the lower the WOSI is. Standard deviations can be important, but they take into account the high value of the WOSI on 2100 points. Nevertheless, the subjective character of this score increases naturally the scattering of data and their indistinctness.

We demonstrate the self-administrated WOSI significantly correlates with the physician-administrated Walch-Duplay score, in terms of global scores and specific items of stability, pain, and return to activity. This retrospective study confirms a correlation of two postoperative scores. The limitation is in the assessment of shoulders’ range of motion, which requires a physical examination. We recommend using both scores (one being totally subjective and self-administrated, the other one being objective and subjective) to measure all the functional disturbances, in

**Table 4** Subjective score results.

| Satisfied       | 37 (77%) |
| Fair and poor   | 11 (23%) |

<table>
<thead>
<tr>
<th>Duplay</th>
<th>Western Ontario Shoulder Instability Index (WOSI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$81 \pm 22$</td>
<td>$263 \pm 296$</td>
</tr>
</tbody>
</table>

Kappa = 0.1983 ± 0.0835

<table>
<thead>
<tr>
<th>Kappa interpretation</th>
<th>Less than 0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tenuous</td>
<td>0.00–0.20</td>
</tr>
<tr>
<td>Poor</td>
<td>0.21–0.40</td>
</tr>
<tr>
<td>Moderate</td>
<td>0.41–0.60</td>
</tr>
<tr>
<td>Good</td>
<td>0.61–0.80</td>
</tr>
<tr>
<td>Virtually perfect</td>
<td>0.81–1.00</td>
</tr>
</tbody>
</table>

WOSI for non-sporty people and amateur sportsmen only [22], since return to the initial sport level, which would be the best outcome measure in athletes, was taken into account in the DASH Outcome Measure, but not in the WOSI.

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**Table 5** Western Ontario Shoulder Instability Index (WOSI) and Walch-Duplay scores correlation and Kappa interpretation.

<table>
<thead>
<tr>
<th>Western Ontario Shoulder Instability Index (WOSI)</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>5</td>
<td>2</td>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>1</td>
<td>4</td>
<td>11</td>
<td>16</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>10</td>
<td>11</td>
</tr>
<tr>
<td>Total</td>
<td>3</td>
<td>8</td>
<td>11</td>
<td>22</td>
<td>44</td>
</tr>
</tbody>
</table>

Kappa = 0.1983 ± 0.0835

<table>
<thead>
<tr>
<th>Kappa interpretation</th>
<th>Less than 0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tenuous</td>
<td>0.00–0.20</td>
</tr>
<tr>
<td>Poor</td>
<td>0.21–0.40</td>
</tr>
<tr>
<td>Moderate</td>
<td>0.41–0.60</td>
</tr>
<tr>
<td>Good</td>
<td>0.61–0.80</td>
</tr>
<tr>
<td>Virtually perfect</td>
<td>0.81–1.00</td>
</tr>
</tbody>
</table>
particular, the small abnormalities whose screening makes all the quality of a functional score.

As a conclusion, it is likely that both types of evaluation are complementary. The present correlation between the WOSI and Walch-Duplay scores reinforces the confidence in the WOSI to assess the clinical status of the patient suffering from shoulder instability, with emphasizing assessment of quality of life. We recommend using the WOSI in addition to the Walch-Duplay score in future studies concerning shoulder instability to combine patients’ and surgeon’s points of view in order to refine the evaluation of surgical techniques.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

Appendix A.

Original WOSI. Twenty-one items are scored using a visual analogue scale measuring 100 mm horizontally placed under each question.

Instructions to patients

In Sections A, B, C, and D you will be asked to answer questions in the following format and you should give your answer by putting a slash ‘/’ across the horizontal line.

Note:
1. If you put a slash ‘/’ at the left end of the line, i.e. no pain / ___________________________ extreme pain then you are indicating that you have no pain.
2. If you put your slash ‘/’ at the right end of the line, i.e.

no pain ___________________________ / extreme pain then you are indicating that your pain is extreme.
3. Please note:

(a) that the further to the right you put your slash ‘/’, the more you experience that symptom;
(b) that the further to the left you put your slash ‘/’, the less you experience that symptom;
(c) please do not place your slash ‘/’ outside the end markers.

You are asked to indicate on this questionnaire, the amount of a symptom you have experienced in the past week as related to your problematic shoulder. If you are unsure about the shoulder that is involved or you have any other questions, please ask before filling out the questionnaire. If for some reason you do not understand a question, please refer to the explanations that can be found at the end of the questionnaire. You can then place your slash ‘/’ across the horizontal line at the appropriate place. If an item does not pertain to you or you have not experienced it in the past week, please make your ‘best guess’ as to which response would be the most accurate.

Section A: physical symptoms

Instructions to patients

The following questions concern the physical symptoms you have experienced due to your shoulder problem. In all cases, please enter the amount of the symptom you have experienced in the last week. (Please answer with a slash ‘/’ across the horizontal line.)

1. How much pain do you experience in your shoulder with overhead activities?
   no pain ___________________________ extreme pain
2. How much aching or throbbing do you experience in your shoulder?
   no extreme aching/throbbing ___________________________
   aching/throbbing
3. How much weakness or lack of strength do you experience in your shoulder?
   no extreme weakness ___________________________ weakness
4. How much fatigue or lack of stamina do you experience in your shoulder?
   no extreme fatigue ___________________________ fatigue
5. How much clicking, cracking or snapping do you experience in your shoulder?
   no extreme clicking ___________________________ clicking
6. How much stiffness do you experience in your shoulder?
   no extreme stiffness ___________________________ stiffness
7. How much discomfort do you experience in your neck muscles as a result of your shoulder?
   no extreme discomfort ___________________________ discomfort
8. How much feeling of instability or looseness do you experience in your shoulder?
   no extreme instability ___________________________ instability
9. How much do you compensate for your shoulder with other muscles?
   not extreme ___________________________ extreme
10. How much loss of range of motion do you have in your shoulder?
    no extreme loss ___________________________ loss

Section B: sports/recreation/work

Instructions to patients

The following section concerns how your shoulder problem has affected your work, sports or recreational activities in the past week. For each question, please indicate the amount with a slash ‘/’ across the horizontal line.

11. How much has your shoulder limited the amount you can participate in sports or recreational activities?
    not extremely limited ___________________________ limited
12. How much has your shoulder affected your ability to perform the specific skills required for your sport or work? (If your shoulder affects both sports and work, consider the area that is most affected.)
    not extremely affected ___________________________ affected
13. How much do you feel the need to protect your arm during activities?
    not extreme ___________________________ extreme
14. How much difficulty do you experience lifting heavy objects below shoulder level?

- no extreme difficulty

15. How much fear do you have of falling on your shoulder?

- no extreme fear

16. How much difficulty do you experience maintaining your desired level of fitness?

- no extreme difficulty

17. How much difficulty do you have ‘’roughhousing or horsing around’’ with family or friends?

- no extreme difficulty

18. How much difficulty do you have sleeping because of your shoulder?

- no extreme difficulty

19. How conscious are you of your shoulder?

- not extremely conscious

20. How concerned are you about your shoulder becoming worse?

- no extremely concern

21. How much frustration do you feel because of your shoulder?

- no extremely frustration

Thank you for completing the questionnaire.

References