Screw loosening and Migration after Dynesys Implantation

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Due to the problems associated with rigid fixation, the concept of dynamic stabilization was introduced. Dynesys is one of the pedicle screw-based dynamic stabilization systems. In spite of the dynamic nature of Dynesys, there are concerns about the rigidity of the Dynesys system. We present a case of vertebral body split fracture after Dynesys implantation in a 74-year-old woman. She had undergone L2-L5 laminectomy and Dynesys implantation for spinal stenosis 15 months ago. She was discharged with improvement in lower back pain and claudication. Follow-up X-ray images were taken at 1, 3 and 6 months and there was no evidence of screw migration. During the follow-up period, she received selective root block due to persistent leg pain. Eight months after the operation, she visited our hospital due to severe lower back pain. Magnetic resonance imaging showed the features of lumbar spondylitis from L2 to L5. Plain X-ray and computed tomography images showed the presence of a superiorly migrated screw at L5. The screws migrated superiorly into the intervertebral disc space creating a bony defect resembling a sagittal migrated fracture. The Dynesys system was removed and lumbar spondylitis was treated with antibiotics. The aim of the present case was to demonstrate the problems caused due to rigidity of the Dynesys system, when postoperative infection occurs after Dynesys implantation.

Key Words: Dynesys • Screw loosening & migration • Infection

INTRODUCTION

Chronic low back pain due to degeneration of the intervertebral disc that has not responded to conservative measures has traditionally been treated by fusion of the affected levels. However, the problems associated with rigid fixation have led us to find adjuncts and alternatives to spinal fusion. Several non-fusion technologies have been introduced as an alternative to fusion procedures in the past decades. Hence, in the recent years, the approach for designing the spinal implants has changed from achieving stable fusion to achieving mobile non-fusion that attempts to lower the incidence of adjacent segment degeneration (ASD) after rigid fusion. Non-fusion technology can be categorized into several types: pedicle screw-based dynamic stabilization systems, artificial discs, nucleus prostheses, total facet arthroplasty system, and interspinous process

spacers.

Dynesys® (Zimmer, Inc., Warsaw, IN, USA) is one of the pedicle screw-based dynamic stabilization systems and it has been used in the clinical field since 1994^{1,3}. The Dynesys consists of pedicle screws, flexible spacers and cords and is intended to control segmental motion and to realign the lumbar spine. Currently, it is also indicated after decompressive surgery for spinal stenosis to neutralize noxious forces and restore normal function of the spinal segment⁴. In spite of the dynamic nature of the Dynesys, it is still rigid due to the compressive force (300 N) applied during assembly of the instrument¹. Being a pedicle screw-based system, problems related to pedicle screws may occur. Problems such as loosening or fracture of the screws, similar to those after rigid fixation were also observed after Dynesys implantation in 3-18% of patients^{4,10}. We experienced sagittal migration of a screw which created a bony defect resembling a sagittal migrated fracture after Dynesys implantation. Although the complication in the present study occurred in an extreme condition of spondylitis which weakened the bone, this case highlights the problems related to inherent rigidity of the Dynesys. To the best of our knowledge, the present case may be the first case to demonstrate the complication of screw loosening and migration due to infection after Dynesys implantation.

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CASE REPORT

A 74-year-old woman was admitted due to lower back pain and claudication. The symptoms started five years ago and were medically intractable. Magnetic resonance (MR) imaging showed spinal stenosis from L2 to L5 (Fig. 1). Instability was not evident on flexion-extension plain X-ray. Bone densitometry showed no evidence of osteoporosis (T-score, -0.9)¹¹. She underwent laminectomy & Dynesys implantation from L2-L5 (Fig. 2). The operation was uneventful and she was discharged when there was partial improvement in the symptoms. Since she received selective root block 4 months after the operation to relieve the leg pain, the pain was tolerable during the follow-up. Plain X-rays were taken at 1, 3 and 6 months after the operation and there was no evidence of mechanical failure. However, 8 months after the operation, the patient visited our hospital complaining of severe lower back pain which had started 2 weeks ago. MR imaging showed diffuse enhancement of the paravertebral muscles and vertebral bodies from L2 to L5 suggesting lumbar spondylitis (Fig. 3). Plain X-ray and computed tomography images revealed a superiorly migrated screw at L5. The screw migrated superiorly into the intervertebral disc space creating a bilateral bony defect in the L5 vertebral body, resembling a sagittal split fracture of the vertebra (Fig. 4). The levels of infection markers (Erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP)) were elevated in blood analysis. Bone biopsy revealed that the pathogen was methicillin-resistant *Staphylococcus epidermidis*. Due to uncontrolled infection in spite of susceptibility to antibiotics (vancomycin), the complete Dynesys system was removed.

The lower back pain gradually improved along with reduction in infection with the use of vancomycin for 6 weeks. Although the lower back pain has improved, the pain is still substantial.

DISCUSSION

Fusion is generally thought to be the treatment of choice for painful degenerative disease of the lumbar spine that has proven unresponsive to conservative management. For a long time, good results were thought to be dependent on radiologically confirmed solid fusion, although in recent studies, patients with adjacent segmental degeneration showed the same clinical outcome as patients with solid fusion have challenged this belief. It was on this basis that the concept of “nonfusion” for manag-

Fig. 2. This lumbar spine X-ray shows that the patient underwent laminectomy & Dynesys implantation from L2-L5.

Fig. 1. This lumbar spine MRI shows multi-level spinal stenosis.

Fig. 3. After 8 months, lumbar spine MRI shows diffuse enhancement of the paravertebral muscles from L2-L5.

Fig. 4. This image shows that the screw migrated superiorly into the intervertebral disc space creating a bilateral bony defect in the L5 vertebral body, resembling a sagittal migrated fracture of the vertebra.

ing painful degenerative disease of the lumbar spine was developed. Initial in vitro studies were able to prove the potential biomechanical advantages of a dynamic neutralization system (Dynesys) for the spine: bending angles and horizontal translations were significantly reduced, although not abolished, while vertical translations were increased and bulging of the posterior annulus was decreased. Clinical use of the Dynesys semi-rigid instrumentation began in 1994. Since then, various individual case studies have been presented, showing restoration of disc height and improvements in Modic changes after Dynesys¹⁰, and the clinical results from some case series have been evaluated and presented at local research meetings. Based on the promising findings, the Dynesys system now enjoys wide clinical application throughout the world. Therefore, the Dynesys the 'dynamic neutralization system' maintains a ROM and prevents ASD (adjacent segment degeneration).

One major concern about the dynamic stabilization system is the possibility of implant failure¹². A case of implantation of a broken Dynesys pedicle screw in a multiple sclerosis patient with abnormal gait pattern has been reported by Schnake et al., Schaeren et al. and Di Silvestre et al. reported no implant-related complications (screw loosening or breakage) in another series of 29 patients^{13,14}. The incidence of screw loosening and the percentage of patients with implants in the current study were similar to that in the previously presented data. Stoll et al. 4 reported loosening of 10 screws in 7 patients out of total 280 screws (3.6%). In 1 of the 7 patients, a radiologically suspected screw loosening correlated with clinical symptoms and necessitated a secondary intervention at postoperative 14.5 months. Moreover, the postoperative complications following Dynesys implantation are vertebral body and pedicle fractures, screw loosening, screw malplacement, complete implant removal, Dynesys extension (adjacent stenosis).

Chien-Lin Liu, MD stated that when the Dynesys was implanted in a finite element (FE) model, the Dynesys system

was able to maintain spinal stability and reduce loading on disc and facet at the surgical level, but greater ROM, annulus stress, and facet loading were found at the adjacent level. In addition, profile of the screw placement caused only a minor influence on the ROM, annulus stress, and facet loading, but the screw stress was noticeably increased¹⁵.

Fabio Galbusera, MD stated that with the use of a finite element model no significant differences were observed in the ROM variations at the adjacent segments among all the fixation rods, both rigid and semirigid¹⁶. Based on the results in his paper, the use of semirigid rods e.g. Dynesys, may not be effective in preventing early degeneration of the adjacent segments, and these semirigid rods have higher stiffness that may cause increased ROM limitation.

Therefore, the inherent rigid nature and recoiling force (physical term force which moves backwards balancing the momentum produced by external pressure of the Dynesys induces vertebral body fracture and screw loosening. At a particular age, injury to the facet joint of the adjacent segments, fusion length, sagittal alignment, a pre-existing degenerative disc disease at the adjacent level, female gender, a postmenopausal state, osteoporosis, and lumbar stenosis are the potential risk factors for inducing ASD.

We have to remember that in the patients who have the above mentioned risk factors, the use of the Dynesys system should be carefully considered³.

CONCLUSION

We report a rare case of mechanical failure of the Dynesys system that caused a screw loosening and migration after Dynesys implantation. Due to the inherent rigid nature and recoiling force of the Dynesys, screw loosening and migration may occur in extreme conditions such as postoperative infection.

Therefore, bone quality should be prudently considered before the application of the Dynesys system.

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