Assessment of a Learning Strategy among Spine Surgeons

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Abstract

Study Design Pilot test, observational study.

Objective To evaluate objectively the knowledge transfer provided by theoretical and practical activities during AOSpine courses for spine surgeons.

Methods During two AOSpine principles courses, 62 participants underwent pre-course assessment, which consisted of questions about their professional experience, preferences regarding adolescent idiopathic scoliosis (AIS) classification, and classifying the curves by means of the Lenke classification of two AIS clinical cases. Two learning strategies were used during the course. A postcourse questionnaire was applied to reclassify the same deformity cases. Differences in the correct answers of clinical cases between pre- and postcourse were analyzed, revealing the number of participants whose accuracy in classification improved after the course.

Results Analysis showed a decrease in the number of participants with wrong answers in both cases after the course. In the first case, statistically significant differences were observed in both curve pattern (83.3%, $p = 0.005$) and lumbar spine modifier (46.6%, $p = 0.049$). No statistically significant improvement was seen in the sagittal thoracic modifier (33.3%, $p = 0.309$). In the second case, statistical improvement was obtained in curve pattern (27.4%, $p = 0.018$). No statistically significant improvement was seen regarding lumbar spine modifier (9.8%, $p = 0.121$) and sagittal thoracic modifier (12.9%, $p = 0.081$).

Conclusion This pilot test showed objectively that learning strategies used during AOSpine courses improved the participants' knowledge. Teaching strategies must be continually improved to ensure an optimal level of knowledge transfer.

Keywords
- learning assessment
- knowledge transfer
- spine surgery
- knowledge acquisition
- principles courses
- teaching strategies

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Introduction

Continuing medical education has gained importance over the last decades. Nowadays it is considered a valuable tool in the knowledge acquisition process for residents, fellows, and young surgeons. The major purpose is to produce changes in knowledge to improve patient care.[1] Different strategies are available to teach specific topics for surgeons such as courses, cadaver laboratories, and online presentations. However, the learning process is complex, and sometimes the knowledge transfer strategy is not as successful as expected. In an attempt to improve teaching tools, de Boer et al developed a set of instruments to provide insights into the effectiveness of surgical education in the field of orthopedic trauma, termed the *Learning Assessment Toolkit*. It was developed to supplement the judgment of surgical educators before and after a teaching event with real evidence of need, motivation, and outcomes of educational programs.[1,2]

The AOSpine educational program was developed to expand knowledge and to promote integration among spine surgeons around the world. It is based on curriculum development tools, by means of congresses, courses, seminars, webinars, cadaveric courses, and fellowship programs.[3] The number of spine surgery teaching activities has gradually increased over the last decades. However, there is a paucity of data about the effectiveness of the learning process and the level of competence acquired by participants in such activities.

The present study is aimed at evaluating objectively the knowledge transfer provided by theoretical and practical activities during AOSpine courses for spine surgeons.

Methods

This pilot test was conducted during two AOSpine principles courses in Brazil, supported by AOSpine Latin America during 2014. The events targeted spine fellows and young spine surgeons. The participants completed pre- and postcourse questionnaires, consisting of nine questions about their professional experience, preferences regarding adolescent idiopathic scoliosis (AIS) classification, and two AIS clinical cases. The students were asked to classify the curves by means of the Lenke classification. The questionnaires were developed based on the Learning Assessment Toolkit.[1]

Learning Assessment Toolkit

The Learning Assessment Toolkit provides information to educators about the strengths and weaknesses of their program, evaluates if educational goals were met, demonstrates objectively if knowledge was transferred, provides objective evidence of the success or failure of an educational strategy, and finally offers evidence about which future changes can be made.[1,2] The key competencies guide the teaching and learning process during a course. A *key competency* was defined as a piece of knowledge and/or skill that educators expected the course participants to have or be able to do after the course.

Lenke Classification

Developed in 2001, the Lenke classification system provides a comprehensive and reliable means to categorize all AIS curves.[4] This classification system requires the analysis of both upright coronal and sagittal radiographs along with the supine side bending views. The triad classification system consists of a curve pattern (1 to 6), a lumbar spine modifier (A, B, C), and a sagittal thoracic modifier (−, N, +). The ultimate goal of this classification system is to organize similar curve patterns to provide comparisons of various treatment methods and to give optimal treatment for each surgical patient with AIS.[4]

Precourse Assessment

The precourse questionnaire was given online 1 week before the event. It consisted of nine questions about the following topics: baseline characteristics of the participants: (1) type of specialty (orthopedic or neurosurgeon) and (2) experience in spine surgery (years); experience in deformity spine surgery: (3) percentage of outpatient deformity cases and (4) percentage of surgeries performed on such cases; (5) scoliosis classification system routinely used and (6) difficulties when applying Lenke classification; and classification of (7) curve pattern, (8) lumbar spine modifier, and (9) sagittal thoracic modifier of two AIS clinical cases according to the Lenke classification system.

Learning Strategies Used during the Course

Two learning strategies were used during the course. Initially, oral lectures focused on AIS radiographic evaluation and the Lenke classification system, and then practical exercises were presented. Participants were divided into small groups (five or six per group) guided by one or two faculty members (►**Fig. 1**). Each participant had his or her own printed version of the two cases (►**Fig. 2**), a goniometer, and a pencil. The activity consisted of measuring the coronal and sagittal Cobb angles and lumbar and sagittal modifiers and finally describing Lenke's classifications. The exercise was performed within 1 hour. After that, an oral review was performed to explain the rationale of the proper case classification. The expected key competencies with this strategy were to improve the knowledge of the Lenke classification system and its proper application.

Postcourse Assessment

One week after the course, participants were contacted by email to reclassify the same deformity cases.

Statistical Analysis

The descriptive analysis was performed for baseline characteristics, experience in spine surgery deformity, routinely used scoliosis classification systems, and difficulties when applying the Lenke classification. The differences in correct answers between the pre- and postcourse were analyzed to reveal the number of participants whose accuracy in classification improved after the course. The Fisher exact test or Pearson chi-square test was used to generate p values. A p value of less than 0.05 was considered statistically significant.

Fig. 1 During the course, practical exercises using printed X-rays of scoliotic spines were performed by participants and overseen by one or two faculty members.

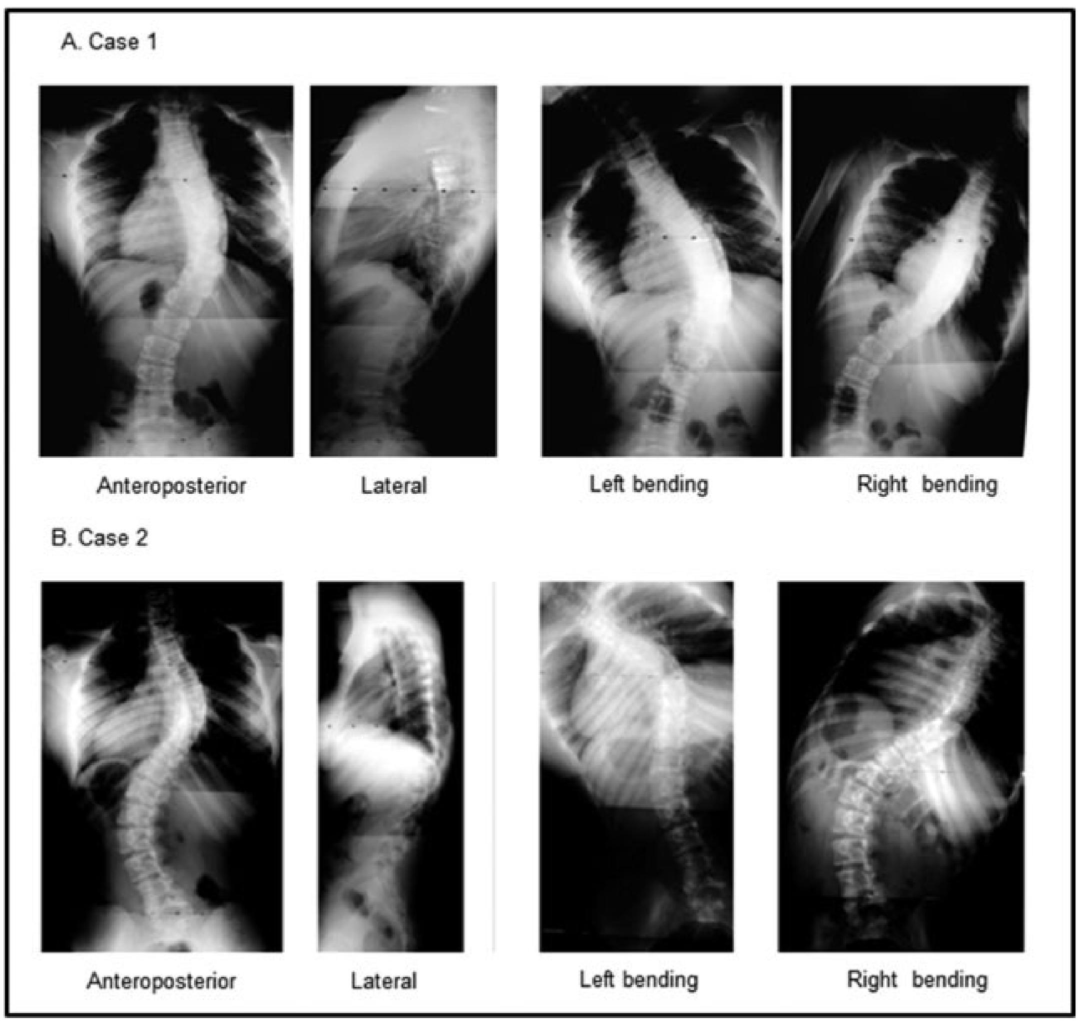

Fig. 2 (A) X-rays of case one. (B) X-rays of case two.

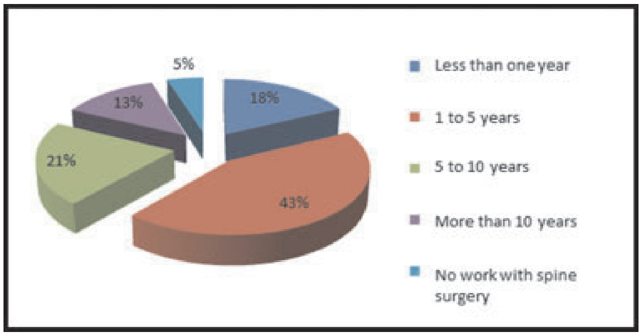

Fig. 3 Years of experience in spine surgery.

Results

A total of 62 participants were included in the study, of whom 51 (82%) were orthopedic surgeons and 11 (18%) were neurosurgeons. Their experience in spine surgery as reported by the participants is presented in ►**Fig. 3**. The experience in deformity spine surgery measured through the number of deformity cases seen in outpatient clinic and surgeries performed annually by the course participants varied (►**Table 1** and ►**Table 2**, respectively).

Eighty-nine percent of the participants were familiar with the Lenke classification system and used it on a routine basis. The King classification was used by 11%. Difficulties using the Lenke classification were reported by 55% of the participants. ►**Table 3** shows the parameters with which participants had difficulties within this classification.

Table 1 Percentage of deformity cases seen in outpatient clinic annually

1–20%, *n* (%)	21–50%, *n* (%)	51–100%, *n* (%)	No deformity cases treated, *n* (%)
47 (76)	11 (18)	2 (3)	2 (3)

Table 2 Percentage of deformity surgeries performed annually

1–20% *n* (%)	21–50%, *n* (%)	51–100%, *n* (%)	No deformity cases operated on, *n* (%)
47 (76)	7 (11)	3(5)	5 (8)

Table 3 Which parameter of the Lenke classification do you find difficult?

	n	%
Curve pattern	17	27.4
Lumbar spine modifier	1	1.6
Sagittal thoracic modifier	0	0.0
More than one parameter	16	25.8
No difficulty	17	27.4
No answer	11	17.7

The precourse assessment evidenced gaps in knowledge regarding the Lenke classification system. In the first case, the curve pattern was correctly identified by 50 participants (80.6%), lumbar spine modifier by 47 participants (75.8%), and sagittal thoracic modifier by 51 participants (82.3%; ►**Table 4**). In the second case, the curve pattern was correctly identified by 29 participants (46.8%), lumbar spine modifier by 54 participants (87.1%), and sagittal thoracic modifier by 49 participants (79%; ►**Table 5**). In the postcourse assessment, a decrease in the number of participants with wrong answers was observed in both cases regarding all three Lenke parameters. In the first case, statistically significant differences were observed in both curve pattern (83.3%, $p = 0.005$) and lumbar spine modifier (46.6%, $p = 0.049$). No statistically significant improvement was seen in sagittal thoracic modifier (33.3%, $p = 0.309$) (►**Table 6**). In the second case, there was a statistical improvement in the curve pattern (27.4%, $p = 0.018$). No statistically significant improvement was seen regarding lumbar spine modifier (9.8%, $p = 0.121$) and sagittal thoracic modifier (12.9%, $p = 0.081$; ►**Table 7**).

Discussion

Interest is increasing in the improvement of medical education quality through measurable effects of the teaching strategies.[5] The present study was based on the Learning Assessment Toolkit proposed by de Boer et al.[1] This method provides accurate information regarding acquired competencies that could help in clinical judgment and the doctor's decision-making process.[1,6] To the authors' knowledge, this study is the first to describe objective data about knowledge

Table 4 Pre- and postcourse answers of participants in case one

Parameter	Precourse, *n* (%)	Postcourse, *n* (%)
Curve pattern		
1[a]	50 (81)	60 (96)
2	4 (6)	1 (2)
3	6 (10)	1 (2)
4	2 (3)	0
5	0	0
6	0	0
Lumbar spine modifier		
A[a]	47 (76)	55 (89)
B	9 (14)	4 (6)
C	6 (10)	3 (5)
Sagittal thoracic modifier		
–	8 (13)	5 (8)
N[a]	51 (82)	54 (87)
+	3 (5)	3 (5)

[a]Correct answer.

Table 5 Pre- and postcourse answers of participants in case two

Parameter	Precourse, *n* (%)	Postcourse, *n* (%)
Curve pattern		
1	2 (3)	2 (3)
2	2 (3)	1 (2)
3	13 (21)	9 (14)
4	5 (8)	1 (2)
5	11 (18)	7 (11)
6[a]	29 (47)	42 (68)
Lumbar spine modifier[b]		
A	5 (8)	1 (2)
B	3 (5)	2 (3)
C[a]	54 (87)	58 (95)
Sagittal thoracic modifier		
−	10 (16)	3 (5)
N[a]	49 (79)	56 (90)
+	3 (5)	3 (5)

[a]Correct answer.
[b]One missed piece of data in the postcourse assessment.

acquisition among young spine surgeons. As a result of the learning strategies used by educators during the course, the participants improved their knowledge of the Lenke classification system. This knowledge acquisition was demonstrated through the decreased number of participants with wrong answers in two cases after the course.

More satisfactory results in the curve pattern of case one were observed than in case two, possibly because the correct answer for case two is Lenke 6. This curve pattern is frequently misclassified as curve 3 because both are double curves. The difference between the two is that in Lenke 3, the main curve is thoracic, and in Lenke 6, it is thoracolumbar/lumbar.

Although orthopedic surgeons are classically more familiar with AIS treatment, every year more neurosurgeons are involved with the disease. Hence, it is necessary to consolidate principles and concepts to create a universal language among spine surgeons that could improve the literature reports. The proper classification of the curve is essential, especially when fusion is considered. The Lenke classification system is commonly used for that purpose.[4] However, despite its broad application, interobserver reliability is considered poor to fair when the degree of professional training is taken into account.[4,7] Surprisingly, 55% of the participants of the present study reported difficulties when applying it, although 89% use it on a routine basis.

The authors applied two learning strategies during two different AOSpine principles courses: oral presentations and a practical exercise using printed X-rays of patients with AIS. The improvement of the students' ability to properly classify AIS curves ranged from 33 to 83%. As previously reported, if only traditional lectures are chosen as an isolated learning strategy, minor changes are expected in the students' behavior as a health professional.[8] In such cases, the amount of information retained is considered low (up to 20%). Educators could expect higher knowledge absorption when students are actively involved and are stimulated to find their own solutions to problems.[8] The relevance of the active participation of the students during AOSPINE diploma curriculum was previously discussed. In the present study, the students were encouraged to think by themselves and, after that, to convince the rest of the participants of the rationale for their thoughts. That fact may have had the most significant effect on the learning process.

The present study has some limitations, such as the small number of participants, which did not allow performing a subgroup analysis. Furthermore, the participants were asked to answer the same questions before and after the course. That fact could have generated a test–retest bias, giving a false impression about knowledge acquisition occurring as a result of the course.

Table 6 Comparison between pre- and postcourse of participants with wrong answer in case one

Parameter	Precourse (*n*)	Postcourse (*n*)	Improvement, *n* (%)	*p* Value
Curve pattern	12	2	10 (83.3%)	0.005
Lumbar spine modifier	15	7	8 (46.6%)	0.049
Sagittal thoracic modifier	12	8	4 (33.3%)	0.309

Table 7 Comparison between pre- and postcourse of participants with wrong answer in case two

Parameter	Precourse (*n*)	Postcourse (*n*)	Improvement, *n* (%)	*p* Value
Curve pattern	33	20	13 (39.3%)	0.018
Lumbar spine modifier	8	3	5 (62.5%)	0.121
Sagittal thoracic modifier	13	6	7 (53.8%)	0.081

Conclusions

This pilot test showed objectively that the learning strategies used during AOSpine courses improved the participants' knowledge. This knowledge acquisition was demonstrated through the decreased number of participants with wrong answers of two clinical cases after the course. Teaching strategies must be continually improved to ensure an optimal level of knowledge transfer.

Disclosures
Alberto Ofenhejm Gotfryd: none
Jose Alfredo Corredor: none
William Jacobsen Teixeira: none
Delio Eulálio Martins: none
Jeronimo Milano: none
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