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Case report

Successful detection of postoperative improvement of dynamic sagittal balance with a newly developed three-dimensional gait motion analysis system in a patient with iatrogenic flatback syndrome: A case report

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ABSTRACT

A 75-year-old Japanese woman with Parkinson's disease complained of lower back pain and gait disturbance because of iatrogenic flatback syndrome. The preoperative global spinal parameters were as follows: C7SVA, 168 mm; TK, 52°; LL, −0.8°; PI, 57°; PT, 55°; TPA, 60°. We performed 3D gait analysis using a VICON System and calculated the dynamic SVA. Preoperatively, her flexion deformity gradually progressed during walking. The dynamic parameters gradually increased as follows: thoracic SVA, 216–241 mm; lumbar SVA, 53–69 mm; spinal SVA, 270–311 mm. We performed two-stage corrective surgery. Her lower back pain and gait disturbance significantly improved. The postoperative global spinal parameters were as follows: C7SVA, 1 mm; TK, 47°; LL, 61°; PI, 52°; PT, 20°; TPA, 13°. Dynamic SVA detected by our 3D gait analysis using VICON were as follows: thoracic SVA, 128 mm; lumbar SVA, 4.9 mm; and spinal SVA, 133 mm. The postoperative dynamic SVA did not change during walking.

This is the first report of a patient with iatrogenic flatback syndrome whose postoperative improvement of dynamic spinal sagittal alignment was successfully detected with a newly developed 3D gait analysis system that enabled us to analyze a dynamic change of SVA based on the patient's actual walking with a continuous long-distance gait. Our 3D gait analysis has potential usefulness for evaluating postoperative sagittal balance for iatrogenic flatback syndrome.

1. Introduction

Iatrogenic flatback syndrome is a sagittal kyphotic deformity with postoperative lumbar lordotic reduction because of lumbar spinal fusion at an unsuitable lumbar lordosis and injury of posterior tissue by posterior spinal decompression/fusion [1,2]. Sagittal imbalance causes lower back pain and gait disturbance; it affects health-related quality of life [3,4]. Static alignment evaluation with lateral whole spine radiographs is the gold standard for diagnosis and evaluation of postoperative changes. In patients whose balance worsens while walking, static alignment evaluation is insufficient. This report describes our new system of three-dimensional (3D) gait motion analysis for evaluating dynamic spinal alignment that detected postoperative improvement in dynamic spinal sagittal alignment in a patient with iatrogenic flatback syndrome.

2. Case presentation

A 75-year-old Japanese woman with lower back pain and gait disturbance had lumbar surgeries at another hospital: posterior L3-4 interbody fusion for lumbar canal stenosis (age, 70 years); and posterior L2-3 interbody fusion for adjacent segment disease (age, 71 years). At 72 years of age, she began treatment for Parkinson's disease (Yahr stage III). Her sagittal kyphotic deformity deteriorated. Rehabilitation was ineffective. She was referred to us for corrective surgery. A preoperative, standing, whole spine radiograph showed severe thoracolumbar kyphosis with the following parameters: C7 sagittal vertical axis (SVA), 168 mm; thoracic kyphosis (TK), 52°; lumbar lordosis (LL), −0.8°; pelvic incidence (PI), 57°; pelvic tilt (PT), 55°; T1 pelvic angle (TPA), 60°.

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A 3D motion analysis was performed using a VICON MX™ System (Vicon, Oxford, UK), comprising 16 cameras and 38 reflective markers on her head, spine, pelvis, upper and lower limbs. Wireless surface electromyogram (EMG) analyses were performed (Tringo™ Lab System, Delsys, Boston, MA, USA), with 12 sensors on her sternocleidomastoid, trapezius, latissimus dorsi, erector spinae, abdominal rectus, and quadriceps muscles bilaterally. The 3D motion and EMG analyses were interconnected to achieve synchronous measurement. The patient was asked to walk continuously at a comfortable pace around an oval course. We calculated dynamic SVA from the VICON System; the parameters were the sagittal distances between reflective markers on the spinous

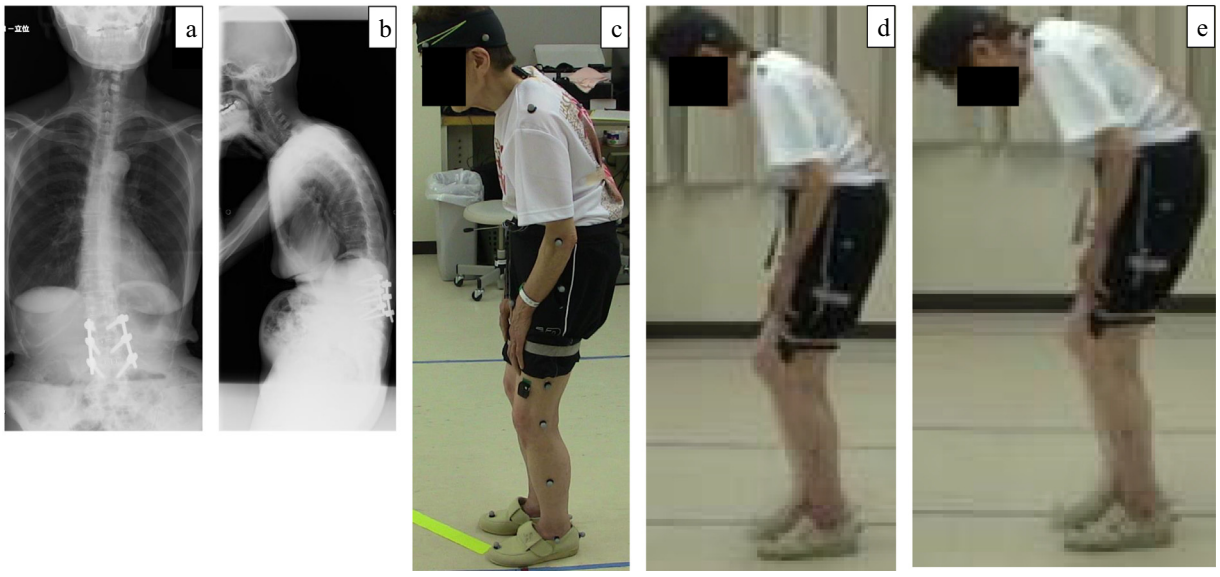

Fig. 1. Preoperative radiographs and posture: (a, b) Whole spine radiograph showing severe thoracolumbar kyphosis after lumbar spinal fusion at L2-L4. (c) Lateral posture on standing. (d) Lateral posture during gait analysis immediately after the patient started walking. (e) Lateral posture during gait analysis just before the patient finished walking showed the progression of spinal kyphosis.

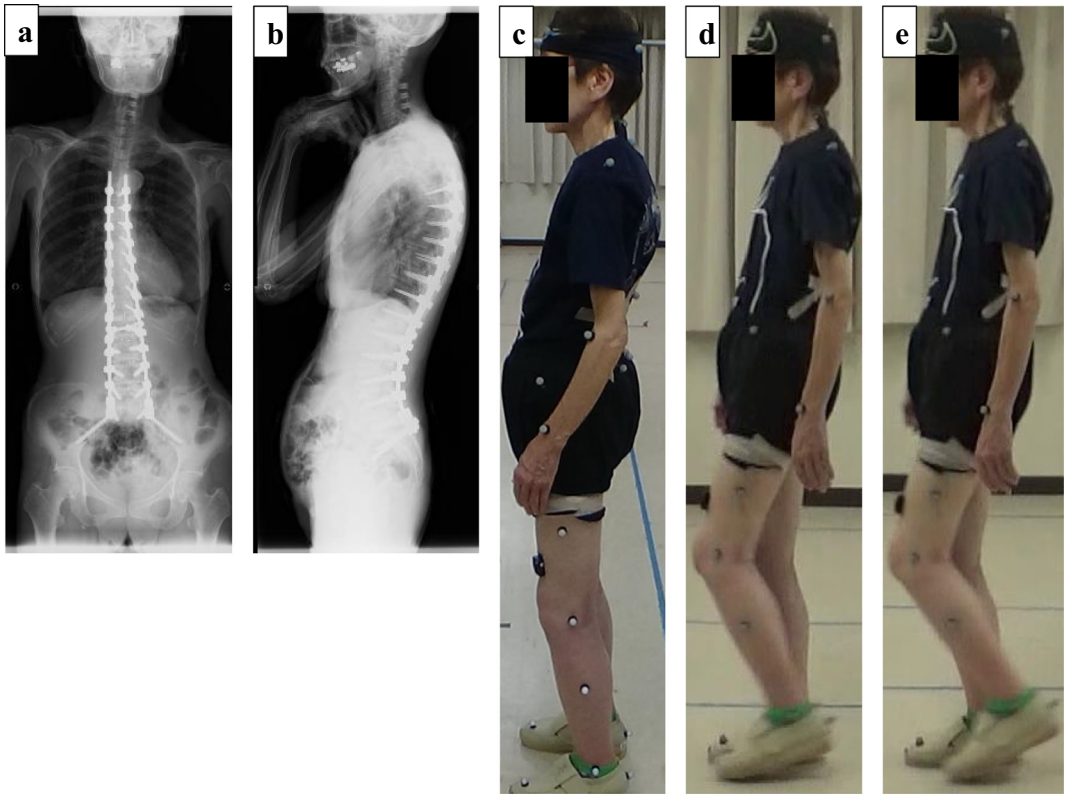

Fig. 2. Postoperative radiographs and posture: (a, b) Whole spine radiograph showing good correction of the spinal kyphotic deformity. (c) Lateral posture on standing. (d) Lateral posture during gait analysis immediately after the start of walking. (e) Lateral posture during gait analysis just before the patient finished walking showing preservation of her corrected posture.

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