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Trends of postoperative length of stay in spine surgery over 10 years in Japan based on a prospective multicenter database

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ABSTRACT

Objectives: To identify factors associated with prolonged length of stay (LOS) in spine surgery, with the goal of establishing details of LOS for multiple diseases and surgical procedures.

Patients and methods: The subjects were patients who underwent spine surgery at 10 facilities in the Nagoya Spine Group from January 2005 to December 2015. Data were collected for patient background, primary spinal pathology, anatomical location of the lesion, and surgical methods. The primary outcome was LOS, which was defined as the calendar days from surgery to hospital discharge.

Results: A total of 10,829 patients (5953 males, 4876 females; age 5–93 years, mean 60.2 ± 28.8 years) were identified in the database. Average follow-up was 61 months (range: 13–120 months). Average LOS was 22.3 ± 21.3 days, and there was a gradual decrease in LOS over the study period. LOS was significantly correlated with age, and prolonged LOS was significantly associated with thoracic spine surgery and significantly longer after surgery with instrumentation. Average LOS was > 30 days for intramedullary tumor resection and posterior cervical fusion, but only 10.2 days for microendoscopic discectomy. Reoperation was performed in 210 patients (1.9%) and these patients had a significantly higher average LOS of 43.1 days.

Conclusion: These results will assist quality improvement in spine surgery. The identified risk factors for prolonged LOS will also assist in planning of surgery, postoperative care, and discharge, with the goal of reducing health care costs.

1. Introduction

A society with over 20% of residents aged 65 or older is defined as a super-aging society. In 2006, Japan became the first super-aging society, and its aging rate is unparalleled worldwide [1] and unprecedented in absolute terms. This rapid aging of society has increased the number of elderly patients with osteoporosis and other progressive degenerative diseases. Recent advances in surgical techniques and anesthesia have also increased the demand for spinal surgery in elderly patients and have increased surgeries performed for improvement of quality of life [2–5]. Advanced spine surgical methods, such as imaging techniques, minimally invasive surgery (MIS), percutaneous pedicle screws (PPS), and intraoperative navigation systems have emerged in recent years. Consideration of sagittal alignment has also become increasingly important [6], and demands for spinal fusion procedures have increased as a result of the rising elderly population. These factors have changed the broader indications for surgery and the treatment goals.

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With these advances, surgery is a major source of health care costs and a target for cost reductions. One such strategy in national health policy is so-called episode-based bundling [7]. Length of stay (LOS) is an important factor determining health care costs in patients undergoing spine surgery. Thus, to reduce medical expenses in Japan, shortening of LOS and moving to a bundled payment system are now national policies. Prolonged LOS is also associated with an increased risk of complications and morbidities after surgery [8,9], and such complications and severely-ill patients increase hospital resource utilization and worsen outcomes [10]. Previous studies of increased LOS after spine surgery have identified associations with morbid obesity, metabolic syndrome, black race, open vs. minimally invasive surgery, age, chronic obstructive pulmonary disease (COPD), use of antidepressants, unemployment, chronic renal disease, and intraoperative fluid volume [11–19].

Spinal surgery is performed for many different conditions, including trauma, degenerative diseases, and congenital diseases, and using procedures with or without instrumentation. LOS for all spinal surgery has not been previously examined. The purpose of this study was to identify factors associated with prolonged LOS in all spine surgery, including details for each disease and surgical procedures, in a multicenter study in Japan over a 10-year period.

2. Materials and methods

The study was performed as a retrospective analysis of a prospectively maintained database of patients who underwent spine surgery at 10 facilities in the Nagoya Spine Group (NSG) from 1 January 2005 to 31 December 2015. The average follow-up period was 61 months (range: 13–120 months). The details of surgery were determined by spine surgeons who were certified by the Japanese Spine Surgery and Related Research (JSSR) society at each facility.

In spinal surgery in Japan, preoperative examinations are generally performed as an outpatient, and patients are hospitalized the day before the operation. After surgery, all patients received acute rehabilitation care, and stitches were removed on about postoperative day 10. Patients were discharged if the wound and general conditions were stable. If there was a motor deficit after surgery or it was difficult for the patient to return home, we suggested transfer to a multidisciplinary rehabilitation program that consisted of sessions with a physical therapist or occupational therapist. This standard care consisted of isometric and dynamic exercises, and included general aerobic fitness work; stretching; stability exercises; strengthening and endurance training for the back, abdominal, and leg muscles; and ergonomic training. Each exercise had a series of levels to permit progression and accommodation of patients with mixed levels of ability.

A questionnaire was prepared to capture clinicopathological and surgical information. Every year, a recordable optical disc for data storage was sent to the 10 facilities of the NSG, and annual data were returned by the end of March of the following year. Clinicopathological data included patient information and primary spinal pathology (degeneration, trauma, tumor, infection, deformity). The requested surgical information included the anatomical location of the lesion (cervical, thoracic, lumbar), surgical approaches, surgical technology, decompression methods, and instrumentation. The primary outcome was LOS, which was defined as the number of calendar days from the operation to hospital discharge. The study protocol was approved by the Institutional Review Board (IRB No. 354-3) at our hospital.

Differences between two groups were analyzed by Mann-Whitney U test, Student t-test, and Chi-squared test. A Pearson correlation coefficient was calculated for the correlation between LOS and age. All analyses were conducted using SPSS ver. 22 for Windows (IBM, Chicago, IL). $P < 0.05$ was considered to be significant in all analyses.

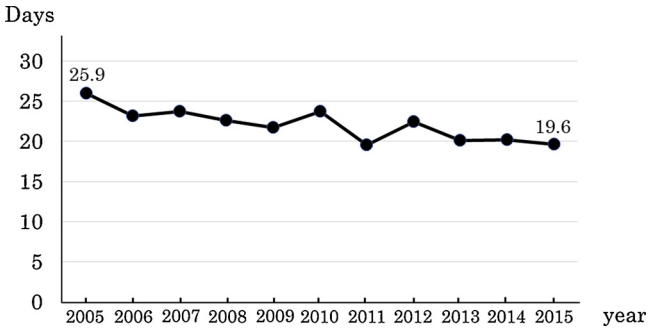

Fig. 1. LOS during the study period.

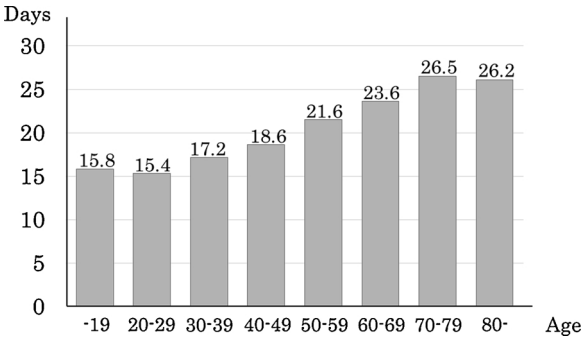

Fig. 2. LOS distribution in the surgical registry from 2005 to 2015.

3. Results

A total of 10,829 patients were identified in the database, including 5953 males and 4876 females. Age ranged from 5 to 93 years, with a mean of 60.2 ± 28.8 years. The average LOS was 22.3 ± 21.3 days, and there was a gradual decrease in LOS over 11 years (Fig. 1). The mean LOS in patients in their 70 s, 80 s, and 90 s was over 26 days (Fig. 2), and LOS was significantly correlated with age ($p < 0.05$) (Fig. 3). Prolonged LOS was also significantly associated with thoracic spine surgery ($p < 0.05$) (Fig. 4), and LOS was significantly longer after surgery with instrumentation compared to that without instrumentation ($p < 0.01$) (Fig. 5). Among major surgical procedures, intramedullary (IM) tumor resection and posterior cervical fusion (PCF) had on average LOS of > 30 days, whereas intradural extramedullary (IDEM) tumor resection, posterior corrective fusion in adolescent idiopathic scoliosis (AIS), lumbar decompression, and microendoscopic

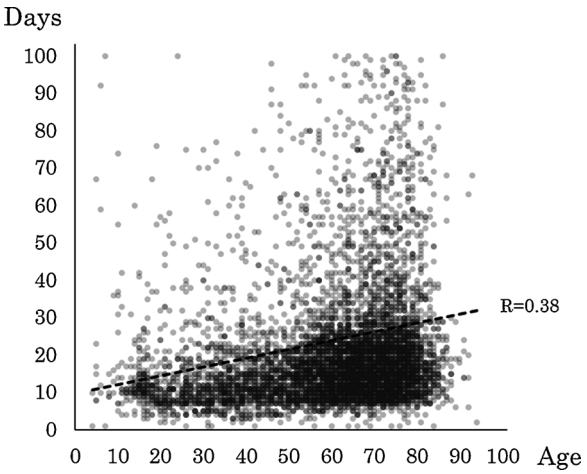

Fig. 3. A significant positive correlation was observed between LOS and age ($p < 0.05$).

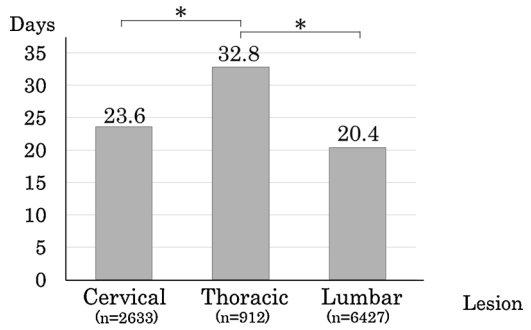

Fig. 4. LOS in patients with different surgical lesions. *p < 0.05 vs. thoracic or lumbar lesions.

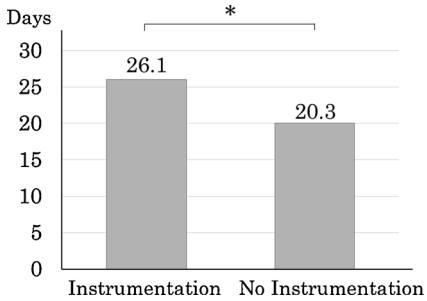

Fig. 5. LOS in patients with or without instrumentation. *p < 0.01 vs. without instrumentation.

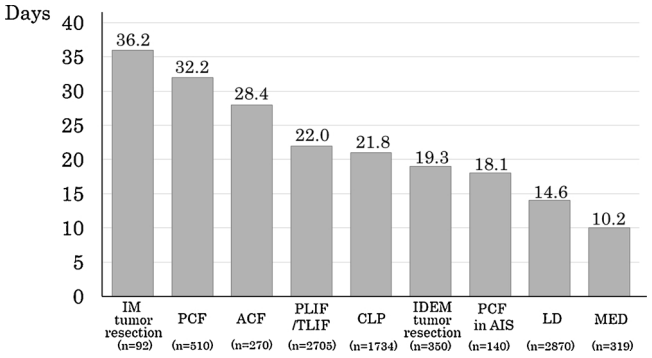

Fig. 6. Details of LOS in each surgical procedure. IM: Intramedullary, PCF: Posterior cervical fusion, ACF: Anterior cervical fusion, PLIF: Posterior lumbar interbody fusion, TLIF: Transforaminal lumbar interbody fusion, CLP: Cervical laminoplasty, IDEM Intradural extramedullary, PCF: Posterior corrective fusion, LD: Lumbar decompression, MED: Micro endoscopic discectomy.

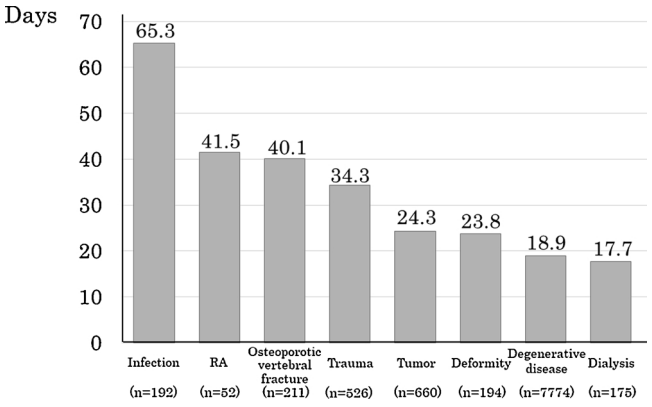

Fig. 7. Details of LOS in each disease.

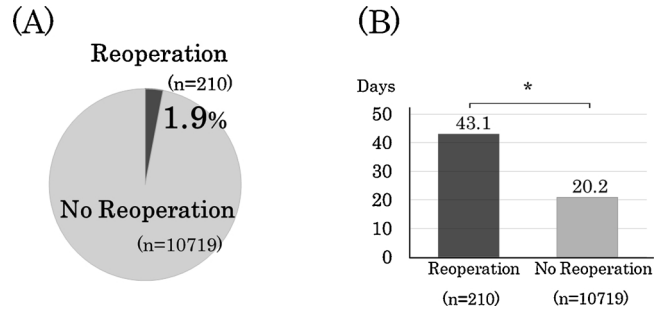

Fig. 8. A) Percentage of reoperation cases. B) LOS in patients with or without reoperation. *p < 0.01 vs. without reoperation.

discectomy (MED) had on average LOS of < 20 days. In particular, the average LOS was 10.2 days after MED (Fig. 6). Surgery for infection had the longest LOS, followed by patients with rheumatism and osteoporotic vertebral fracture (Fig. 7). Reoperation was performed in 210 patients (1.9%), with the main causes being SSI in 141 patients (67%), postoperative epidural hematoma in 45 (21%), and screw misinsertion in 11 (5%). Patients who underwent reoperation had an average LOS of 43.1 days ($p < 0.01$) (Fig. 8).

4. Discussion

In Japan, aging of society has resulted in an increase in the age of patients and in health care costs. Therefore, more efficient functional recovery from surgery and capacity improvement are required in hospitals. LOS is at the core of many quality improvement initiatives because it reflects the quality of care delivered to patients and is directly related to health care costs [7,20]. Prolonged LOS is likely to increase health care expenditures; thus, surgeons and providers are seeking ways to improve cost-effectiveness while maintaining or improving outcomes in an era of rising healthcare costs [21]. Shortening the number of hospital days is required by medical system reform, and further expediting discharge will lead to a reduction in medical costs. This also has benefits for patients and their families, and may be associated with a decreased incidence of perioperative complications, early ambulation, and improved perioperative functional status in elderly patients.

Previous reports have identified operative time, blood loss, instrumentation, and transfusion as risk factors for increased LOS after spine surgery [13–15,19,21,22]. An increased number of fused levels and increasing age also seem to be risk factors [22]. However, these reports have focused on specific procedures such as ACF, PLIF, and corrective fusion in degenerative scoliosis [10,23–27]. To our knowledge, there have been no large-scale studies of LOS in general spinal surgery.

This study provides a clear understanding of the current situation of LOS after general spine surgery in Japan. Previous reports have shown that elderly patients have higher comorbidity and postoperative complication rates [2–5], and these findings are consistent with those in our series. We also found instrumentation to be a risk factor for prolonged LOS. This may be due to patients requiring fusion having more severe degenerative conditions than those requiring non-fusion surgery, and because more complicated surgeries require larger exposure and longer operation times, both of which can affect surgical outcomes adversely. Thoracic surgery also led to extension of LOS, which may be because walking disorder due to thoracic myelopathy required time to improve and allow postoperative walking. In addition, IM tumor resection tends to be accompanied by muscle weakness after surgery [28,29] and the patient takes a long time to recover, which leads to prolonged LOS. In infection, LOS prolongation is inevitable due to long-term treatment with antibiotics, which may require longer hospitalization. The reoperation rate in this study was 1.9%, and 88% of reoperations were due to SSI and postoperative epidural hematoma. Reoperation

significantly extends the number of hospital days, and this emphasizes the important of reduction of complications in all cases.

Despite these results, we also found that LOS after spine surgery has generally decreased over the past decade. This is consistent with the trend for decreased LOS after other orthopedic procedures [30–32]. All patients in Japan have public insurance that uses a fixed payment system that is evaluated based on the Diagnosis Procedure Combination (DPC). A bundled payment system is now a national medical policy. These changes may have decreased LOS over the past decade, and might have reduced medical expenses. In our series, all surgeries at each facility were performed by spine surgeons who were certified by the JSSR. The time of stabilized gait was used as a criterion for discharge, which is common in the medical environment in Japan. In general, hospitalization was required until the wound site and walking ability had stabilized, and this might explain the longer LOS in our study compared to that in other countries.

There were several limitations regarding the tracking of hospital LOS. First, a number of factors were not captured in the study, including details of preoperative demographics, health economics, socioeconomic factors, insurance status, employment status, and living conditions. In particular, neurological status for radiculopathy or myelopathy, and health-related QOL outcome data were not available. Furthermore, we could not confirm whether patients stayed in hospital for rest until just before surgery, or were hospitalized before surgery at another hospital. Second, an uninsured patient may require additional time to obtain medical assistance for rehabilitation placement or home physical therapy, or a patient may be unable to obtain transportation home, despite being ready for discharge. All of these factors prolong LOS. Third, data for LOS in Japan differ from those in other countries. However, despite these limitations, this is the first large scale report on LOS after spinal surgery with identification of risks factors for prolonged LOS, and we believe that the results will be of benefit to surgeons and patients.

The current study indicates that there has been a gradual decrease in LOS after spine surgery over 11 years. LOS prolongation is associated with age, thoracic surgery, and instrumentation, and appropriate choice of surgical procedures is important to reduce LOS. Being mindful of the identified risk factors will assist in obtaining informed consent before surgery, surgical planning, discharge planning, and optimization of postoperative care, with the goal of reducing health care expenditures by decreasing the number of cases with prolonged LOS.

Consent

This study was approved by the IRB of Nagoya Spine Group Hospital. All patients have signed consent forms for this study.

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Conflict of interest

The authors have no financial conflicts of interest.

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