

*CASE REPORT*

## **Six Minutes Walking Test as Assessment in Determining Fitness to Work After Spinal Tuberculosis Post Stabilization and Comprehensive Rehabilitation: A Case Report**

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### **ABSTRACT**

**Introduction:** Spinal tuberculosis is the most common extrapulmonary skeletal form of tuberculosis that can lead to neuromuscular deficit. Neuromuscular deficit may include paraplegia in both legs, inability to perform daily activities, and an increased risk of loss of occupation.

**Case Presentation:** A 37-year-old male presented with a chief complaint of weakness in both legs and was unable to stand properly without assistance. This patient was diagnosed with spinal tuberculosis, confirmed by MRI. The rehabilitation program was designed for 6 months, focusing on the preservation of cardiorespiratory endurance and planning a return to work. Evaluation of physical fitness and working ability was carried out using the 6-Minute Walking Test (6MWT) and Work Ability Index (WAI) questionnaires to determine whether the patient was fit to work. Six months after the rehabilitation program, the patient showed moderate physical fitness and a WAI score of 37 indicating fitness to work.

**Conclusion:** Complications of spinal tuberculosis can cause disability in daily activities and result in loss of occupation. In this case, after six months of a comprehensive rehabilitation program and evaluation of fitness capacity, the patient can return to work but still needs more support of his work ability than before the illness.

**Keywords:** Spondylitis, tuberculosis, rehabilitation, work ability index

## ABSTRAK

**Latar Belakang:** Tuberkulosis tulang belakang merupakan tuberkulosis ekstra paru pada tulang yang dapat menyebabkan defisit neuromuskular. Defisit neuromuskular diantaranya dapat menyebabkan paraplegia pada kedua tungkai, disabilitas dalam melakukan aktivitas keseharian, serta meningkatkan risiko kehilangan pekerjaan.

**Ilustrasi Kasus:** Seorang laki-laki usia 37 tahun mengeluhkan kelemahan pada kedua tungkai yang progresif dan tidak dapat berdiri mandiri tanpa bantuan. Pasien mendapatkan diagnosa tuberkulosis tulang belakang yang dikonfirmasi dengan Magnetic Resonance Imaging (MRI). Program rehabilitasi di desain selama 6 bulan berfokus pada pemulihan kekuatan dan ketahanan kardiorespirasi serta mempersiapkan pasien untuk kembali bekerja. Evaluasi kebugaran fisik dan kemampuan bekerja dilakukan menggunakan 6-Minute Walking Test (6MWT) and kuesioner Work Ability Index (WAI) untuk menentukan kesiapan pasien kembali bekerja. Setelah 6 bulan melaksanakan program rehabilitasi, pasien menunjukkan kebugaran fisik derajat sedang dengan skor WAI 37 yang mengindikasikan pasien cukup bugar untuk kembali bekerja.

**Kesimpulan:** Komplikasi dari tuberkulosis tulang belakang dapat menyebabkan disabilitas pada aktivitas keseharian dan dapat menyebabkan kehilangan pekerjaan. Pada kasus ini, setelah enam bulan pasien mengikuti program rehabilitasi komprehensif dan evaluasi kapasitas kebugaran, pasien dapat kembali bekerja, namun masih membutuhkan pendukung untuk melakukan pekerjaannya dibandingkan sebelum sakit.

**Kata Kunci:** spondilitis, tuberculosis, rehabilitasi, work ability index

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## INTRODUCTION

Spinal tuberculosis is the most common extrapulmonary form of skeletal tuberculosis, which is mostly located in the thoracic and lumbar regions. Epidemiologically, the incidence of spinal tuberculosis is 1% of all tuberculosis cases and almost 50% of skeletal tuberculosis cases.<sup>1</sup> The most predisposing factors for spinal

tuberculosis include poverty, overcrowding, and malnutrition.<sup>2</sup>

The first symptoms are neurological deficits of the lower extremities like pain in the thoracic region followed by numbness and paralysis of the upper or lower extremities depending on spine level. Delay in diagnosis and treatment leads to disease progression to complete paraplegia or tetraplegia.<sup>3</sup> Patients with complete paraplegia or tetraplegia will have disruption of daily activities such as difficulty in walking, self-care, and management of the bowel and bladder. Emotional instability often follows physical disturbances: mainly anxiety, fear, and depression.<sup>4</sup> Early diagnosis is an important factor for successful therapy, improving the prognosis and thus increasing quality of life.<sup>3,4</sup>

A late complication is emerging deconditioning syndrome that is associated with immobilization. Long-term immobilization induces changes in musculoskeletal and cardiorespiratory function leading to physical decline and increased disease complications.<sup>5</sup> Declining physical fitness implies the inability to resume the activities of daily living.<sup>6</sup> Currently, there are several modalities commonly used to evaluate functional cardiorespiratory fitness like the Six Minutes Walking Test (6MWT), the 30-second modified Sit to Stand Test (30-mSTS), and the 4-meter gait speed.<sup>7</sup>

The most common clinical exercise test to evaluate cardiorespiratory functional capacity is a 6MWT, which is practically a simple examination. The test requires only a 100-foot walking track and the patient's ability to walk according to his walking speed. From the result of 6MWT, we can evaluate functional capacity fitness as one of the indicators in determining the fitness of patients to return to work.<sup>8</sup>

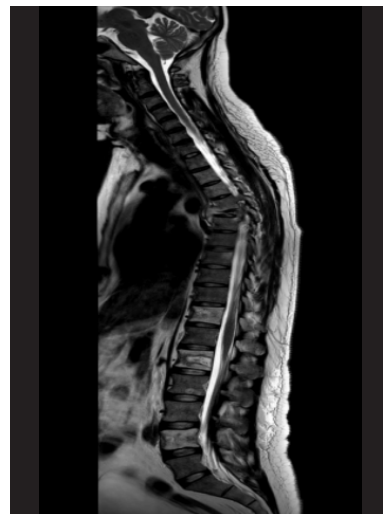
This study aims to evaluate the patient's functional capacity with spinal tuberculosis after stabilization and deconditioning syndrome as one of the indicators of determining fitness to work after comprehensive rehabilitation.

## CASE PRESENTATION

A 37-year-old male presented with a complaint of gradual-onset weakness and inability to walk in both extremities for one month before being admitted to the hospital. Weakness of both extremities caused the patient not to carry out daily tasks and eventually not to go to work. The patient's family and relatives did not have similar complaints or history of illness as the

patient. Previously, the patient was an employee in a freight forwarding service, responsible for recording the packets that were sent. In daily work, the patient needs to sit in front of a computer and does not require a lot of changing positions or lifting of heavy objects.

Diagnosis of spinal tuberculosis was confirmed by MRI that found spondylitis at levels T4 to T6, T8, T11 to L4 with destruction of corpus T5 along with paravertebral abscess and epidural abscess at levels T4 to T6 causing severe canal stenosis and spinal oedema. Motoric and sensory function was evaluated by International Spinal Cord Society (ISCS) score and concluded with SCI ASIA Impairment Scale (AIS) B level Thoracal 4. Furthermore, functional capacity assessment was evaluated by m30STS with a resulting score of 5. Activities of daily living ability were evaluated using the Modified Barthel Index (MBI) resulting in a score of 35 which means fully dependent in all activities.



**Figure 1. Non-contrast MRI of the whole spine, weighted sagittal view: hyperdense at T4 to T6, T8, T11 to L4 and destruction of corpus T5 along with paravertebral abscess and epidural abscess at levels T4 to T6 and signs suggestive of spinal oedema.**

The patient underwent surgical procedures for debridement, decompression, and posterior stabilization. After surgery, the patient was assigned to comprehensive rehabilitation programs that focus on reducing the effects of prolonged bed rest, preserving motoric strength, increasing cardiorespiratory function, achieving a better quality of life, and returning to work eventually.

Rehabilitation programs started with the application of a Thoracolumbar Sacral Orthosis (TLSO) brace that is used to minimize pain and position posture to maintain vertebral stabilization. The next rehabilitation program aims to preserve cardiorespiratory endurance and muscle strength through active and passive range-of-motion exercises in the upper and lower extremities. After being discharged from the hospital, the patient then followed a comprehensive rehabilitation program focused on further improvement of cardiorespiratory function and muscle strength through continued physical exercise such as sit-stand exercise, arm ergocycle exercise, and quadriceps muscle strengthening. This rehabilitation program's final goal was to restore the patient's physical fitness as before the illness so he could return to work.



**Figure 2. Arm ergocycling exercise for cardiorespiratory endurance and preparation for using an assistive device, performed twice a week for 30 minutes.**



**Figure 3. Performing 6MWT stress testing on a 30m track**

## RESULT

Six months after comprehensive rehabilitation programs, the ISCOS score improved from SCI AIS B to AIS D, and a better functional capacity was measured by the Modified Barthel Index with a score of 95 and an m30STS test with a score of 17. Currently, the patient has been able to walk around the house for around 1 km without an assistive device, however, he still tires easily. Furthermore, as the patient could walk, we performed a 6MWT examination to evaluate the cardiorespiratory functional capacity. The results of 6MWT obtained a walking distance of 381 meters which means a score of 13,9 for VO<sub>2</sub>max and 3,9 for METs. This result showed that the patient has a moderate cardiorespiratory fitness level. Evaluation continued to ensure that the patient was fit to work using a work ability index (WAI) questionnaire. The WAI questionnaire assesses the work ability of the patient when he planned to return to his previous work. The WAI result score was 37, which means that the patient's ability to work was categorized as a good level. At this level, the patient could

return to his previous work with the support of surrounding environment modification.

## DISCUSSION

Neurological deficit and functional impairment may occur in patients with spinal tuberculosis.<sup>4</sup> In this case, the patient experiences numbness and paraplegia as neuromuscular deficits and disabilities. The earliest signs of spinal tuberculosis are pain followed by weakness of lower extremity, thoracic cage muscle weakness and numbness of extremities, eventually leading to paraplegia or tetraplegia.<sup>3</sup> Due to weakness, patients alter their lifestyles and activities leading to even further weakness and atrophy of skeletal muscles, which causes further disability due to disuse atrophy and weakness.<sup>9</sup> Physical immobilization in turn can lead to diminished cardiovascular fitness and general deconditioning.<sup>6</sup> Immobilisation alters muscle mass volume within only 2 weeks and is accompanied by decrease of 6%-40% of muscle strength.<sup>5</sup>

The key point in spinal tuberculosis rehabilitation is performing rehabilitation programs immediately after stabilization surgery.<sup>10</sup> In a previous study of Brucellosis spondylitis cases, those who underwent a rehabilitation program scored significantly higher on motor score evaluation and improved functional outcome evaluation by Modified Barthel Index (MBI) at discharge.<sup>10</sup> MBI is an ordinal scale with a total score of 100. This score shows the level of independence and the ability to work ranging from 0 (totally dependent) to 100 (fully independent). The scores consist of 10 domains related to activities of daily living: feeding, bathing, grooming, dressing, bladder control,

bowel control, toileting, chair/bed transfer, mobility, and stair climbing. The first seven items are evaluated for activities of daily living (ADL) (maximum score of 70) and the last three for mobility (maximum of 30). The MBI scores should be evaluated on admission and at the end of the rehabilitation program.<sup>10</sup>

Proper positioning in the acute phase after surgery followed by early passive, active-assisted, and active exercises will improve standing ability and accelerate mobilization to allow for further rehabilitation programs.<sup>11</sup> In our study, the acute phase early rehabilitation program focused on the prevention of prolonged bed rest complications and early mobilization assisted by Thoracolumbar Sacral Orthosis (TLSO) braces while the patient was in the in-patient ward. The program was followed by muscle strengthening and muscle endurance exercises for the preservation of cardiorespiratory endurance and muscle strength to prevent deconditioning syndrome. Performing strengthening and endurance exercises resulted in significantly improved muscle power characterized by the increase of muscle power in the lower extremities from 2 to 5. Increased muscle strength can be caused by an increase in mitochondrial density in skeletal muscles and oxidative enzyme activity which improve maximal oxygen consumption (VO<sub>2</sub>max) three- to fivefold.<sup>12</sup>

Cardiopulmonary endurance exercise in paraplegic patients is mainly achieved using the upper extremity muscles with arm ergocycle exercise to establish increased cardiorespiratory fitness.<sup>13</sup> Concomitant with the previous study, SCI patients who received arm ergocycle exercise 3-5 times a week showed a significant improvement in VO<sub>2</sub>max ( $p < 0.05$ ).<sup>13</sup> In another

program to improve cardiorespiratory fitness, we continued by giving sit-to-stand exercise assigned based on the results of the previous m30STS score (5 times). The m30STS test has a high correlation with 6MWT ( $r=0.611$ ) and is useful as an alternative tool for the measurement of functional capacity in young adults and the elderly, especially as a substitute test for patients with limited functional capacity after immobilization.<sup>7, 14</sup> In the early phase of rehabilitation, we started with sit-to-stand exercise due to the patient's limited walking ability and to avoid falls. Six months after the rehabilitation program the patient had better cardiorespiratory fitness characterized by an increase in the m30STS score which means better walking ability. Finally, the 6MWT is used to evaluate cardiorespiratory capacity at the end of rehabilitation.<sup>7, 15</sup>

The VO<sub>2</sub>max result of the 6-minute walk test shows a person's physical fitness.<sup>16</sup> A person with a moderate VO<sub>2</sub>max score is able to do moderate daily activities according to the New York Heart Association (NYHA) 2 standard. However, a person's ability to work relates into many factors other than health. A previous study showed that occupational stress during work, caused mostly by a gap between an individual's ability and his occupation, led to musculoskeletal disorders.<sup>(17)</sup> Thus, it is important to assess a person's work ability before entering work in order to prevent stress at work and avoid musculoskeletal disorders.<sup>17</sup>

Continuing evaluation of work ability have to be performed as a supportive examination tool to evaluate the interaction between the physical and psychological capacities of human beings and job demands.<sup>(15)</sup> The Work Ability Index

(WAI) is a tool developed by the Finnish Institute of Occupational Health as a self-assessment questionnaire, which consists of seven items that compare current work ability with ability in the period before the illness. The tool shows the health and physical fitness of workers and predicts future work ability.<sup>15</sup> The questionnaire describes the work ability of the patient along with assessing the risk of health problems that can affect a person's health status. The score divides into several levels (poor-excellent) indicating the level of work ability in determining fitness to work before returning to previous work.<sup>17-19</sup>

**Table 1. Classification and recommendation of work ability index<sup>19</sup>**

Score (Points)	Work Ability	Action
7 – 27	Poor	Restore
28-36	Moderate	Improve
37- 43	Good	Support
44-49	Excellent	Maintain

In our study, the WAI score was 37, which means patients categorized as "good", however still need supporting intervention while working. Patients who previously worked as office workers were required to sit for long periods while operating a computer. A supporting intervention is recommending an ergonomic posture during work hours to achieve a better sitting position as a computer worker.<sup>20</sup> Specific education must be aimed at ensuring that patients can work optimally without any complaints by improving postural control and body position while operating computers. Moreover, surrounding environment modifications should be considered like modifying chairs, tables, and interior space design to reduce the risk of falls.<sup>20</sup>

The reference score to evaluate work ability is above 36, which means at this score a person is categorized as fit to do work at a low-medium activity level or in a METs range of 3-6.<sup>17</sup> The patient’s activity before having spinal tuberculosis involved low-medium activity like sitting, walking slowly, and working at a desk. The patient’s WAI score is 37, which means the patient is able to return to work. The WAI score correlated also with the 6MWT score

achieved by the patient, which is categorized as moderate fitness. In a previous study, a patient who completed a rehabilitation program for 6 months was able to return to his previous daily living activity independently.<sup>10</sup> Currently, the patient still needs more support for his work ability than before the illness. More intensive rehabilitation programs are required to optimally improve his work ability.

**Table 2. Work Ability Index**

<b>Item</b>	<b>Scale</b>	<b>Explanation</b>
1- Subjective estimation of present work ability compared with lifetime best	1-10	0= very poor to 10= very good
2- Subjective work ability in relation both to physical and mental demands of work	2-10	2= very poor to 10= very good
3- Number of diagnosed diseases	1-7	1= 5 or more diseases, 2 =4 diseases, 3= 3 diseases, 4 =2 diseases 5= 1 diseases, 7 = no diseases
4- Subjective estimation of work impairment due to disease	1-6	1= fully impaired to 6= no impairment
5- Absence due to sickness during the past year	1-5	1=100 days or more, 2 = 25-99 days, 3 = 10 -24 days, 4 = 1-9 days, 5 = 0 days
6- Own prognosis of work ability in the next 2 years	1, 4 or 7	1 = hardly able to work, 4 = not sure, 7= fairly sure
7- Psychological resources (enjoying daily tasks and activities, life spirit, and optimism about the future)	1-4	1 = very poor to 4 – very good

## CONCLUSION

Complications of spinal tuberculosis cause physical and psychological dysfunction and negative socioeconomic effects due to neuromuscular deficits causing disability in daily activities and resulting in loss of occupation. Six months of a comprehensive rehabilitation program and evaluation of fitness capacity followed by evaluation of work ability resulted in the patient being finally fit to return to his previous occupation although still in need of ongoing support. Further rehabilitation programs and periodic evaluation of work ability are important steps to confirm fitness to work in order to return to his previous work.

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