Instrumented fusion surgery in elderly patients (over 75 years old): clinical and radiological results in a series of 53 patients

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Abstract

Objective To evaluate the clinical and radiological outcomes of elderly (>75 years old) patients who underwent spinal instrumented fusion surgery.

Methods Patients underwent lumbar pedicle screw fixation and fusion for degenerative spondylolisthesis. Clinical and radiological outcomes were assessed.

Results 53 patients were studied. Pre-operative VAS was 7.8, ODI was 47.6 %. 254 screws were placed (36 single level; 13 double levels and 4 cases three-levels). No mortality occurred. At 18 months follow-up VAS was 4.1, ODI was 21.8 %. A stable fusion was observed in 41 patients (78.8 %); in four cases there was minimal sign of instability and seven patients underwent a second surgery due to screw mobilization.

Conclusion Spinal fixation and fusion in patients older than 75 years old grants good results in terms of quality of life but the rate of morbidity is higher than standard spine surgery. Rate of fusion especially is still a critical point.

Keywords Spine surgery · Elderly · Complication · Navigation system · Outcome

elderly patients (defined as age >75 years) has doubled in the 80s and tripled in the 90s and is still increasing as the life expectancy of the population on the rise (up to 86.6 years for women and 81.1 for men in 2,050) [1]. However, even though the improvement of medical, surgical and anaesthesiological care allow the treating of a larger number of elderly patients, the incidence of chronic diseases, illness and disability determine a considerable rate of peri-operative complications, especially for major spinal procedures [3, 5]. Although the necessity to perform elective surgical procedures for the over 75-year-old patients is still under debate, surgeons are required to solve the daily contention between increasing demands on the quality life and the technical problem/morbidity related with instrumented surgery. To date, there are little data on the clinical and radiological outcome following spinal fixation and fusion in elderly patients and the studies present some limitations, mainly due to small populations and the use of heterogeneous evaluation tools [6–8].

The aim of this study was to evaluate the clinical and radiological outcomes of elderly patients who have undergone spinal instrumented fusion surgery.

Introduction

Degenerative diseases of the spine, the so-called “aging spine”, are an entity that has increased over past years, and today represents a relevant part of the daily activity of spine surgeons [1–4]. In fact, the rate of lumbar fusion in

Materials and methods

The population of the present study comprised patients admitted to the Neurosurgical department with a diagnosis of degenerative spondylolisthesis, who underwent a surgical procedure of lumbar pedicle screw fixation and fusion. The data of patients from January 2006 to December 2009 were collected prospectively: neurological examination, Oswestry Disability Index (ODI) [9] and the Visual Analogue Scale (VAS) [10] were collected for each patient. Inclusion criteria comprised age >75 years.

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Fig. 1 Intraoperative spinal navigation. **a** IGS based on a pre-operative spiral CT scan, **b** IGS based on an intraoperative CT scan (O-Arm™ Imaging system)

All surgical procedures were performed, under general anaesthesia, using an image-guided system (IGS) based on computed tomography (CT). The navigation system adopted and used in all cases was the StealthStation® TREON™ (Medtronic, Minneapolis, State of Minnesota, USA). Two types of CT data set adopted for the navigation system were used: before March 2009, all patients underwent a pre-operative spiral CT scan (SOMATOM™ Volume Zoom—Siemens, Munich, Germany) (Fig. 1a), while from March 2009 to the end of the study we had an intraoperative CT scan due to the acquisition of the O-Arm™ Imaging system (Medtronic, Minneapolis, State of Minnesota, USA) (Fig. 1b) [11, 12]. The fusion was achieved using autologous bone deriving from the decompressive laminectomy for lateral fusion. Post-operative management included early mobilization with bracing for 12 weeks starting from the first post-operative day.

The radiological follow-up comprised polyaxial CT scans and flexion–extension radiography. Fusion was defined as the absence of segmental instability on flexion–extension radiography and Bridwell grade I or II on CT scans [13]. Clinical outcome was measured using the ODI and the VAS.

Results

From January 2006 to December 2009 a total of 53 patients (age >75 years old), who underwent surgery for degenerative spondylolisthesis with a lumbar spinal arthrodesis, with pedicle screws/rod rod fixation and posterolateral fusion were suitable for the study. Mean age of the population was 77.8 years (range 75–82); 31 (58.4 %) female and 22 (41.6 %) male. The mean duration of symptoms was 15.3 months (range 9–24). Back pain was the dominant symptom, affecting all of the patients; radiculopathy

Table 1 Incidence of comorbidities

Comorbidities	Patients (%)
0	5 (9.4)
1	27 (51.0)
2	11 (20.7)
3	7 (13.2)
4	3 (5.7)
Mean $\pm$ SD	1.54 $\pm$ 0.7

was present in 38 cases (71.7 %) and claudication neurogenica in 29 patients (54.7 %). The pre-operative VAS was 7.8, while ODI was 47.6 % (severe disability).

The incidence of co-morbidity was of 70.6 % and is summarized in Table 1. 36 (67.9 %) patients presented a single level pathology, 13 (24.5 %) double levels and in 4 (7.6 %) cases three-levels. In 47 cases (88.7 %) the spondylolisthesis was of I grade, while in 6 (11.3 %) it was of grade II.

A total of 254 titanium screws were placed using a CT-based navigation system (mean 4.79 screws/patient, range 4–8), were inserted between L2 and S1. The proper diameter of the screw was selected according to information provided by the CT scan images using the navigation system.

29 (54.7 %) patients were operated on before March 2009, using a pre-operative CT scan: the pre-surgery images of the patients with 3D reconstruction were merged with the surgical anatomy (anatomic landmarks for paired-point matching were registered). After March 2009, in 24 cases (45.3 %), the navigation system adopted images obtained intraoperatively by the O-arm™ system.

The mean operating time was 79.4 $\pm$ 13 (range 55–98) min: between the two types of data set acquisition of CT scans, for the IGS there is a difference of mean surgical time: 86.7 vs. 73.6 min without statistical difference.

No major screw misplacement, requiring surgical correction, was assessed with a CT scan control. A complete correction of the slippage of spondylolisthesis was achieved in 46 cases (86.8 %), while a partial reduction from grade II to grade I was observed in 4 patients (7.5 %) and in the remaining 3 cases (5.7 %) was performed a fixation in situ.

All patients were mobilized on the first post-operative day to at least a sitting position.

The median blood loss was 320 ml (range 210–490 ml). In 4 cases (7.5 %) a dural lesion (due to strict adherence between the dural sac and ligamentum flavum) occurred and primary repair was performed. No spinal drainage was necessary. A sieroma was observed and treated with aspiration in two patients. During hospitalization nine patients (16.9 %) received transfusions of red cell units. 14 patients (26.4 %) referred some discomfort (i.e., nausea, vomiting, stipsis) due to post-operative analgesic drugs (morphine) and the drugs were stopped and changed. Five patients developed cardiac complications (atrial fibrillation, cardiac insufficiency), two pulmonary and five metabolic (diabetes, renal insufficiency). Three patients presented a wound infection, and in one case a surgical toilette was necessary. No mortality occurred. Mean hospitalization was 7.8 days (range 5–21 days).

All patients completed the first follow-up (<6 months) and VAS was 5.6 and ODI 38.1 %. The radiological exams showed initial signs of fusion in 52 cases: in one case bony reabsorption around screws of L5 were detected and the patient underwent revision surgery of the instrumentation. The last follow-up performed at 18.4 months (range 15–20) was completed for 49 patients of the initial 53: one had died and the other three were lost at the follow-up time. The mean final clinical evaluation tools were: VAS = 1.8 and ODI = 21.8 %, with a statistically significant improvement ($p = 0.004$).

A stable bony fusion was documented in 39 patients (79.5 %); in four cases the fusion was considered questionable (minimal sign of instability) and these patients were treated conservatively. 6 (12.2 %) patients were defined as non-fused before the final end-point of follow-up and underwent a second surgery due to screw mobilization. The objective of the revision surgery was the substitution of screws with a higher diameter and implementation of bony fusion (two cases); in five cases a cement augmentation was performed with PMMA and/or posterior lumbar interbody fusion (PLIF) (one case).

Discussion

With the growing life expectancy of the population, the number of patients over 75 years old will also increase

significantly in coming years [1, 14]. Moreover, the demands for a better quality of life and the improvement of technology, as well as medical assistance, have raised the numbers of procedures for these patients. Several surgical options are available at present, depending on the severity and extent of the cases, however, one of the most crucial points to consider for the elderly is the length of surgery and general anaesthesia. It is accepted that a reduction of surgical time grants better results and reduces the comorbidity due to anaesthesia and blood loss. In our experience, the use of neuronavigation and intraoperative CT allows a reduction of surgical time in spinal arthrodesis with a mean time of almost 73 min [11]. Moreover, the use of an IGS based on a CT scan intraoperatively allowed a defining of the bone quality of the pedicle and vertebral body, granting a proper choice of the type of screws, as well as the suitable diameter and length to adopt.

Although in the literature there are no conclusive studies conducted on elderly patients, good clinical results are described with improvements both in VAS and ODI of 45 and 27 %, respectively [2, 3, 6, 15, 16]. Our results are in-line with published data, with a significant score improvement both on VAS and ODI, at the latest check. No mortality occurred in the present population; the overall peri-operative complication rate was of 52.8 % (28 patients): of these, nine patients presented direct surgical-related complications (dural lesion, wound infection and sieroma). The rate of medical and post-operative complications (35.8 %) is higher if compared with the rate of the overall population operated on for the same pathologies (17.4 %) in our department, resulting in a higher mean hospitalization (7.8 vs. 5.9 days). Reviewing the literature, the complication rate in elderly patients operated on for instrumented spinal surgery ranges from 8 to 80 %. A direct comparison of these data is quite difficult due to the heterogeneity of patient selection, surgical procedure and data analysis.

Knowledge of solid fusion rates after arthrodesis in the elderly is a crucial point for choosing surgery for these patients and especially for the proper surgical technique to optimize the fusion rate. In fact, the main concern regarding instrumented spinal fusion in elderly patients is represented by the risk of screw loosening. However, to date there are few series which properly evaluate this aspect of surgery in the elderly. Abdu et al. [17] referred a fusion rate of 80 % at the one-year follow-up, which is only slighter lower than the rate of 85.9 % of series of miscellaneous patients. Similar results were also referred by Fischgrund et al. [18] (83 %), while Tokuhashi et al. [19] found an overall fusion rate of 90.1 %. In our series a stable bony fusion was clearly documented in 39 patients (79.5 %), while in four cases (8.1 %) the fusion was considered questionable and these patients were treated conservatively. A second surgery due to screw mobilization

was necessary in seven patients: one before the first follow-up and six patients (12.4 %) after this end-point. In the present series, the authors used cannulated screws for a cement augmentation with PMMA only for the revision surgery. Recently, (in the last 6 months), this practice has been adopted more routinely in our department if vertebral osteoporosis or osteopenia are present, while the implementation of a PLIF is at present considered in longer construct (≥ 2 levels) and also in the presence of high-degree instability in elderly patients.

Despite increasing efforts to establish a solid fusion, the Cochrane review on fusion for a variety of degenerative conditions of the lumbar spine determined that no conclusions are possible with regards to the relative effectiveness of various fusion procedures (anterior, posterior, or circumferential) [20].

It is generally believed that a more conservative treatment should be chosen for elderly patients due to the higher risks of surgery and lower surgical outcomes, compared with younger patients. The results of this study and the literature suggest that age should not be a limiting factor in choosing a surgical procedure as a therapeutical option in degenerative spondylolisthesis. The choice of treatment for elderly patients, as for all other cases, must depend on the balance of risks and benefits in the treatment itself.

Conclusion

Spinal surgery for fixation and fusion in patients older than 75 years old actually represents a feasible therapeutical option, granting good results in terms of quality of life. Reduction of surgical time, mainly due to the use of a IGS, in our experience, represents a crucial point to reach better results and to reduce the co-morbidity due to anaesthesia and blood loss. However, due to general morbidity as well as the rate of fusion the choice of a surgical treatment for spinal fixation in elderly patients must depend on the balance of risks and benefits in the treatment itself.

Conflict of interest None.

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