MEASURING SPINAL MOBILITY IN ANKYLOSING SPONDYLITIS: COMPARISON OF MOTION CAPTURE RESULTS AGAINST CONVENTIONAL METROLOGY AND RADIOLOGICAL SCORES.

1 J.L.Garrido-Castro, 1 R.Medina-Carnicer, 2 E.Collantes, 1 A.M. Galisteo, 2 C. Gonzalez-Navas, 2 D. Ruiz-Vilches
1 Computing and Numerical Analysis Dpt. University of Cordoba, Cordoba, Spain, email: cc0juanl@uco.es
2 Reina Sofia University Hospital, Cordoba, Spain

SUMMARY
Ankylosing spondylitis (AS) is a chronic rheumatic disease that affects mainly to the spine reducing its mobility. Spinal mobility restrictions are the measures most commonly used in AS but rheumatologist use basic tools as tapes and goniometers. They also use certain indexes (for example BASMI) that group several measurements. Some studies show lack of reliability, accuracy and responsiveness in these measurements.

Motion capture is an emerging technology used to analyze the human movement with high level of accuracy and offers new three-dimensional measurements that could reflect better spinal ROM.

The authors of this communication developed a video-based motion capture system, the UCOTRACK.

In this study we examine reliability and validity of measuring spinal mobility using UCOTRACK for the assessment of AS, comparing the measures obtained with conventional metrology and with radiological scores.

Measurements obtained by the motion capture system when we analyze spinal mobility according to our protocol (marker set and movements) shows better results according to reliability (ICC 0.99), and correlation with radiological structural damage (r=0.90).

UCOTRACK appears to be reliable and valid for measure spinal mobility in AS. This kind of systems could help for quantitative and objective clinical assessment of spinal mobility in AS.

INTRODUCTION
Ankylosing spondylitis (AS) is a chronic rheumatic disease. This disease affects to the spine reducing spinal range of movement (ROM). Spinal mobility restrictions are the most commonly used measures in AS and are also of prognostic value. The rheumatologist obtains some measurements using tape, goniometer and others basic instrumentation. They also used certain indexes (for example BASMI [1]) that groups several measurements. However, this measurements show low level of reliability, depending of the observer, and lack of precision.

Motion capture is an emerging technology used to analyse the human movement with high level of accuracy. It could be a promising tool for an objective quantification of disease activity in the spine of AS patients.

The authors of this communication developed a video-based motion capture system, the UCOTRACK (formerly SOMCAM3D [2]). The objective was to examine the reliability and validity of measuring spinal mobility using UCOTRACK for the assessment of AS, comparing the measures obtained by this system with the measures obtained by conventional metrology, and radiological scores.

METHODS
We designed a 21 marker set. Twenty three three-dimensional measurements, obtained from these markers attached to the subject, have been defined, some of these also used in conventional metrology.

Thirty three AS patients and 20 healthy subjects (control group) were measured using conventional metrology by two different rheumatologists and by a motion analysis system, the UCOTRACK, in three different occasions: two in the same day and another one two weeks before. The subject does certain movements to measure spinal mobility: cervical flexion/extension, cervical lateral flexion, cervical rotation, lumbar flexion, lateral lumbar flexion and trunk rotation. The system calculates range of movements from the markers’ position.

RESULTS AND DISCUSSION
AS produces a spinal ROM reduction of until 90% on severe cases. On disease initial stages does not appears significat reduction of ROM.

Table 1 shows results of ICC for different measurements that show high correlation values with conventional metrology (BASMI) and radiological indexes (mSASSS). In two weeks retest reliability ICC was also excellent (0.96 to 0.99).

A new index based in motion capture measurements called UCOASMI has been also defined. This index show high value of realiability and correlation. Minimal detectable difference of this new index is 0.65 (BASMI 2.00) and medium absolute error 0.23 (BASMI 0.75) in a scale of 0 to 10.
<table>
<thead>
<tr>
<th>Measurement</th>
<th>ICC</th>
<th>BASMI (pearson)</th>
<th>mSASSS (pearson)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cervical flexion</td>
<td>0.995</td>
<td>0.89</td>
<td>0.86</td>
</tr>
<tr>
<td>Cervical rotation</td>
<td>0.992</td>
<td>0.92</td>
<td>0.92</td>
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<tr>
<td>Finger to floor dist.</td>
<td>0.985</td>
<td>0.74</td>
<td>0.85</td>
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<tr>
<td>Frontal - back inclination</td>
<td>0.988</td>
<td>0.80</td>
<td>0.84</td>
</tr>
<tr>
<td>Lateral– shoulders hips angle</td>
<td>0.987</td>
<td>0.88</td>
<td>0.88</td>
</tr>
<tr>
<td>Trunk Rotation</td>
<td>0.996</td>
<td>0.86</td>
<td>0.89</td>
</tr>
<tr>
<td>UCOASMI</td>
<td>0.990</td>
<td>0.92</td>
<td>0.90</td>
</tr>
<tr>
<td>BASMI</td>
<td>0.96</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1: Results of reliability and correlation

Figure 1 shows mobility results obtained by two patients. Blue areas represents normality zone calculated with the results obtained by control group. Subject 2 shows according to subject 1 a reduction up to 90% on cervical movements and up to 67% on lumbar movements.

CONCLUSIONS

Some studies conclude that conventional metrology cannot be used to demonstrate the efficacy of new treatments in AS due to lack of accuracy.

UCOTRACK appears to be reliable and valid for measure spinal mobility in AS. It obtains more precise and reliable results and offers new three-dimensional measurements that could reflect better spinal ROM. This kind of systems could help for quantitative and objective clinical assessment of spinal mobility in AS.

ACKNOWLEDGEMENTS

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