

# Instrumented posterolateral fusion – clinical and functional outcome in elderly patients

## Dorsal instrumentierte posterolaterale Spondylodese – klinisch-funktionelles Ergebnis beim älteren Patienten

### Abstract

**Background:** Data on the clinical outcome after spinal fusion in the elderly patient are rare. Limitation of most studies were small population, evaluation of the perioperative complication rate and the radiographic assesment. Therefore the aim of the current study was to evaluate the clinical outcome of patients older than 75 years who underwent a spinal fusion procedure (instrumentation and posterolateral fusion) for degenerative spinal stenosis with instability.

**Methods:** Elderly patients who underwent instrumented, posterolateral fusion were evaluated with regard to functional outcome, fusion rates and complications after a mean follow-up of 3.8 years. Questionnaires were completed by the patients before surgery and at final follow-up. Changes in mean visual analogue scale (VAS) and Oswestry Disability Index (ODI) scores (decrease from the baseline VAS and ODI scores) were evaluated.

**Results:** The mean final follow-up for all subjects was 3.8 years. Of the 58 patients, 1 patient was deceased at the time of the follow-up, 1 patient did not want to participate and 56 patients completed the questionnaires. This resulted in an overall follow-up rate of 96%.

At final follow-up, the patients demonstrated significant improvement in the VAS and ODI scores compared with the preoperative scores.

**Conclusions:** The results of this study shows that elderly patients aged over 75 benefit from instrumented, posterolateral fusion. The study suggests that there is no need to force an intervertebral fusion because elderly patients do not seem to benefit from this procedure.

**Keywords:** posterolateral fusion, intervertebral fusion, elderly, outcome

### Zusammenfassung

**Einleitung:** Aktuell gibt es nur wenige Studien, die sich mit dem klinischen Outcome nach Wirbelsäulenfusion beim älteren Menschen befassen. Die meisten Studien befassen sich vor allem mit dem Komplikationsspektrum nach erfolgter Fusionsoperation.

Ziel der vorliegenden Studie ist es, das klinische Ergebnis von älteren Patienten (>75 Jahre) zu untersuchen, die sich einer instrumentierten Wirbelsäulenoperation mit posterolateraler Fusion unterzogen hatten und mit den Daten der aktuellen Literatur zu vergleichen.

**Methodik:** 58 Patienten (>75 Jahre), die im Zeitraum Januar 2005 bis Juni 2008 operativ versorgt wurden, wurden im Rahmen dieser Studie nachuntersucht. Indikation zur Operation war eine degenerativ, erworbene Spinalstenose mit begleitender Instabilität. Evaluiert wurden das klinische Ergebnis (Oswestry disability index (ODI) und Visuelle Analogskala (VAS): primäres Studienziel), Fusionsraten und Komplikationen nach einem mittleren Follow-up von 3,8 Jahren.

**Ergebnisse:** Von den insgesamt 58 Patienten konnten 56 Patienten in der vorliegenden Studie ausgewertet werden. 1 Patient war zwischenzeitlich verstorben, 1 weiterer Patient war nicht bereit an der Studie

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teilzunehmen. Die Follow-up-Rate entspricht somit 96%. Zum Zeitpunkt des Follow-ups zeigten alle Patienten eine deutliche Verbesserung des ODI und auch der subjektiven Schmerzeinschätzung auf der VAS im Vergleich zur präoperativen Situation

**Diskussion:** Insgesamt zeigte sich, dass auch ältere Patienten von einer instrumentierten Wirbelsäulenoperation mit posterolateraler Fusion profitieren. Im Vergleich zu den Ergebnissen der aktuellen Literatur lässt sich vermuten, dass eine intervertebrale Fusion mit Cage-Implantation nicht zwingend notwendig ist um ein zufriedenstellendes Operationsergebnis zu erzielen. Unter Berücksichtigung des Komplikationsrisikos kann aus Sicht der Autoren durchaus auf eine Cage-Implantation beim älteren Patienten verzichtet werden.

**Schlüsselwörter:** posterolaterale Fusion, älterer Patient, Instrumentierung, spinale Stenose, Instabilität

## Introduction

As the population ages, the number of spinal fusions in the elderly patient is continuously increasing. But there is a historic conflict concerning the safety and efficiency of spinal surgery in the elderly [1], [2], [3].

Data on the clinical outcome after spinal fusion in the elderly patient are rare. Limitation of most studies were small population, evaluation of the perioperative complication rate and the radiographic assessment.

Therefore the aim of the current study was to evaluate the clinical outcome of patients older than 75 years who underwent a spinal fusion procedure (instrumentation and posterolateral fusion) for degenerative spinal stenosis with instability. We evaluated the functional outcome, fusion rates and complications after a mean follow-up of 3.8 years.

## Methods

### Study design

58 patients older than 75 years who underwent spinal fusion surgery in the period from January 2005 to June 2008 were evaluated after a mean follow-up of 3.8 years. The surgery and follow-up was performed by the author (S.E.). Preoperative diagnoses were degenerative spinal stenosis with instability (Figure 1).

All patients underwent fusion with pedicle screws and rod instrumentation (Tango RS, Fa. Ulrich, Germany) with posterolateral fusion. The bone graft for posterolateral fusion was a mix of Endobone® and autologous bone obtained from the decompression procedure. Wide central laminectomy, partial resection of the facet and a foraminotomy was performed in all patients.

Postoperative management included early mobilization with bracing for 12 weeks on the first postoperative day. The patient population received a lumbar fusion with posterolateral fusion (male/female: 38/20, mean age: 80.5 years (range 73–88 years)). The average number of fused levels was 1.8 (range 1–5). The review of anesthesia records for the patients showed that 7 patients

were of ASA (American Society of Anesthesiologists) class I, 31 of ASA class II and 20 were of ASA class III (Table 1).

**Table 1: Patient characteristics**

Sex (male / female)	38 / 20
Age	80.5 (73–88)
Operation time	88 min
Blood loss	470 ml (320–580 ml)
Transfusion red cell units	0.35 (0–2)
ASA class I	7
ASA class II	31
ASA class III	20
Level of fusion (avg)	1.8 (1–5)

## Outcome parameters

All patients who were still alive in July 2010 were given the questionnaires including the Oswestry Disability Index (ODI) [4] and a visual analogue scale (VAS) score to assess their functional outcome and quality of life. Questionnaires were completed by the patients before surgery and at final follow-up. Changes in mean VAS and ODI scores (decrease from the baseline VAS and ODI scores) were compared.

Fusion was assessed at final follow-up on plain anteroposterior and lateral radiographs using the criteria suggested by Christensen et al. [5].

Additional the time of surgery, the need of red cell transfusions and the need of re-surgery were documented.

## Ethical board statement

Ethical board approval of the University of Münster, Germany for the current study was given by the ethical board [AZ 2010-218-f-s].



**Figure 1:** Exemplary preoperative X-ray of a degenerative spinal stenosis and instability. 75-year-old female patient with spinal stenosis and instability L2 to L4. Walking distance of 30 m.

## Statistical analysis

The data were analyzed using SPSS software (version 10.0; SPSS, Chicago, IL), and statistical analysis was performed. The dichotomous variables were compared using the Fisher exact and  $\chi^2$  tests. The P-values were based on the Student t-test for independent variables. The threshold for statistical significance was established at  $P \leq 0.05$ .

## Outcome assessment

The mean final follow-up for all subjects was 3.8 years. Of the 58 patients, 1 patient was deceased at the time of the follow-up, 1 patient did not want to participate and 56 patients completed the questionnaires. This resulted in an overall follow-up rate of 96%.

At final follow-up, the patients demonstrated significant improvements in VAS and ODI scores as compared to preoperative scores.

The mean VAS score was 8.8 before surgery, and 5.2 at final follow-up, showing 45% improvement (Figure 2). The mean ODI score was  $53.43 \pm 10.12$  before surgery, and  $39.01 \pm 14.02$  at follow-up, showing 27% improvement (Figure 3).

Fusion rate was determined by plain radiographs evaluated by the author (S.E.) and an independent radiologist. 46 of the 56 subjects demonstrated signs of posterolateral fusion, 6 subjects were questionably fused, and 4 were defined as non-fused.

The average intraoperative blood loss was recorded as a mean of 470 mL (range 320–580 mL). Length of stay averaged 11.6 days (range 7–18). Average time of surgery

was 1 h 28 min. The need for transfusions (red cell units) was on average 0.35 (range 0–2).

## Discussion

The life expectancy of the population is increasing and is up to the year 2050 for women 86.6 and for men is 81.1 years. The population share of very elderly (80 years and older) is about 4% and will rise by 2050 to 12–13% [6]. Therefore it must be assumed that as a result of the increasing proportion of the elderly population, the frequency of symptomatic degenerative spinal stenosis with concomitant instability will increase. The rate of lumbar fusions to treat degenerative diseases has doubled in the eighties and tripled in the 90s [7], [8], [9].

In the past, sometimes even today, the age was considered as contraindication for elective spinal surgery, so that older patients were treated conservatively. However that leads to physical pain and limitations in quality of life [10], [11].

While still in the recent past, a surgical treatment of symptomatic degenerative spinal stenosis with concomitant instability was seen as too risky [1], the demands on the quality of life of affected patients steadily increased, so the demand for adequate and lasting solutions by the affected patients also proceeds and remains not only a question of the technical opportunity.

Several surgical options are available depending on the severity and the extent of spinal stenosis and instability. The variety of the surgical procedures varies from laminotomy or wide central laminectomy alone to an anterior release with posterior decompression and fusion with instrumentation. The surgical risks and complications

## Visual analogue scale

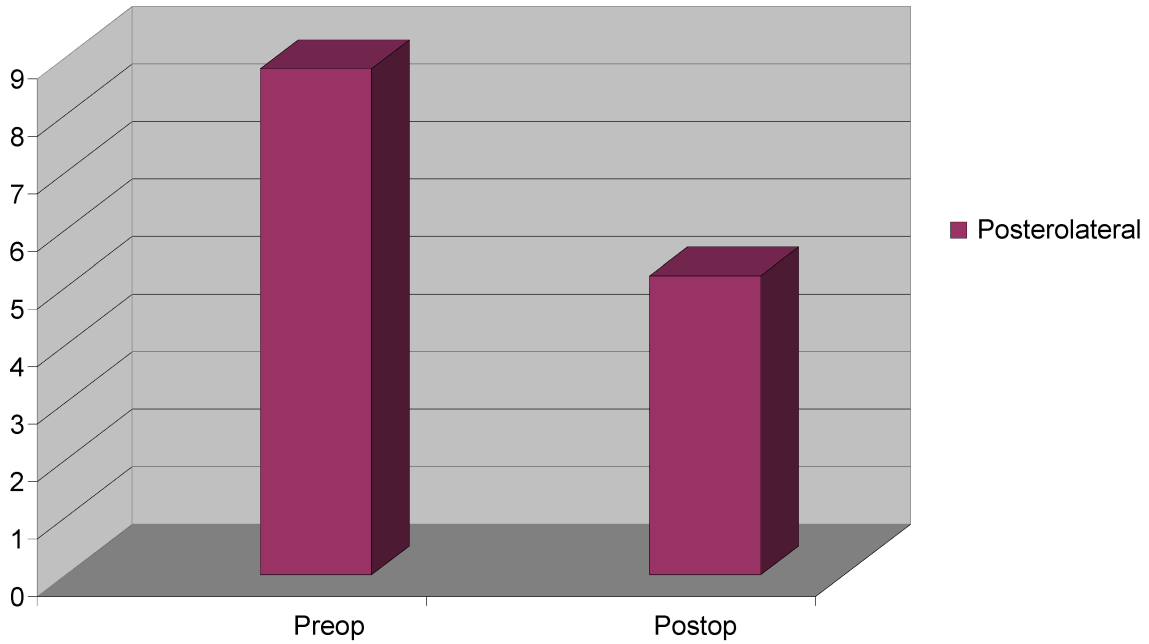


Figure 2: Course of VAS

## Oswestry Disability Index

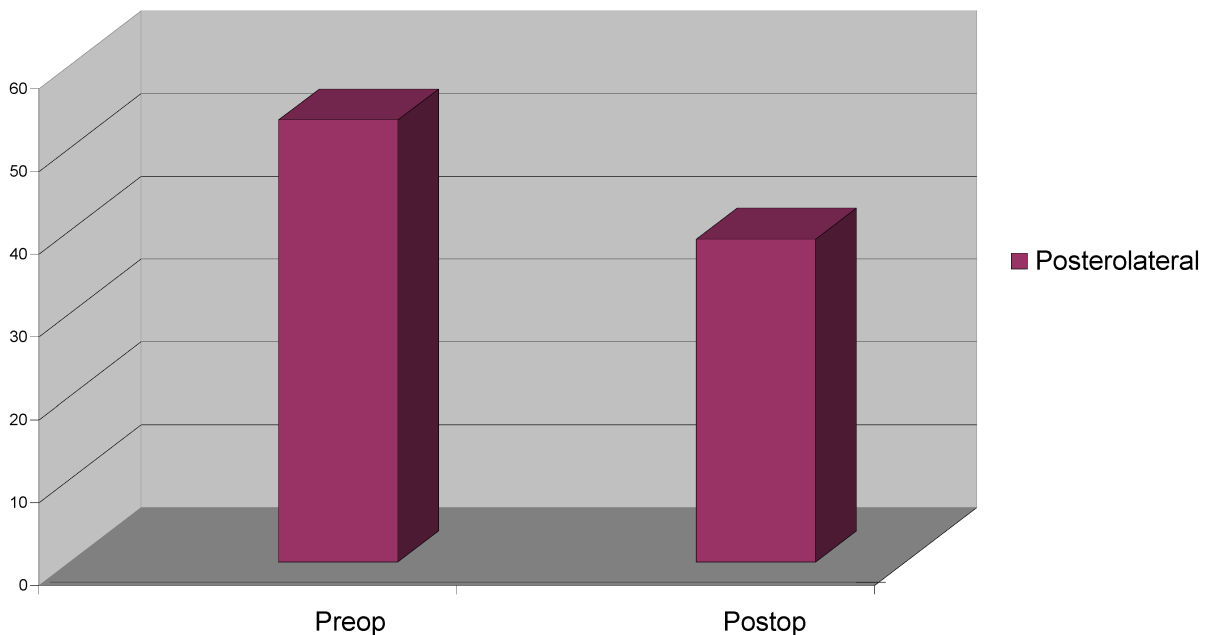


Figure 3: Course of ODI

are higher because of advanced age, medical co-morbidities, lower bone density, and more spinal stiffness. The main objective of the surgical selection is to achieve the greatest benefit with the least complex intervention.

Wide central laminectomy alone is not recommended because it can lead to further instability and progression of the instability.

In the present work the authors performed a wide central laminectomy to decompress the neural structures and an instrumented posterolateral fusion to stabilize the

spine and evaluated the clinical outcome in these patients.

Reviewing the literature, there are many studies dealing with the clinical outcome after spinal fusion surgery [12], [13], [14].

But the literature reveals different opinions about when fusion is indicated and how it should be done. Especially the question how to treat degenerative spinal stenosis with concomitant instability of the elderly and the question of whether it is necessary to do an intervertebral fusion by implanting a cage or a posterolateral fusion (deposition of bone, bone substitutes) is sufficient remains controversial.

The literature on complications after spinal surgery of elderly patients varies from 8 to 80%, with the further differentiation of the rate of minor complications that do not lead to prolongation of hospital stay, usually accounting for more than half [2], [15], [16], [17], [18], [19], [20], [21], [22].

The existing studies show that the assessment of success after spinal fusion surgery in the geriatric patient has been focused on the perioperative complication rate, with little attention directed toward improvement in function, quality of life, patient satisfaction, or improvement in perceptions of pain and the need for medication.

Looking at the most recent literature a number of authors have examined the role of pedicle screw fixation as an adjunct to posterior lumbar fusion (PLF) following decompression in the geriatric patient.

Okuda et al. were the first who assessed a large number of elderly patients by health status questionnaires after posterior lumbar interbody fusion. But they compared patients with a mean age of 74 and patients with a mean age of 59. They found no differences in the clinical and functional outcome between both groups and stated that it is a safe and accurate procedure for geriatric patients [23].

Bridwell et al. performed a prospective study of 44 patients with claudication symptoms and stenosis due to degenerative spondylolisthesis. They distinguished between decompression alone (Group I); decompression and noninstrumented fusion (Group II); and decompression and instrumented fusion (Group III). Outcomes were assessed using a satisfaction scale approximately 3 years following surgery. The authors noted improved radiographic and functional outcomes among patients in Group III [24].

Fischgrund et al. performed a prospective clinical trial of 68 patients with spinal stenosis and instability who were divided into one of two groups: decompression and PLF and decompression and PLF supplemented with pedicle screw fixation. Fusion rates were assessed by plain and dynamic radiography, and clinical outcomes were assessed using a VAS for pain as well as a patient satisfaction scale. The patients treated with pedicle screw fixation had a statistically significantly higher fusion rate (83%). Both groups demonstrated significant score improvements on the VAS for both back and leg pain and the majority of patients reported their outcomes as good or

excellent. This paper provides evidence that pedicle screw fixation improves fusion rates and that pedicle screw fixation does not improve functional outcome following PLF [25].

Andersen et al. reported that superior outcomes after lumbar spinal fusion in elderly patients can be achieved by use of instrumentation. But their aim of the study was to compare instrumented and non-instrumented lumbar spinal fusion performed using fresh frozen allograft in patients older than 60 years with regard to functional outcome and fusion rates. The outcome was better in patients in which a solid fusion was obtained. However instrumentation was associated with a larger number of additional surgeries, which resulted in a lesser degree of improvement [26].

Tokuhashi et al. evaluated the clinical outcome of elderly patients who underwent posterior instrumentation and posterolateral fusion over a mean follow-up of 8.2 years. They found an overall fusion rate of 91%. No major complications or perioperative death was observed and they concluded that the procedure was useful for maintaining the grade of independence for activities of daily living, at least in selected geriatric patients [27].

Using the ODI and VAS, we found a significant improvement in life after a mean follow-up of 3.8 years. With regard to complications, including intraoperative blood loss, need for transfusion of red cell units and surgical time, there was a difference to the recent literature showing a possible superiority for the posterolateral fusion in comparison to intervertebral fusion techniques.

But for posterolateral fusion techniques sometimes it is challenging to achieve an adequate improvement in sagittal spinal balance of the lumbar spine. This might influence the clinical outcome over time and might be the cause for persistent low back pain after surgery in degenerative lumbar spine disease.

Even if several investigators have stressed the importance of maintaining sagittal balance to avoid lumbar “flat back”, accelerated adjacent segment degeneration, pain, and inferior functional outcome only limited evidence exists on how sagittal alignment affects clinical outcome. The use of intervertebral fusion as well as devices with adequate restoration of sagittal spinal balance must not have an effect on clinical outcome [28], [29].

Explanation for this phenomenon is that in addition to sagittal balance, clinical outcomes of instrumented lumbar fusion in patients with degenerative lumbar spine disease are influenced by a variety of pathophysiologic factors, including residual compression of the neural tissues, recurrence of spinal canal stenosis, irreversible changes to the nerve root, or cauda equina.

The present study has some limitations. The duration of the follow-up was relatively short. The long-term results of this surgical procedure are needed. The second issue is that the fusion rate in the present study could only be evaluated indirectly as conventional X-ray was used for follow-up. Owing to ethical issues concerning high radiation, CT scans were not performed. In addition, clinical outcome should be considered as the most relevant cri-

terion for success of the procedure. Moreover, it was demonstrated by Pfeiffer et al. that there is a weak correlation between intervertebral fusion and the clinical symptoms of the patient [30].

Nevertheless, no broken screws or rods were found in the present study. It might indicate that good stability of the spine was achieved.

## Conclusion

The results of this study show that elderly patients over 75 benefit from instrumented lumbar posterolateral fusion. With regard to clinical and functional outcomes, a posterolateral fusion seems to be sufficient. Additionally, the intraoperative blood loss, need for transfusions and surgical time are reduced for elderly patients receiving posterolateral fusion.

## Notes

### Competing interests

The author declares that he has no competing interests.

### Funding

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