Impact of age on the likelihood of reaching a minimum clinically important difference in 374 three-column spinal osteotomies

Clinical article

JUSTIN K. SCHEER, B.S.,1 VIRGINIE LAFAGE, PH.D.,2 JUSTIN S. SMITH, M.D., PH.D.,3 VEDAT DEVIREN, M.D.,4 RICHARD HOSTIN, M.D.,5 IAN M. MCCARTHY, PH.D.,5 GREGORY M. MUNDIS, M.D.,6 DOUGLAS C. BURTON, M.D.,7 ERIC KLINEBERG, M.D.,8 MUNISH C. GUPTA, M.D.,9 KHALED M. KEBASHI, M.D.,9 CHRISTOPHER I. SHAFFREY, M.D.,3 SHAY BESS, M.D.,10 FRANK SCHWAB, M.D.,11 CHRISTOPHER P. AMES, M.D.,11 AND THE INTERNATIONAL SPINE STUDY GROUP (ISSG)

1University of California, San Diego, School of Medicine; 2San Diego Center for Spinal Disorders, La Jolla; Departments of Orthopaedic Surgery and Neurological Surgery, University of California, San Francisco; 4Department of Orthopaedic Surgery, University of California, Davis, California; 2Department of Orthopaedic Surgery, NYU Hospital for Joint Diseases, New York, New York; 3Department of Neurosurgery, University of Virginia Health System, Charlottesville, Virginia; 5Department of Orthopaedic Surgery, Baylor Scoliosis Center, Plano, Texas; 7Department of Orthopaedic Surgery, University of Kansas Medical Center, Kansas City, Kansas; 8Department of Orthopaedic Surgery, Johns Hopkins University, Baltimore, Maryland; and 10Rocky Mountain Hospital for Children, Denver, Colorado

Object. Spinal osteotomies for adult spinal deformity correction may include resection of all 3 spinal columns (pedicle subtraction osteotomy [PSO] and vertebral column resection [VCR]). The relationship between patient age and health-related quality of life (HRQOL) outcomes for patients undergoing major spinal deformity correction via PSO or VCR has not been well characterized. The goal of this study was to characterize that relationship.

Methods. This study was a retrospective review of 374 patients who had undergone a 3-column osteotomy (299 PSOs and 75 VCRs) and were part of a prospectively collected, multicenter adult spinal deformity database. The consecutively enrolled patients were drawn from 11 sites across the United States. Health-related QOL outcomes, according to the visual analog scale (VAS), Oswestry Disability Index (ODI), 36-Item Short-Form Health Survey (SF-36, physical component score [PCS] and mental component score), and Scoliosis Research Society-22 questionnaire (SRS), were evaluated preoperatively and 1 and 2 years postoperatively. Differences and correlations between patient age and HRQOL outcomes were investigated. Age groupings included young (age ≤ 45 years), middle aged (age 46–64 years), and elderly (age ≥ 65 years).

Results. In patients who had undergone PSO, age significantly correlated (Spearman’s correlation coefficient) with the 2-year ODI (ρ = 0.24, p = 0.0450), 2-year SRS function score (ρ = 0.30, p = 0.0123), and 2-year SRS total score (ρ = 0.30, p = 0.0133). Among all patients (PSO+VCR), the preoperative PCS and ODI in the young group were significantly higher and lower, respectively, than those in the elderly. Among the PSO patients, the elderly group had much greater improvement than the young group in the 1- and 2-year PCS, 2-year ODI, and 2-year SRS function and total scores. Among the VCR patients, the young age group had much greater improvement than the elderly. Among the 1-year SRS pain score, 1-year PCS, and 2-year ODI. There was no significant difference among all the age groups as regards the likelihood of reaching a minimum clinically important difference (MCID) in each of the HRQOL outcomes (ρ > 0.05 for all). Among the VCR patients, the elderly group was significantly more likely than the young to reach an MCID for the 1-year PCS (61% vs 21%, p = 0.0077) and 2-year PCS (67% vs 17%, p = 0.0054), SRS pain score (57% vs 20%, p = 0.0457), and SRS function score (62% vs 20%, p = 0.0250). Among the VCR patients, the young group was significantly more likely than the elderly patients to reach an MCID for the 1-year (100% vs 20%, p = 0.0036) and 2-year (100% vs 0%, p = 0.0027) PCS scores and 1-year (60% vs 0%, p = 0.0173) and 2-year (70% vs 0%, p = 0.0433) SRS pain scores.

Conclusions. The PSO and VCR are not equivalent surgeries in terms of HRQOL outcomes and patient age. Among patients who underwent PSO, the elderly group started with more preoperative disability than the younger patients but had greater improvements in HRQOL outcomes and was more likely to reach an MCID at 1 and 2 years after treatment. Among those who underwent VCR, all had similar preoperative disabilities, but the younger patients had greater improvements in HRQOL outcomes and were more likely to reach an MCID at 1 and 2 years after treatment.

(http://thejns.org/doi/abs/10.3171/2013.12.SPINE13680)

**Key Words** • spinal deformity • three-column osteotomy • pedicle subtraction osteotomy • MCID • technique • HRQOL • age • PSO • VCR

Abbreviations used in this paper: HRQOL = health-related quality of life; ISSG = International Spine Study Group; MCID = minimum clinically important difference; MCS = mental component score; PCS = physical component score; PSO = pedicle subtraction osteotomy; SRS = Scoliosis Research Society-22 questionnaire; VAS = visual analog scale; VCR = vertebral column resection.

Spinal osteotomies for adult spinal deformity correction may include the resection of all 3 spinal columns. Three-column osteotomies, including pedicle subtraction osteotomy (PSO) and vertebral column resection (VCR), allow for the extensive correction of severe rigid spinal deformity in the sagittal view.
Impact of age on MCID for three-column osteotomies

tal, coronal, and axial planes simultaneously through a posterior-only approach. Although these osteotomies can have powerful corrective effects, they also have significant risks of morbidity given the operative time, high intraoperative blood loss, and technically demanding nature of the procedures. In fact, studies evaluating these osteotomies observed major complications in up to 35% of 3-column osteotomy cases, the most common being medical complications and neurological deficits. Despite such complications, however, both 3-column osteotomy techniques have demonstrated significant improvement in clinical and radiographic outcomes.

The benefits of VCR and PSO are numerous and evident in the literature, but their more technically challenging nature often elicits hesitation in performing them in the elderly population, which more often presents with complex spinal deformity, medical comorbidities, and poor bone quality. An increased age has been shown to be a significant factor in major complications following adult deformity surgery involving a minimum 5-level arthrodesis procedure. Specifically, one study showed that patients older than 75 years of age who underwent major spinal deformity surgery had an overall perioperative complication rate of 62% and a long-term postoperative complication rate of 52%.

Authors of a few studies have investigated age and outcomes in adults requiring 3-column osteotomies. One of these studies focused on patients older than 60 years of age undergoing 3-column osteotomies and demonstrated that these procedures still provide considerable benefit to quality of life while significantly restoring coronal and sagittal spinopelvic alignment. Previous studies have primarily focused on complications or outcomes in the elderly without considering the younger patient population. To date, no study has directly investigated the relationship between patient age and health-related quality of life (HRQOL) outcomes specifically for those undergoing major spinal deformity correction via PSO or VCR. Therefore, the goal of the present study was to characterize the relationship between age and HRQOL in patients treated with PSO or VCR.

Methods

This study was a retrospective review of 374 patients who had undergone a 3-column osteotomy (299 PSOs and 75 VCRs) and were part of a prospectively collected multicenter adult spinal deformity database. The consecutively enrolled patients were drawn from the International Spine Study Group (ISSG), which is composed of 11 sites across the United States. All patients were enrolled into an institutional review board–approved protocol by each site. Inclusion criteria for the ISSG database are an age ≥ 18 years and the presence of spinal deformity as defined by a scoliosis Cobb angle ≥ 20°, sagittal vertical axis ≥ 5 cm, pelvic tilt ≥ 25°, and/or thoracic kyphosis ≥ 60°. Exclusion criteria consisted of spinal deformity having a neuromuscular etiology and the presence of active infection or malignancy. Information regarding age, sex, body mass index, operation time, estimated blood loss, major intraoperative and postoperative complications, and HRQOL outcomes was collected. The major intraoperative complications recorded were as follows: cardiac arrest, spinal cord injury, death, nerve root injury, optical deficit, vessel and/or organ injury, blood loss > 4 L, pneumothorax, and having an unplanned staged surgery. The major postoperative complications were as follows: bowel and/or bladder deficit, death, deep vein thrombosis, deep infection, motor deficit, myocardial infarction, optical deficit, pneumonia, pulmonary embolism, reintubation, sepsis, stroke, acute respiratory distress, pancreatitis, tracheostomy, unplanned return to the operating room, and arrhythmia. Patients were stratified by age: ≤ 45 years (young), 46–64 years (middle aged), and ≥ 65 years (elderly). Health-related QOL measures, including the visual analog scale (VAS) for pain assessment, Oswestry Disability Index (ODI), 36-Item Short-Form Health Survey (SF-36, physical component score [PCS] and mental component score [MCS]), and the Scoliosis Research Society-22 questionnaire (SRS, subdomains: activity, pain, satisfaction, mental, appearance, and total), were used to evaluate patients preoperatively and 1 and 2 years postoperatively. Differences and correlations between age groups for HRQOLs at the standard preoperative time and follow-up time points were investigated. Furthermore, the change in HRQOL at the postoperative time points versus preoperative values was compared across surgery and age groups. Changes in the VAS and ODI were calculated as the preoperative value – the postoperative value. Changes in the MCS, PCS, and SRS values were calculated as the postoperative value – the preoperative value. Positive values for either of these equations indicate an improvement in outcomes, and negative values indicate a decrease in outcomes. To place HRQOL outcomes in a clinically relevant context, minimum clinically important difference (MCID) values have been established for the HRQOL instruments. Therefore, differences in the proportion of patients across age groups reaching the MCID for each HRQOL measure were analyzed. The MCID values used in this study are presented in Table 1.

Statistical analysis was performed using the Student t-test and the Wilcoxon rank-sum or Kruskal-Wallis tests, as appropriate. Differences in the likelihood of reaching an MCID and major complication distributions between groups were assessed using chi-square tests. Spearman correlation coefficients (ρ) were calculated for all com-

<table>
<thead>
<tr>
<th>HRQOL</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>VAS</td>
<td>−1.2</td>
</tr>
<tr>
<td>ODI</td>
<td>−1.5</td>
</tr>
<tr>
<td>PCS</td>
<td>+5.2</td>
</tr>
<tr>
<td>SRS</td>
<td></td>
</tr>
<tr>
<td>activity</td>
<td>+0.375</td>
</tr>
<tr>
<td>pain</td>
<td>+0.587</td>
</tr>
<tr>
<td>appearance</td>
<td>+0.8</td>
</tr>
<tr>
<td>mental</td>
<td>+0.42</td>
</tr>
</tbody>
</table>

TABLE 1: Various MCID values across HRQOL measures used in this study

J Neurosurg: Spine / Volume 20 / March 2014 307
combinations of radiographic measures and HRQOL scores. All statistical analyses were conducted using commercially available software (JMP version 5.0, SAS Institute Inc.), and the level of significance was set at \( p < 0.05 \) for all tests. All values are presented as the means ± standard deviation.

**Results**

**Demographic and Surgical Data Comparisons**

A summary of the demographic and surgical data is presented in Table 2. The mean patient age was 57.7 ± 12.6 years. Those who underwent PSO were significantly older (59.3 ± 11.8 years [range 20–82 years]) than those who underwent VCR (51.2 ± 13.6 years [range 20–82 years]; \( p = 0.0001 \)). The average body mass index for the young group (27.2 ± 8.3) was significantly lower than that for the elderly group (29.4 ± 8.1, \( p = 0.0473 \)) and the middle-aged group (29.1 ± 6.7, \( p = 0.0266 \)). There were no significant differences in intraoperative blood loss and operative time between the surgical groups (PSO vs VCR) and the age groups (\( p > 0.05 \) for all). For the entire study cohort (PSO+VCR) and the VCR group, the correlation between age and HRQOL outcome was statistically indistinguishable from 0 (\( p > 0.05 \) for all); however, the correlation was statistically significant for the PSO group based on the 2-year ODI (\( r = 0.24, p = 0.0450 \)), 2-year SRS function score (\( p = 0.30, p = 0.0123 \)), and 2-year SRS total score (\( p = 0.30, p = 0.0133 \)).

**Comparison of HRQOL Between Time Points**

All 1-year HRQOL measures were significantly improved compared with preoperative values (\( p < 0.05 \) for all) with the exception of the MCS (\( p > 0.05 \)). Furthermore, all 2-year HRQOL measures were significantly improved compared with preoperative values (\( p < 0.05 \) for all) with the exception of the MCS and SRS mental (\( p > 0.05 \) for both). Within the young patient group, 1-year SRS satisfaction and SRS total scores were significantly improved over preoperative values (\( p < 0.05 \) for both). Also in the young group, 1- and 2-year SRS images, VAS, and PCS were all significantly improved over preoperative values (\( p < 0.05 \) for all). For both the middle-aged and elderly groups, all 1- and 2-year HRQOL outcomes were significantly improved compared with preoperative values (\( p < 0.05 \) for all) except for both the 1- and the 2-year MCS (\( p > 0.05 \) for all).

**Preoperative Comparison of HRQOL Between Age Groups**

Preoperative PCS (35.4 ± 11.3) and ODI (37.6 ± 21.8) for the young group were significantly higher and lower, respectively, than those for the elderly group (27.8 ± 9.6, \( p = 0.0227 \); and 49.9 ± 16.7, \( p = 0.0089 \); Fig. 1). The young patients had significantly favorable preoperative PCS (35.4 ± 11.3 vs 30.5 ± 8.5, \( p = 0.0228 \)), ODI (37.6 ± 21.8 vs 46.9 ± 19.2, \( p = 0.0453 \)), SRS total (2.9 ± 0.9 vs 2.6 ± 0.7, \( p = 0.0310 \)), and VAS (5.9 ± 2.8 vs 6.9 ± 2.4, \( p = 0.0347 \)) as compared with the middle-aged group. Preoperative PCS was significantly higher in the middle-aged group than in the elderly group (30.5 ± 8.5 vs 27.8 ± 9.6, \( p = 0.0353 \)).

**Comparison of HRQOL Changes From Preoperative Values**

Values reported are the mean change from preoperative values ± standard deviation. A negative value implies that the average change in HRQOL was worse than preoperatively.

**Young Versus Elderly.** Overall, there were no significant differences in the changes in outcomes between the young and elderly groups (\( p > 0.05 \)). However, within the PSO group, the elderly had much greater improvement in the 1-year (9.2 ± 11.3 vs 1.1 ± 11.1, \( p = 0.0380 \)) and 2-year (9.8 ± 11.3 vs 0.7 ± 7.1, \( p = 0.0222 \)) PCS, 2-year ODI (10.9 ± 16.3 vs −6.0 ± 24.7, \( p = 0.0271 \)), and 2-year SRS function (0.6 ± 0.9 vs −0.6 ± 1.2, \( p = 0.0159 \)) and SRS total scores (0.6 ± 0.8 vs −0.2 ± 0.5, \( p = 0.0031 \)) than the young group. Within the VCR group, the young had much greater improvement in the 1-year SRS pain (0.8 ± 0.7 vs −0.3 ± 0.5, \( p = 0.0194 \)), 1-year PCS (13.0 ± 4.6 vs 1.5 ± 8.7, \( p = 0.0465 \)), 2-year PCS (1.5 ± 8.7 vs −1.8 ± 7.3, \( p = 0.0442 \)), and 2-year ODI (9.3 ± 12.3 vs −15.0 ± 1.4, \( p = 0.0314 \)).

**Young Versus Middle-Aged.** Overall, there were no significant differences between the young and middle-age patients (\( p > 0.05 \)). Within the PSO group, the middle-aged patients had a significant improvement over the young patients in the 1-year PCS (8.4 ± 10.8 vs 1.1 ± 11.1, \( p = 0.0461 \)), 2-year SRS pain (0.8 ± 1.1 vs −0.1 ± 1.2, \( p = 0.0490 \)), function (0.4 ± 0.9 vs −0.6 ± 1.2, \( p = 0.0197 \)), mental (0.5 ± 1.1 vs −0.7 ± 1.1, \( p = 0.0101 \)), total (0.8 ± 0.7 vs −0.2 ± 0.5, \( p = 0.0005 \)), 2-year ODI (14.5 ± 19.1 vs −6.0 ± 24.7, \( p = 0.0077 \)), and 2-year MCS (1.5 ± 12.6 vs −11.7 ± 17.8, \( p = 0.0427 \)). In the VCR group, the young patients had greater improvement in the 1-year PCS than the middle-aged group (13.0 ± 4.6 vs 3.6 ± 6.2, \( p = 0.0187 \)). There

**TABLE 2: Summary of demographics for 374 patients overall and by age group**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Total</th>
<th>45 Yrs</th>
<th>46–64 Yrs</th>
<th>≥65 Yrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>total no. of patients</td>
<td>374</td>
<td>59</td>
<td>199</td>
<td>116</td>
</tr>
<tr>
<td>M/F</td>
<td>106/258</td>
<td>23/36</td>
<td>51/42</td>
<td>32/90</td>
</tr>
<tr>
<td>PSO patients</td>
<td>299</td>
<td>35</td>
<td>157</td>
<td>107</td>
</tr>
<tr>
<td>VCR patients</td>
<td>75</td>
<td>24</td>
<td>42</td>
<td>9</td>
</tr>
<tr>
<td>op time in min</td>
<td>451.0 ± 130.2</td>
<td>410.9 ± 115.0</td>
<td>468.5 ± 136.6</td>
<td>440.0 ± 120.0</td>
</tr>
<tr>
<td>EBL</td>
<td>2721.9 ± 1951.3</td>
<td>2430.0 ± 1581.6</td>
<td>2737.4 ± 2041.8</td>
<td>2867.2 ± 1984.6</td>
</tr>
</tbody>
</table>

* EBL = estimated blood loss.

J. K. Scheer et al.
were no significant differences in any HRQOL outcomes between the two age groups at 2 years (p > 0.05 for all).

**Middle-Aged Versus Elderly.** Overall, there were no significant differences between the middle-aged and elderly groups for any time point (p > 0.05) or in those undergoing PSO (p > 0.05). For the patients undergoing VCR, the middle-aged patients had significantly greater improvement in the 1-year SRS pain score (0.6 ± 0.7) than the elderly group (-0.3 ± 0.5, p = 0.0391). There were no significant differences for any HRQOL outcomes between the two age groups at 2 years (p > 0.05 for all).

**Minimum Clinically Important Difference Between Age Groups**

All values presented are the percentage of patients that met the MCID for the reported HRQOL measure. Overall (that is, for the PSO and VCR groups combined), there were no significant differences between age groups for the likelihood of reaching an MCID within each of the HRQOL outcomes (p > 0.5 for all).

**Young Versus Elderly.** Among the patients who underwent PSO, the elderly were significantly more likely than the young patients to reach an MCID for the PCS at 1 year (61% vs 21%, p = 0.0077) and 2 years (67% vs 17%, p = 0.0054; Fig. 2), as well as for the 2-year SRS pain (57% vs 20%, p = 0.0457) and SRS function (62% vs 20%, p = 0.0250) scores. For the patients who underwent VCR, the young patients were significantly more likely than the elderly to reach an MCID for the PCS at 1 year (100% vs 41%, p = 0.0070) and 2 years (100% vs 0%, p = 0.0027; Fig. 3), the 1-year SRS pain score (60% vs 0%, p = 0.0173) and SRS mental score (50% vs 0%, p = 0.0362), and 2-year SRS pain score (70% vs 0%, p = 0.0433).

**Young Versus Middle-Aged.** Among those who underwent PSO, the middle-aged patients were significantly more likely than the young patients to reach an MCID for the 1-year PCS (55% vs 21%, p = 0.0201; Fig. 2), 2-year SRS function score (58% vs 20%, p = 0.0275) and SRS pain score (63% vs 20%, p = 0.0143), and 2-year ODI (49% vs 17%, p = 0.0392). Among those who underwent VCR, the young patients were significantly more likely than the middle-aged patients to reach an MCID for the PCS at 1 year (100% vs 41%, p = 0.0070) and 2 years (100% vs 0%, p = 0.0027).

**Middle-Aged Versus Elderly.** Among those who underwent PSO, there were no significant differences between the middle-aged and elderly groups (p > 0.05 for all). Among those who underwent VCR, the middle-aged patients were significantly more likely than the elderly ones to reach an MCID for the 1-year SRS pain score (59% vs 0%, p = 0.0111).

**Distribution of Major Complications**

**Intraoperative Complications.** Overall, the percentage of patients within each age group was statistically similar for the occurrence of major intraoperative complications, with the young having 25.4%, middle aged
having 22.1%, and elderly having 19.8% (p > 0.05 for all comparisons; Table 3). Furthermore, when stratified by type of surgery, the patient groups had no significant differences in the proportion having a major intraoperative complication (p > 0.05 for all comparisons).

**Postoperative Complications.** Overall, the percentage of patients within each age group was statistically similar for the occurrence of major postoperative complications with the young having 54.2%, the middle aged having 35.7%, and the elderly having 32.8% (Table 3; p > 0.05 for all comparisons). Furthermore, when stratified by type of surgery, the age groups showed no significant differences in the proportion having a major postoperative complication (p > 0.05 for all comparisons).

**Discussion**

It has been well established in the literature that the treatment of severe rigid spinal deformity with 3-column osteotomies can result in improved correction and HRQOL outcomes. However, these osteotomies are associated with significant complications, and elderly patients may be at particular risk for such complications. It remains unclear if age has an effect on outcomes in patients undergoing 3-column osteotomies. Few studies have investigated age and 3-column osteotomies, specifically focusing on the elderly.

There was no difference in operative time and blood loss among patients grouped according to age or surgery type. However, patients who underwent PSO were significantly older than those who underwent VCR. This age difference is probably attributable to the different disease processes being treated in the 2 groups. Pedicle subtraction osteotomy is used primarily to correct sagittal misalignment in the lumbar area, whereas VCR is often used to correct both sagittal and coronal malalignment in the thoracic spine. The elderly tend to have primary sagittal malalignment from degenerative processes and intradiscal degeneration in the lumbar spine, whereas the younger population may have more rigid coronal deformity and multiplanar deformity, often in the thoracic spine.

All age groups had a significant improvement in HRQOL at 1 and 2 years after treatment compared with preoperative values, indicating that all groups benefited from surgical correction with either PSO or VCR. Overall (PSO and VCR groups combined), there were no significant differences between age groups in the likelihood of reaching an MCID for each of the HRQOL outcomes (p > 0.5 for all).

Age demonstrated a significant association with HRQOL outcomes only when 3-column osteotomies were investigated separately as PSOs and VCRs. Among those undergoing PSO, the elderly patients started with more preoperative disability than the younger patients but had greater improvements in HRQOL and were more likely to reach an MCID at 1 and 2 years after treatment. Of the patients who underwent VCR, all three age groups had the same preoperative disability, but the young patients had greater improvements in HRQOL and were more likely to reach an MCID at 1 and 2 years. The incidences of major intraoperative and postoperative complications were also assessed between the age groups, with all groups having similar proportions of complications. This finding suggests that the effect of age on the likelihood of reaching an MCID for the different groups is independent of both major intraoperative and postoperative complications.

This interpretation may be in line with findings in the study conducted by Smith et al., which illustrated that significant differences in HRQOL outcomes exist between younger and older populations undergoing operations to correct scoliosis. In general, the outcomes of adult spinal deformity may very well be influenced by the age of the patients and their baseline scores.

Another study by Hassanzadeh et al. also demonstrated that while older patients had more complications than younger ones, the older patients (age > 65 years old) still experienced an improvement in HRQOL outcomes. Data in the current study confirm these findings between age and outcome measures in different types of 3-column osteotomies but also reveal the likelihood of reaching an MCID. Specifically, older patients not only experienced significant improvement in PSO outcomes, but actually showed greater improvement than the younger population.

There are a few limitations to this study, including its retrospective design and the MCID values used, which have not been validated for spinal deformity patients. Despite the retrospective nature of this study, the data used were obtained from a large multicenter prospective database of adults with spinal deformity. This allows for further generalization of the results. However, the MCID values in this study were taken from studies in which the outcomes were determined from patients with lumbar arthrodesis and adult idiopathic scoliosis. Thus, the generalizability of these MCID values is limited; however, there is no strong prospective adult deformity study defining MCID values for HRQOL. The results of this study are still valuable, as there are clear differences between ages within the surgical subgroups all using the same MCID cutoff values.
Impact of age on MCID for three-column osteotomies

This study demonstrates that the type of osteotomy may play a role in outcome when stratified by patient age. This emphasizes the importance of an agreed upon standard classification of spinal osteotomies to improve our ability to better investigate outcomes when stratified by specific procedure types and other demographic variables.2

Conclusions
Three-column osteotomies are technically challenging high-risk surgeries; however, they can offer significant correction of a rigid spinal deformity and improve outcomes across all ages. Pedicle subtraction osteotomy and VCR are not equivalent surgeries as regards the HRQOL outcomes and age. For patients specifically undergoing PSO, elderly patients start with more preoperative disability than younger patients but have greater improvements in HRQOL and are more likely to reach an MCID at 1 and 2 years after treatment. Among those who undergo VCR, all three age groups have similar preoperative disabilities, but the younger patients achieve greater improvements in HRQOL and are more likely to reach an MCID at 1 and 2 years after treatment.

Disclosure
Dr. Shaffrey is a consultant for Biomet, Globus, Medtronic, NuVasive, and Stryker; and receives royalties from and holds patents with Biomet and Medtronic. Dr. Ames is a consultant for DePuy, Medtronic, and Stryker; has direct stock ownership in Visualase, Doctors Research Group, and Baxano Surgery; holds a patent with Fish & Richardson, P.C.; has received grants from and has grants pending with Baxano Surgery; and receives royalties from Aesculap and Lanx. Dr. Smith is a consultant for Biomet, Globus, DePuy, and Medtronic; has received support from DePuy and ISSGF for the study described; and has received support from DePuy for non-study-related clinical or research effort. Dr. Deviren is a consultant for NuVasive, Stryker, and Guidepoint. Dr. Burton is a consultant for and receives royalties from DePuy Spine. Dr. Gupta is a consultant for Medtronic, DePuy, and Osteotech; has direct stock ownership in Pfizer, Johnson & Johnson, Proctor & Gamble, and Pioneer; receives royalties from DePuy; and is an unpaid treasurer for FOSA. Dr. Bess is a consultant for DePuy/Synthes, Medtronic, K2M, and Alphatec Spine; and has received support from DePuy/Synthes for the study described. Dr. Mundis is a consultant for NuVasive and K2M; has received support from ISSGF for the study described; has received support from NuVasive and OREF for non-study-related clinical or research effort; and receives royalties from NuVasive and K2M. Dr. Klineberg has received honoraria and/or grants from DePuy, Stryker, AOspine, and OREF.

Author contributions to the study and manuscript preparation include the following. Conception and design: Ames. Acquisition of data: Lafage. Analysis and interpretation of data: Scheer, Lafage, Smith, Bess, Ames. Drafting the article: Scheer. Critically revising the article: all authors. Reviewed submitted version of manuscript: all authors. Approved the final version of the manuscript on behalf of all authors: Scheer. Statistical analysis: Scheer. Study supervision: Ames.

References

Manuscript submitted July 20, 2013. Accepted December 2, 2013. Please include this information when citing this paper: published online January 3, 2014; DOI: 10.3171/2013.12.SPINE13680. Address correspondence to: Justin K. Scheer, B.S., UC San Diego School of Medicine, 9500 Gilman Dr., La Jolla, CA 92093. email: jscheer@ucsd.edu.