OVERLOAD STUDY ON ADJACENT DISC AFTER ARTHRODESIS IN THORACOLUMBAR FRACTURES

ABSTRACT
Objective: To analyze the degeneration of the adjacent disc after arthrodesis due to thoracolumbar fractures. Methods: Eighty-three patients who underwent posterolateral arthrodesis in thoracolumbar levels had their x-rays analyzed for degeneration of adjacent discs to the arthrodesis. The disc spaces were classified by the UCLA scale. Results: Of the 83 patients evaluated, 66 were males (79%) and 18 females (21%), with a mean age of 35.5 years. The mean follow-up period was 40 months. As the fractures 75% were between T12 and L2 (p < 0.001), being of the A3 type in 65% of the cases (p < 0.001). The most common mechanism of injury, accounting for 50% of the cases (p < 0.001), was fall from height. Only 6% of the superior discs and 12% of the inferior ones showed some degree of degeneration. No patient underwent a new surgical approach. Conclusion: The incidence of degeneration on adjacent disc in patients after arthrodesis resulting from fractures ranged from 6% to 12% with an average follow-up of 40 months.

Keywords: Spinal fractures; Spinal fusion; Lumbosacral region; Thoracic vertebrae; Intervertebral disc degeneration; Radiography.

INTRODUCTION
Thoracolumbar fractures are the most common fractures of the axial skeleton, corresponding to around 89% of all fractures of the vertebral spine, which mainly occur between T11 and L2.1 In recent decades, the growing number of automobile and industrial accidents has directly increased the complexity of fractures, as has the emergence of new instrumentation techniques, which have led to an increased prevalence of thoracolumbar arthrodesis. This process may take the form of disc degeneration (39%), instability,
facet hypertrophy, disc hernia (28%), stenosis of the spinal canal (33%), vertebral fracture and scoliosis (17%). Its occurrence depends on the type of fusion, due to the increased mobility of the free segments of the fusion, intra-disc metabolic changes, increased intradiscal pressure, or biomechanical changes caused by changes to the spinal column, such as loss of lumbar lordosis.2

With the appearance of ADD, careful considerations were made on the use of fusion implants and new implants, such as dynamic stabilization and the use of artificial discs.5 However, no conclusions have been drawn on this subject as yet i.e. whether ADD is a radiological finding, or a consequence that indicates poor clinical results.3 Some authors still divide the definition of this disease into adjacent level degeneration, in which there are altered imaging exams with asymptomatic patients, or symptomatic patients with compatible imaging exams.8

This article performs a retrospective radiographic analysis of 83 patients with thoracolumbar fracture submitted to posterolateral arthrodesis. It evaluates the behavior of the discs adjacent to the fusions performed, with an average follow-up of 40 months.

METHODS

A retrospective study analyzed by the Institutional Review Board of the Faculdade de Medicina de Marilia (CAAE: 41787115.4.0000.5413), opinion number 965.154. All the patients agreed with and signed the Informed Consent Form.

A retrospective analysis was conducted of eighty-three records of patients seen at Hospital das Clínicas de Marília (FAMEMA), in the period 2000 to 2012, who presented thoracolumbar fractures, treated surgically and with outpatient follow-up. All the patients had undergone posterolateral arthrodesis, with fixation by pedicle screws of 2 to 5 levels.

The radiographic images of the thoracolumbar spine (T4 to S1) on the day of the trauma, and at least 24 months after surgery, were analyzed and compared, by different doctors. The fractures were given an AO score,7 and the discs adjacent to the arthrodesis (upper and lower), by the Scale of the University of California at Los Angeles (UCLA), which was used to measure the radiographic disc degeneration,8 (Table 1) type of trauma and some type of associated lesion.

Inclusion criteria: minimum age of 18 years, last level of arthrodesis of the lumbar spine, minimum of 24 months since surgery.

Exclusion criteria: age below 18 years, any motor deficit, pure thoracic arthrodesis, less than 24 months since surgery, signs of degeneration in the initial radiograph, infection, and patients who have undergone removal of material for any reason.

RESULTS

Of the 83 patients evaluated, 65 were male (78.3%) and 18 female (21.7%); ages ranged from 18 to 51 years, with an average age of 35.6 years (CI 95%: 32.9 – 38.1). A minimum follow-up period of 24 months and a maximum of 115 months was observed, with an average of 40 months (CI 95%. 36.3 – 46.6). All the patients underwent posterolateral arthrodesis with instrumentation using pedicle screws via the posterior route, and decompression.

The fracture levels were T11 – 9 (10.8%), T12 – 20 (24.1%), L1 – 21 (25.3%), L2 – 23 (27.7%), L3 – 9 (10.8%), L4 – 1 (1.2%) (p < 0.001). (Table 2) Graded as A2 – 4 (4.8%), A3 – 55 (66.3%), B1 – 4 (4.8%), B2 – 13 (15.7%), C – 7 (8.4%) (p < 0.001). (Table 3)

Associated lesions, such as head injury, chest trauma, abdominal trauma and/or other fractures, were found in 31 (37.3%) of the patients (p = 0.02).

Types of trauma: automobile accident 31 (37.3%); being run over 2 (2.4%); falling from a height 42 (50.6%); direct trauma 8 (9.6%) (p < 0.001).

Findings of the disc above: grade 1 – 70 (84.3%), grade 2 – 8 (9.6%), grade 3 – 3 (3.6%), grade 4 – 2 (2.4%); disc below: grade 1 – 56 (67.5%), grade 2 – 17 (20.5%), grade 3 – 9 (10.8%), grade 4 – 1 (1.2%). (Table 4) (Figure 1)

Table 2. Level of the fracture (p < 0.001).

| Grade | T11 | T12 | L1 | L2 | L3 | L4 | Total |
|-------|-----|-----|----|----|----|----|-------|
|       | 9   | 20  | 21 | 23 | 9  | 7  | 83    |
|       | 10.8| 24.1| 25.3| 27.7| 10.8| 1.2| 100.0 |

Table 3. Grading of the fractures (p<0.001).

| Grade | A2 | A3 | B1 | B2 | C  | Total |
|-------|----|----|----|----|----|-------|
| Frequency | 4  | 55 | 4  | 13 | 7  | 83    |
| Percentage | 4.8| 66.3| 4.8| 15.7| 8.4| 100.0 |

Table 4. Disc degeneration (UCLA).

| Grade | Disc above | Disc below |
|-------|------------|------------|
|       | Frequency | Percentage | Frequency | Percentage |
|       | Valid     |           | Valid     |           |
| Grade 1 | 1 | 70 | 84.3 | 56 | 67.5 |
| Grade 2 | 2 | 8  | 9.6  | 17 | 20.5 |
| Grade 3 | 3 | 3.6 | 9    | 10.8|
| Grade 4 | 4 | 2  | 2.4  | 1  | 12  |
| Total   | 83 | 100.0 | 83 | 100.0 |

DISCUSSION

Fractures of the thoracolumbar spine are the most common fractures of the axial skeleton, corresponding to around 89% of all fractures of the vertebral spine, which mainly occur between T11 and L2. Two thirds of thoracolumbar fractures occur at the thoracolumbar transition between T11 and L2 (50% of fractures of the thoracic spine at level T12 and 60% of spinal fractures at level L1). The prevalence of fractures in this region is related to the reduction of stability between the thoracic segment (more rigid and stable) and the lumbar (greater flexibility and greater range of movement). These fractures are the result of falling from a height in 47% of patients, automobile accidents in 44.1% and direct trauma 8.8%.14 Disc lesion associated with fracture (at the time of the trauma) should be considered, as this influences the stability and genesis of acute and chronic pain, and can lead to
sagittal imbalance and worsening of the quality of life (pain); however, this is rarely found in the discs adjacent to the levels of arthrodesis in the immediate postoperative period.

Adjacent disc disease (ADD) after fusion of the lumbar vertebral spine is responsible for a significant percentage of revision surgeries of the spine. Although the development of degeneration of the adjacent segment can be considered a normal part of the degenerative process that occurs with aging, this phenomenon appears to be, at least in part, influenced by changes that emerge as a result of the lumbar arthrodesis.16,19

Other studies have been conducted on the disc, which take into consideration the height of the disc and the signs of instability. Wide variation in prevalence is seen; from 5% to 43%, but the need for revision surgeries ranged from 2% to 15%.13,16 in which, in the majority of cases, only decompression of the canal was performed, without increasing the level of the arthrodesis.

Biomechanical studies defend the increased prevalence of adjacent degenerative disease after arthrodesis.9,10,16 Their authors affirm that a possible etiology of degeneration of the adjacent segment after arthrodesis is due to increased stress, or to a hypermobility. Lee and Langrana show that there is increased tension in the adjacent joints of L3-L4 and L4-L5 after lumbosacral arthrodesis.16 A single level of lumbar arthrodesis was studied by Quinnell and Stockdale, who observed that the adjacent disc above was not affected, unlike the disc below, which suffered changes in its characteristics.11 Tests using in vitro models were conducted by Axelsson et al.,17 who found hypermobility of the adjacent segment, thereby proving, biomechanically, that lumbar fusions produce negative consequences on the adjacent disc.

According to Ghiselli et al.,8 the incidence of ADD ranged from 0 to 6.1%, with an average of 3.9% per year, with follow-up of five to ten years. Of these patients, 83.5% and 63.9% were free of disease, respectively, and it was concluded that 16.5% and 36.1%, respectively, would require a new surgical procedure due to the adjacent disc disease.

Park et al.,9 point out the causes that most favor the development of ADD, described in Chart 1. The main factor for non-occurrence of DDA is preservation of the proximal facet, as affirmed by Witte et al.18

By comparing the increased load on the joints, in the different forms of fusion, it is concluded that in posterior arthrodesis this is greatest; in anterior, intermediary and circumferential fusion, there is little effect. ADD has been greater in posterior fusions when compared with circumferential arthrodesis and with anterior fusion.15,19,20

In our study, the vast majority of patients were male (79%) as these are more exposed to traumas. As in the literature, the most frequent level of the fracture was T12 – L2 in 75% of cases, and the most common grade was A3, in 65%.

CONCLUSION

Adjacent disc degeneration (ADD) should continue to be the object of studies, with longer follow-up times, as its incidence is still low in patients with arthrodesis following fractures without previous pathologies and low age group. Within this context, we also emphasize that preservation of the joint facet at the adjacent level above, and sagittal alignment, continue to be the main forms of prevention of ADD.

ACKNOWLEDGEMENTS

We thank the nurse Aparecida Bezerra de Lima, and Ms. Maria Isabel Brichi da Silva for the years of dedication to the Orthopedics and traumatology team of the Faculdade de Medicina de Marília – FAMEMA – Marília (SP), Brazil.

All the authors declare that there are no potential conflicts of interest regarding this article.

CONTRIBUTIONS OF THE AUTHORS: All the authors made individual and significant contributions to the development of the manuscript. GSR, JMSJ, ECMCM and RYO performed the surgeries and followed up the patients. GSR, FZG and RST were the main contributors to writing the manuscript and the data collection. JMSJ, ECMCM, RYO, ABF and RRM revised the manuscript and contributed to the intellectual concept of the study.

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