ADOLESCENT IDIOPATHIC SCOLIOSIS AND SIMILAR CONDITIONS: NEW TOOL TO MEASURE THE CORONAL PLANE

ESCOLIOSE IDIOPÁTICA DO ADOLESCENTE E SIMILARES: NOVA FERRAMENTA PARA MEDIR O PLANO CORONAL

ESCOLIOSE IDIOPÁTICA DEL ADOLESCENTE Y AFECCIONES SIMILARES: NUEVA HERRAMIENTA PARA MEDIR EL PLAN CORONAL

ABSTRACT

Objective: To create a method to measure the overall coronal plane of the spine, called the sacral clavicular angle (SCA). Methods: A line is drawn at the base of the sacrum; a second central line is drawn perpendicular to the first one in the proximal extension of the spine. A third line is drawn passing through the intersections of the superior points of the clavicles with the two second ribs, forming two angles, the greater of which is measured. Therefore, the degrees exceeding 90° are the SCA values. This tool was tested retrospectively in a study of 46 patients with idiopathic scoliosis who underwent short, apical, single or multiple fixations. Third generation instrumentation was used and the SCA was evaluated in the pre- and postoperative periods, which were compared with another group of 46 patients treated with the traditional technique. Results: Patients submitted to the traditional fixation method presented a median SCA of 3° in the preoperative period, and in the postoperative period, the SCA remained in 3°. Therefore, there was a 0% reduction. Patients submitted to short, apical, single or multiple fixation method presented a median preoperative SCA of 6°, and a postoperative median SCA of 1°, a reduction of approximately 83%. Conclusions: The group treated with short, apical, single or multiple instrumentation presented a reduction in the SCA of approximately 83% in the postoperative period compared to the preoperative period. The difference between preoperative and postoperative values was considered statistically significant. Level of Evidence II; Retrospective study.

Keywords: Scoliosis; Preoperative care; Postoperative care.

RESUMO

Objetivo: Criar um método para mensurar o plano coronal global da coluna vertebral, denominado Ângulo Sacro Clavicular (ASC). Métodos: Executa-se uma linha na base do sacro; faz-se uma segunda linha central perpendicular à primeira na extensão proximal da coluna. Executa-se uma terceira linha passando nos pontos de encontro superiores das claviculas com as duas segundas costas formando dois ângulos, mensura-se o maior. Portanto, os graus superiores a 90° são os valores do ASC. Testou-se essa ferramenta estudando, retrospectivamente, 46 pacientes portadores de escoliose idiopática que sofreram tratamento de fixação curta, apical, única ou múltipla. Terceira geração de instrumentação foi usada e o ASC foi avaliado nos períodos pré e pós-operatório, que foram comparados com um grupo de 46 pacientes que receberam o tratamento tradicional. Resultados: Os pacientes submetidos ao método de fixação tradicional apresentaram uma mediana de 3,0° referente ao ASC no pré-operatório. No pós-operatório, a mediana manteve-se em 3°, portanto houve uma redução de 0%. Os pacientes submetidos ao método de fixação curta, apical, única ou múltipla apresentaram no pré-operatório a mediana de 6,0°, no pós-operatório SCA de 1°, uma redução de aproximadamente 83%. Conclusões: O grupo abordado com instrumentação curta, apical, única ou múltipla, apresentou uma redução de aproximadamente 83% no pós-operatório em relação ao pré-operatório. A diferença entre o pré e o pós-operatório foi considerada estatisticamente significativa. Nível de Evidência II; Retrospectivo.

Descritores: Escoliose; Cuidados pré-operatórios; Cuidados pós-operatórios

RESUMEN

Objetivo: Crear un método para mensurar el plano coronal general de la columna vertebral, denominado Ángulo Sacro Clavicular (ASC). Métodos: Se hizo una línea en la base del sacro; una segunda línea central se hizo perpendicular a la primera en la extensión proximal de la columna vertebral. Se hizo una tercera línea que pasa a través de las intersecciones de las porciones superiores de las clavículas con las dos segundas costillas, formando dos ángulos, el mayor de los cuales se midió. Por lo tanto, los grados superiores a 90° son los valores del ASC. Esta herramienta fue probada retrospectivamente en un estudio de 46 pacientes con escoliosis idiopática que se sometieron a fijaciones cortas, apicales, únicas o múltiples. Terceira geração de instrumentação foi usada e o ASC foi avaliado nos períodos pré e pós-operatório, que se compararon com outro grupo de 46 pacientes tratados con la técnica tradicional. Resultados: Los pacientes sometidos al método de fijación tradicional presentaron una mediana de 3° de ASC en el período preoperatorio, y en el postoperatorio, el ASC se mantuvo en 3°. Por lo tanto, hubo una reducción del 0%. Los pacientes sometidos a una método de fijación corta, apical, única o múltiple presentaron una mediana de ASC preoperatoria de 6° y una mediana de ASC postoperatoria de 1°, una reducción de aproximadamente 83%. Conclusiones: El grupo tratado con instrumentación corta, apical, única o múltiple presentó una reducción en el ASC de aproximadamente 83% en el período postoperatorio en comparación con el período preoperatorio. La diferencia entre los valores preoperatorios y postoperatorios se consideró estadísticamente significativa. Nivel de Evidencia II; Estudio retrospectivo.

Descritores: Escoliosis; Cuidados preoperatorios; Cuidados posoperatorios.

Study conducted at the Orthopedics and Traumatology Group of the Santa Casa and of the Instituto da Coluna Vertebral, in Belo Horizonte, MG, Brazil. Correspondence: Av. Francisco Sales, 427, Floresta, Belo Horizonte, MG, Brazil. 30150220. enguerbg@gmail.com
INTRODUCTION

Scoliosis is a deformity with a lateral deviation in the coronal plane of the spine that can be observed in infants, children, adolescents, and adults, depending on the type of scoliosis in question. Idiopathic scoliosis is characterized as a three-dimensional deformity of the spine, but, in addition to the lateral curve, it involves spinal rotation and is more prevalent in female adolescents. To evaluate the differences between the preoperative and postoperative findings for the patients being studied, the non-parametric Wilcoxon test was used for each method, since the data did not follow Gauss distribution.

The parametric t test for independent variables was used to compare the pre- and postoperative SCA values between traditional fixation and short, apical, single or multiple fixation methods.

RESULTS

In a comparative analysis between the groups defined by fixation method applied, either traditional or short, apical, single or multiple, by sex, race, and age range, as observed in Table 1 and Table 2, there was no difference between the groups in terms of demographic characteristics, since the p-value was >0.05.

In Table 3 and Figure 2, we observe that the patients in the traditional fixation group had both a mean preoperative SCA of 3° and the difference between the ages of the patients by method applied, traditional fixation or short, apical, single or multiple fixation.

The study data were analyzed using the PASW statistical program, version 18. In all the statistical tests performed, a significance level of 5% was considered. Thus, associations with a p-value less than 0.05 were considered to be statistically significant.

METHODS

The project was submitted by the Santa Casa de Belo Horizonte on 05/17/17 and approved as CAAE number 68440417.2.0000.5138. The study participants signed the Informed Consent Form.

The Spine Groups of the Instituto da Coluna Vertebral and of the Orthopedics and Traumatology Service of the Santa Casa, both located in Belo Horizonte, created a new tool to measure the overall coronal plane of the spine, called the Sacral Clavicular Angle (SCA).

To measure the SCA, a line is drawn parallel to the base of the sacrum and a second line is drawn from the center of and perpendicular to the first one for the entire extension of the spine. A third line is drawn passing through the intersections of the superior portions of the clavicles with the second ribs, thus forming two angles, which measure 90° by 90° in non-scoliotic people. The standard established was to measure the greater angle on the side exceeding 90° with the goniometer and the SCA value was defined as the number of degrees in excess of 90°. (Figure 1)

To test the new tool, we studied the pre- and postoperative SCAs of 46 patients submitted to short, apical, single or multiple fixation surgeries using 3rd generation instrumentation. Eleven were excluded because the images were not suitable for the study. These were compared with 46 other patients, who had also undergone surgery with 3rd generation instrumentation, using the traditional technique.

To evaluate the differences between the preoperative and postoperative findings for the patients being studied, the non-parametric Wilcoxon test was used for each method, since the data did not follow Gauss distribution.

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Table 3. Frequency distribution of the 46 patients in each method by SCA measured.

<table>
<thead>
<tr>
<th>SCA</th>
<th>Method</th>
<th>n</th>
<th>Mean</th>
<th>S.D.</th>
<th>Minimum</th>
<th>Maximum</th>
<th>1Q</th>
<th>Median</th>
<th>3Q</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Traditional fixation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.965</td>
</tr>
<tr>
<td>pre op</td>
<td>46</td>
<td>3.46</td>
<td>2.86</td>
<td>0</td>
<td>9</td>
<td>7.75</td>
<td>3.00</td>
<td>6.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>post op</td>
<td>46</td>
<td>3.37</td>
<td>2.90</td>
<td>0</td>
<td>10</td>
<td>1.00</td>
<td>3.00</td>
<td>6.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Multiple fixation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>p&lt;0.001**</td>
</tr>
<tr>
<td>pre op</td>
<td>46</td>
<td>5.48</td>
<td>3.0</td>
<td>0</td>
<td>13</td>
<td>3.00</td>
<td>6.00</td>
<td>7.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>post op</td>
<td>46</td>
<td>2.02</td>
<td>2.5</td>
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<td>10</td>
<td>0.00</td>
<td>1.00</td>
<td>3.25</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 2. Frequency distribution of the 46 patients in each method by SCA measured.

a mean postoperative SCA of 3°. Comparing these two moments, there was a reduction of 0% in the postoperative period in relation to the preoperative period. The statistical test confirmed that the difference between the preoperative and postoperative values was considered to be non-significant.

Also, in Table 3 and Figure 2, a preoperative median of 6° is observed in the patients belonging to the short, apical, single or multiple fixation method, while in the postoperative period the median was 1°. Comparing these two moments, there was a reduction of approximately 83% in the postoperative value in relation to the preoperative value. The statistical test confirmed that the difference between the pre- and postoperative values is significant.

According to the results in Table 4 and Figure 3, the t test confirmed that a statistical difference exists between the reductions in the angles of the traditional and short, apical, single or multiple methods. The short, apical, single or multiple fixation method reduced the angle more than the traditional method. That is, the postoperative reduction averaged 3.46° for the short, apical, single or multiple fixation and 0.09° for the traditional method.

Table 5 shows that among the 46 patients in the traditional method group 8 or 17.4% had a postoperative increase in the angle, while among the 46 patients in the short, apical, single or multiple fixation method group 4 or 8.7% had a postoperative increase in the angle.

**DISCUSSION**

The purpose of short and selective fixation in the correction of AIS was achieved with 3rd generation instrumentation, but for many years we, as well as other authors, have observed the frequent presence of trunk imbalance. Therefore, the creation of this new tool to measure the SCA may be quite timely.

According to the worldwide lack of a tool that can measure the overall coronal plane of the spine mathematically to determine whether corrective surgeries for scoliosis using 3rd generation instrumentation are really balancing or unbalancing the trunk, we created the Sacral Clavicular Angle (SCA). Figures 4 to 8.

A quality image is necessary to show the strategic points for the measurement of the SCA, hence our exclusion of 11 of the original study group of 57 patients submitted to multiple fixations due to unsatisfactory images. Great accuracy is recommended when tracing and measuring the angle. Mathematical quantification is indispensable to confirm whether the trunk is imbalanced.

We believe that the correction and stabilization in order to align the curves of scolioses with structural curves of evolutionary tendencies, but I am concerned that we may cause greater trunk imbalance.

The SCA may initially be positive and become negative postoperatively and vice-versa. Figures 4 to 8.
Among the 46 patients studied who were submitted to the traditional method, 8 or 17.4% had a postoperative increase in the SCA, while among the 46 patients operated by the short, apical, single or multiple fixation method, 4 or 8.7% had an increased postoperative angle. It is therefore evident that this new fixation principle may be a good option. Tables 3 to 5, Figures 1 to 6.

In this study, the median postoperative SCA of patients operated by the traditional method showed no correction. Figure 7 and 8.

The patients who were submitted to the short, apical, single or multiple fixation method had a reduction of approximately 83% in the postoperative as compared to the preoperative median SCA. Table 3, Figures 1, 4-6.

Because the Cobb method is considered the gold standard
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for planning the treatment of deformity and evaluating the results, measuring the magnitude of each curve separately, a gap is left open for a tool that can measure the overall coronal plane before and after scoliosis treatment, be it clinical or surgical. It is precisely to meet this demand that the SCA emerges, making it possible for us to know if we are truly producing gold standard results in relation to the balance of the coronal plane.

CONCLUSIONS

This “new tool” to measure the SCA lets us quantify mathematically the balance of the overall coronal plane of the spine. It was evident that the group treated with short, apical, single or multiple instrumentation has a reduction of approximately 83% postoperatively as compared to the preoperative period, while the patients treated with traditional fixation had a reduction of 0%. This difference between pre- and postoperative was confirmed as statistically significant by the biostatistical test.

All authors declare no potential conflict of interest related to this article.

CONTRIBUTION OF THE AUTHORS: Each author made significant individual contributions to this manuscript. EBG (0000-0002-1737-7811)* was the main author. GBP (0000-0001-6812-1245)*, LFG (0000-0002-2425-8802), EBGJ (0000-0002-7612-2579)*, JGC (0000-0003-4054-0821)*, and MFC (0000-0001-9741-1727)* contributed greatly to the preparation of the article. RGG (0000-0003-0376-8763)*, STG (0000-0002-8482-479X)*, and VOM (0000-0001-8808-4787)* reviewed the manuscript.*ORCID (Open Researcher and Contributor ID).

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