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[Case Report] Acquiring Walking with Lower Leg Prosthesis by Passive Shoulder Blades and Improved Trunk Range of Motion: A Case Report

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Abstract

I report the first case of a patient who presented with lower thoracic vertebral deformity and difficulty walking with a prosthesis but had improved the range of motion of the thorax and achieved walking with a lower leg prosthesis. The patient was a 75-year-old man with a history of arteriosclerosis and renal failure following treatment for malignant lymphoma. Due to a traffic accident, the patient developed an arteriosclerotic thrombus in his left artery below the knee, resulting in below-knee amputation. Regular rehabilitation with additional trunk stretching was performed. As the range of motion of the trunk expanded, the movement improved. At the time of discharge, he was able to walk with a single T-cane. Enhancing the range of motion of the trunk may contribute to the acquisition of prosthetic locomotion and expand indications.

Keywords: leg prosthesis, walking, thoracic vertebral deformity.

Introduction

In a previous study [1], the author reported that patients with thoracic spinal deformity in the coronal plane had an average 70% lower expectation of achieving an independent prosthesis gait. In one epidemiological study [2], it was reported that the walking ability of people with deformed spinal alignment in the sagittal plane decreased with age. In a previous review [3], it was shown that spinal segmental movement disappeared due to osteophyte formation between vertebral bodies. In addition, in a study of spinal segmental movements during walking [4], vibrational movements of the spinal segment were observed on the coronal and sagittal planes of the spine, and changes in vibrational movements and gait speed decreased when gait conditions became more difficult. Considering these findings, there may be a relationship between well-balanced walking movements and segmental movements of the thoracic spine. However, a method for obtaining well-balanced walking motion when the thoracic spine is deformed, and segmental motion is reduced has not yet been clarified. We report the first case in which segmental movement was presumed to be diminished due to deformation

of the thoracic vertebral body; however, good gait balance was obtained by training the range of motion of the scapulothoracic joint and trunk. The study protocol was approved by the institutional reviewed boards of the Hospital (2020C-002), with participants' written informed consent for this study implied by the return of the questionnaires.

Case Report

A 75-year-old man presented with a history of hypertension, arteriosclerosis obliterans, and chronic renal failure associated with the treatment of malignant lymphoma. After a car accident, the patient had an arteriosclerotic thrombotic occlusion in his left popliteal artery and underwent below-knee amputation at an acute care hospital. He was admitted to our hospital 36 days after the surgery to create a prosthesis, although wound healing was delayed. Upon admission, the phantom limb pain remained, a part of the amputated end was dissociated, and treatment was required. The Berg Balance Scale [5] scored 0, and it was difficult to turn over. He needed help in getting up from bed and maintaining a sitting position. Chest radiography showed an osteophyte deformity on the coronal plane of the middle and lower thoracic vertebrae (Fig. 1), and chest computed tomography (CT) showed a bone spine deformity between the anterolateral vertebrae of the thoracic vertebrae (Fig. 2). Since it was expected that it would be difficult to walk, he underwent manual manipulation of adduction and abduction to the upper corner of the scapula in addition to normal rehabilitation on the 7th day after admission. He was then instructed to perform trunk extension, flexion, rotation, and lateral bending self-training. Exercise evaluation was performed in a sitting position with according to the Berg Balance Scale. At the beginning of his instruction, he could not reach forward, pick up objects from the floor, or look back. On the 14th day, he was able to get up and his wheelchair movement became independent. Next, the rowing movement in the sitting position was instructed for self-training to stretch the thorax. He was trained with a temporary prosthesis and started walking on both crutches on the 56th day. At this point, he was able to pick up and reach but could only turn to the side. On the 60th day, independent walking with double crutches was achieved. The epithelialization of the wound was delayed, and it was difficult to adjust the prosthesis. However, on the 103rd day, he could walk indoors 1 km or more and outdoors 500 m or more with the T-cane. Even at this point, it was impossible to look back in the sitting position, and phantom limb pain remained. At discharge, the patient was walking freehand indoors, and with the T-cane when walking outdoors.

Discussion

Age<65 years, lower amputation level, good balance ability, and no comorbidity at admission are associated with successful prosthesis walking [6]; however, this case only satisfies the amputation level. The spinal segmental motion may be changed to adjust the balance [4] as the walking condition changes. Although it is presumed that the segmental motion pattern of the spine is an important factor, the effect of the decline in segmental movement remains unelucidated. Considering that the author's report [1] could be caused by a decrease in balance ability due to a decrease in segmental movement of the thoracic spine, the expansion of the range of motion of the trunk, in this case, may have contributed to the improvement of balance ability. Although it has been previously reported that training in trunk strength improves balance ability [7], this case suggests that improvement in trunk flexibility may be related to balance ability.

Previous studies [8] have reported a relationship between the range of motion of the scapulothoracic joint and rotation of the trunk. Another study [9] has reported that lateral flexion and axial rotation of the trunk are coupled in the thorax. In addition, the reaching movement, which is associated with balance, has been reported to be associated with hip flexion, thoracic flexion, and thoracic rotation [10]. In this case, the range of motion of the scapulothoracic joint was believed to be expanded by mobilizing the superior angle of the scapula, which increased the range of rotation of the thorax and, as a result, expanded the trunk range of motion. Although it is presumed that improvement in scapula movement affected the range of motion of the trunk and improved balance ability, detailed motion was not checked in this case, and further research is needed on the movement of the scapula.

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Figures

Figure1

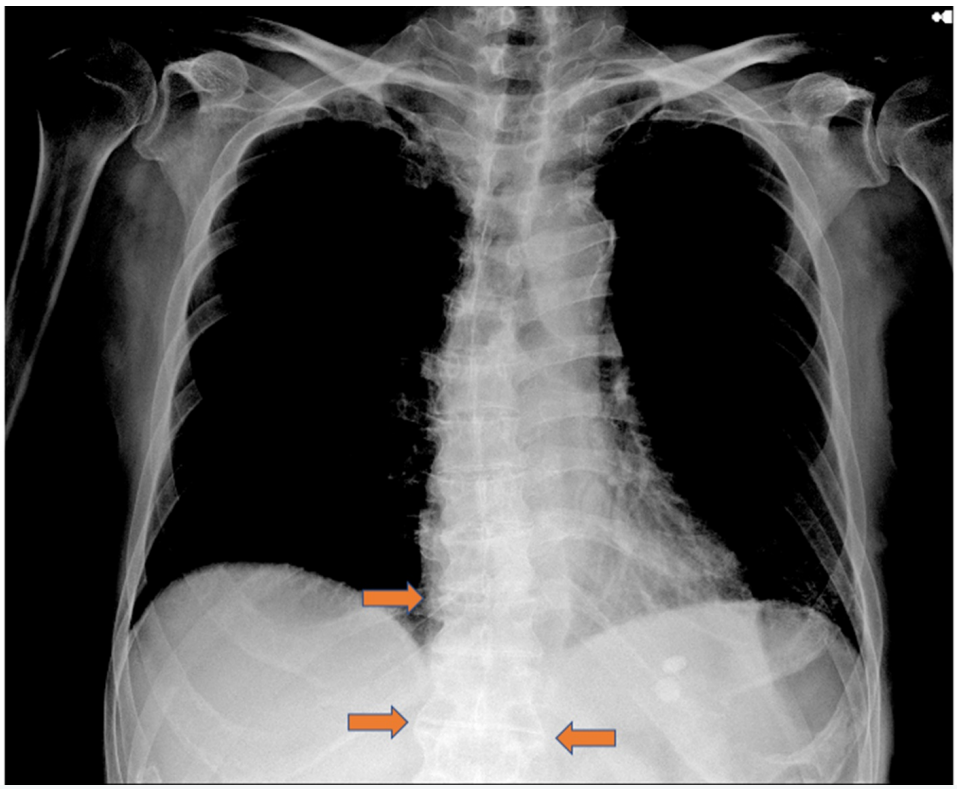

Figure 1. Presence of bridging osteophytes between the thoracic vertebral body in the lower thoracic spine

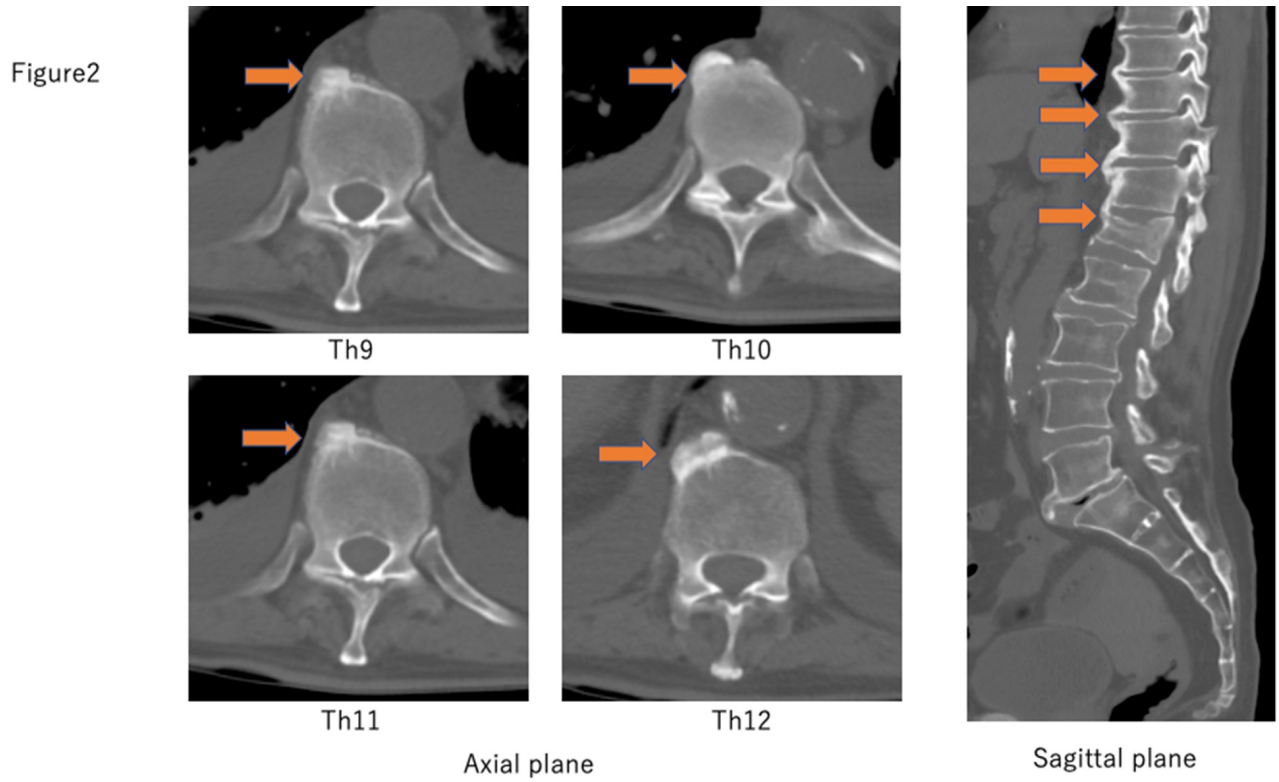

Figure 2. CT images show right anterior bridging osteophyte formation between the 9th and 12th thoracic vertebrae

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