Japanese Journal of Comprehensive Rehabilitation Science (2025)

Case Report

Prosthesis Rehabilitation in a Left Transfemoral Amputee with Rheumatoid Arthritis

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ABSTRACT

Ishizaka M, Imai Y, Murata S, Okazaki T. Prosthesis Rehabilitation in a Left Transfemoral Amputee with Rheumatoid Arthritis. Jpn J Compr Rehabil Sci 2025; 16: 30–36.

Background: This report describes the rehabilitation experience of a left-sided transfemoral amputee. The patient developed rheumatoid arthritis and multiple pyogenic arthritis immediately after left transfemoral amputation; additionally, he had multiple joint dysfunction and complications of immobilization, which altered his activities of daily living (ADL). He experienced difficulties in maintaining his economic status and living in his environment.

Case presentation: The patient was in his 50s, and at the beginning of the intervention, upper limb joint pain due to rheumatoid arthritis, muscle weakness of the limbs and trunk, reduced exercise tolerance caused by immobilization, and ADL disturbances, including one-leg standing, made prosthetic gait training impossible. Nevertheless, the patient was young, and his physical activity had been preserved until the left transfemoral amputation. Therefore, we speculated that he could achieve a prosthetic gait by improving the complications of immobilization under appropriate rheumatoid arthritis control. Rehabilitation training was conducted to improve ADL ability in stages taking rheumatoid arthritis into consideration, and social resources were utilized. Finally, he achieved prosthetic gait ability, which was necessary for survival in his living environment, and was discharged.

Discussion: Even in cases where successful prosthetic ambulation is considered difficult during lower limb amputation, it is important not to exclude a patient from prosthesis fabrication by carefully predicting residual abilities that could be acquired afterward.

Key words: transfemoral (above knee) amputation, rheumatoid arthritis, prosthesis gait, team approach

Introduction

This report describes the rehabilitation of a left-sided transfemoral amputee. The patient developed rheumatoid arthritis and multiple pyogenic arthritis immediately after left transfemoral amputation; additionally, he had multiple joint dysfunction and complications of immobilization (disuse syndrome), resulting in disturbances in his activities of daily living (ADL). Furthermore, he experienced difficulties in maintaining his economic status and living environment. Successful prosthetic rehabilitation is related to the ability to stand on one leg, motivation, comorbidities, etc. [1]. At the beginning of the intervention, upper limb joint pain due to rheumatoid arthritis, muscle weakness of the limbs and trunk caused by immobilization, ADL disturbances, including one-leg standing, and reduced exercise tolerance, made prosthetic gait training impossible. However, the patient underwent functional training that considered rheumatoid arthritis, improved ADL in stages, and utilized social resources. Accordingly, the patient eventually achieved prosthesis gait and was discharged home through a team-based approach in a convalescent rehabilitation ward. Herein, we report and discuss the clinical progress of this patient. Written informed consent was obtained from the patient for

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Accepted: April 7, 2025
Conflict of Interests: The authors have no conflict of interest directly relevant to the content of this article.

publication of this case report.

Case Presentation

The patient was in his 50s, and he was independent in his ADL before hospital admission; he lived with his mother and sister on the second floor of an apartment without an elevator. He worked part-time and primarily depended on his sister's income for his livelihood. He applied for a physical disability certificate at his previous hospital and received a Level 4 certificate.

1. Present Illness

The patient had pain in the left leg that had gradually increased since February 20XX, causing ambulation difficulty with dark red skin. He was urgently admitted to his previous hospital due to high fever and was diagnosed with left lower leg gangrene due to acute arterial occlusion of the left lower limb. He underwent left transfemoral amputation on March 3, 20XX. He was then transferred to our hospital at five weeks after the amputation; however, he was transferred back to his previous hospital due to continuous high fever and multiple joint pain. The patient was subsequently diagnosed with multiple pyogenic arthritis and rheumatoid arthritis. After treatment, he was readmitted to our hospital at 19 weeks after the amputation, which was 12 weeks after his transfer.

2. Past Medical History

He has a history of chronic aortic dissection (20XX−7 years ago) and atopic dermatitis.

3. Assessment on Admission

Regarding the patient's cognitive function, his Hasegawa Dementia Scale-Revised score was 27. He had no cognitive problems during ADL; moreover, he had intense motivation for prosthesis fabrication.

Regarding the patient's physical function, stump length was 19 cm (ischial tuberosity- tip of stump) and stump maturation was not achieved; however, he did not have phantom sensation or phantom pain. Although there was eczema and keratosis pilaris with dry skin and itching mainly on the face and neck, skin lesions on the upper and lower limbs were mild, and the skin condition of the left transfemoral amputation stump was noticeably dry. (Figure 1)

Symptoms of rheumatoid arthritis were severe in the upper limbs; therefore, he had mild bilateral shoulder joint pain on movement, joint pain in the bilateral wrist joint and fingers, swelling of the bilateral wrist joint, and bilateral index finger button hole deformity. Additionally, the patient complained of severe stiffness and worsening joint pain, mainly in the bilateral wrist joints in the morning. Figure 2a shows a radiograph of the patient's fingers. The lower limb joints had no pain or deformities.

Range of motion was preserved in the lower limbs, including the left lower limb, which was the amputated limb. Range of motion (R/L) in the wrist joint was as follows: palmar flexion was 70/70, dorsal flexion was 70/70, and mild limitations were observed bilaterally

Figure 1. Stump of left transfemoral amputation. Stump length was 19 cm.

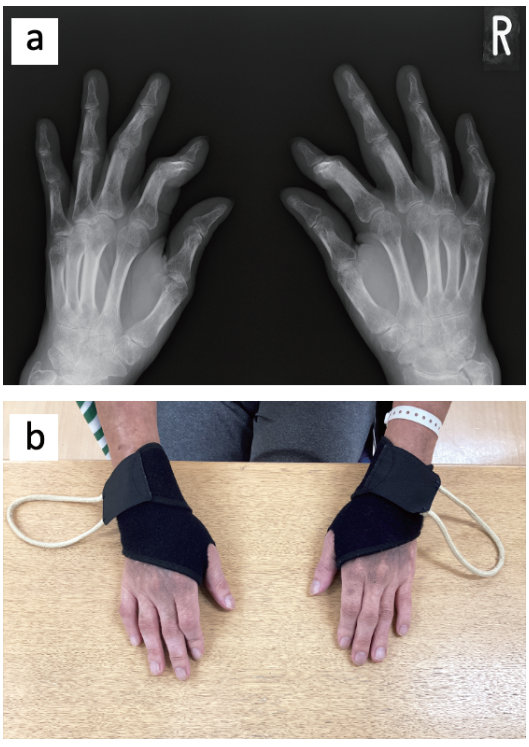

Figure 2. Fingers and Wrist joints of this case.
a. Radiograph. Steinbrocker classification: Stage 3. Bilateral bone atrophy, cartilage destruction in the radiocarpal and intercarpal joints, and hyperextension deformity of the distal interphalangeal joint of the index finger were observed.
b. Wearing the supporter. A loop is attached to enable donning and doffing by oneself.

in the shoulder and elbow joints.

Muscle strength of the lower limbs and trunk, especially that of the proximal muscles, was generally weakened. His manual muscle test (MMT) scores for the left lower limb were in the range of 3−4 during hip flexion, extension, and abduction, 3−4 for the right lower limb, and 2 for the trunk. The MMT scores for the upper limbs were 3−4, and grip strength (R/L) was 2 kg/5 kg.

In his ADL, roll-over and sitting up required maximal assistance due to upper limb joint pain. Maintaining one-leg standing on the right leg was impossible, even with handrails, and assistance from two persons was needed for transfer. He moved in a wheelchair with full assistance and therefore needed assistance for self-care, except for eating and grooming. Consequently, the Functional Independence Measure score was 57 (motor 25/cognition 32).

Regarding the patient's demand and socioeconomic and environmental status, he hoped for a prosthesis gait; however, the cost of manufacturing the prosthesis was burdensome. He lived on the second floor of an apartment building without an elevator. Although he hoped to return to his current home with the possibility of a change in residence in the future, caregiving by his employed sister and older mother was not expected.

Figure 3 shows the International Classification of Functioning, Disability, and Health of the patient.

Course

Figure 4 shows the treatment details and progress in this case.

1. Treatment and progression of rheumatoid arthritis

At the time of transfer to our hospital, the patient was administered prednisolone (20 mg/day, salazosulfapyridine (1,000 mg/day), and methotrexate (8 mg/week). He had severe swelling and pain in the bilateral wrist joints and persistent inflammatory findings on blood examination at the time of transfer. The steroid dosage was carefully reduced in consideration of the increased workload associated with the progress of rehabilitation training. At the time of discharge, the dose of methotrexate was increased to 10 mg/week, iguratimod 50 mg was started, and the prednisolone dosage was reduced to 10 mg/day.

2. Physical/Occupational therapy

During physical and occupational therapies, we set

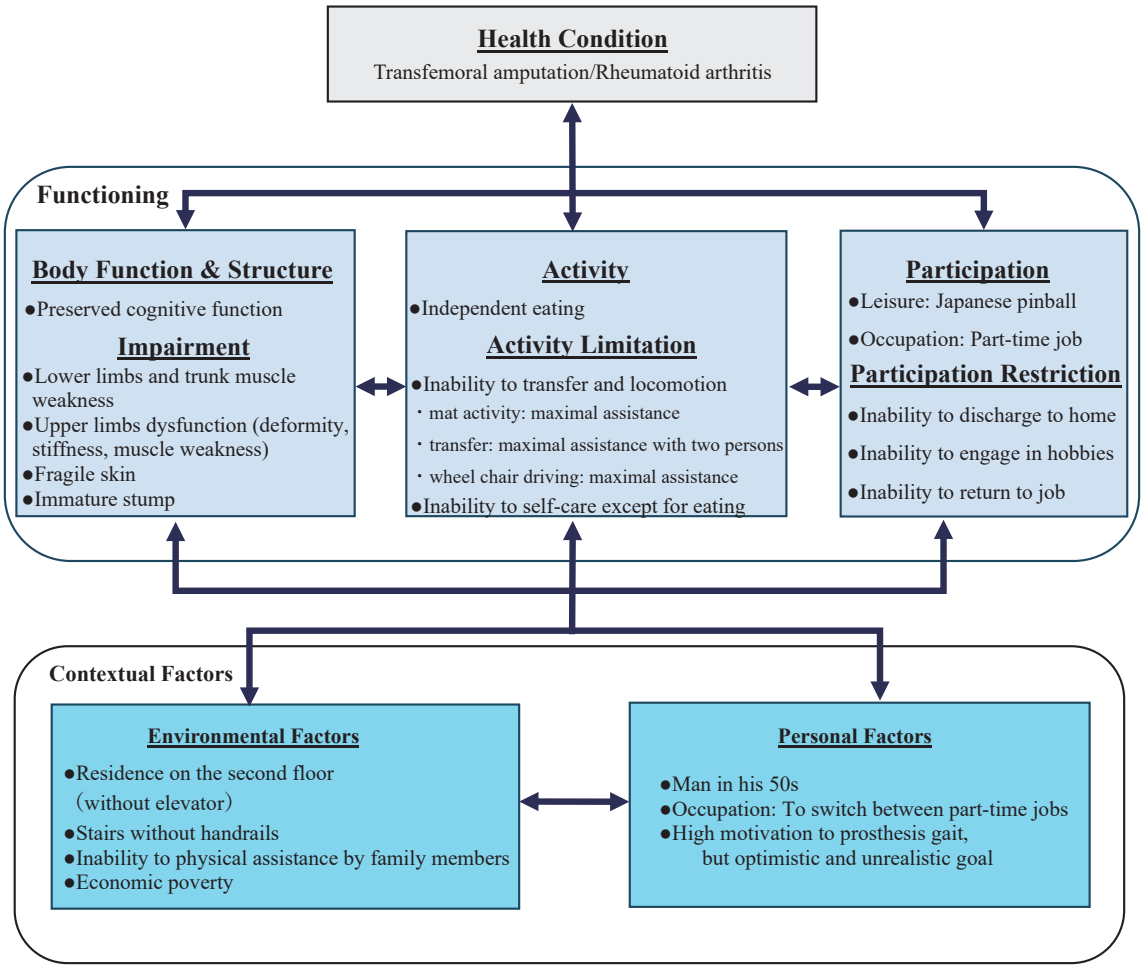

Figure 3. International Classification of Functioning, Disability and Health (ICF) of the patient.

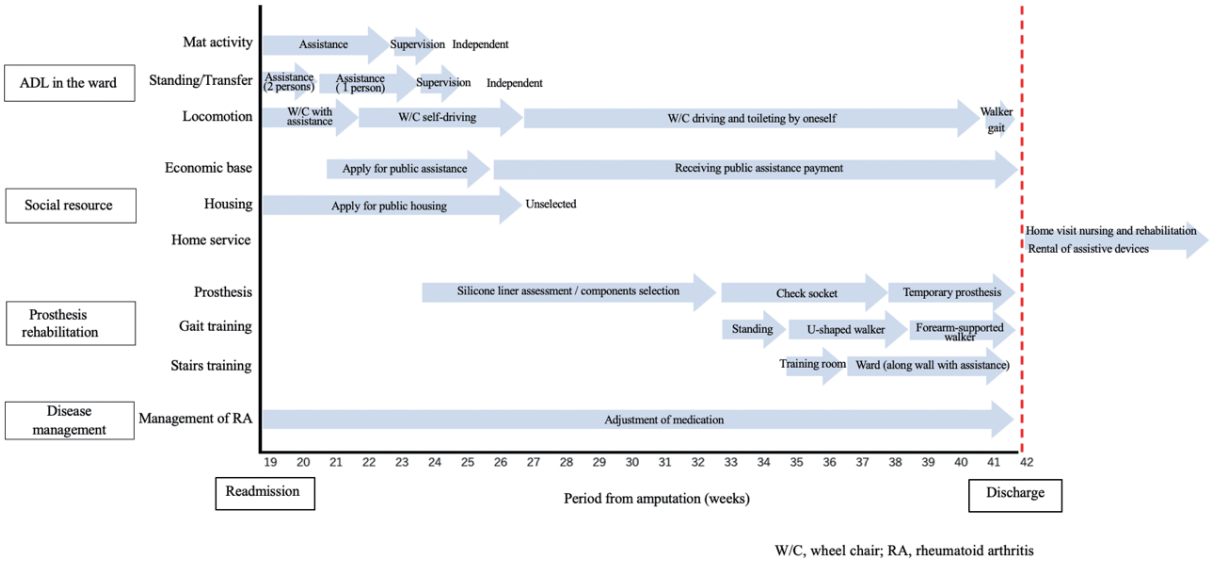

Figure 4. Course and details of the treatment.

the short-term goal of independence in ADL using a wheelchair and initiated a rehabilitation program. Muscle strength training, basic mat activity training, and wheelchair driving training were mainly performed, and stand-up and standing training were gradually introduced while adjusting the height of the seat and amount of assistance. Supporters were employed during the training to protect the bilateral wrist joints, and loops were devised to enable self-attachment and removal (Figure 2b). When utilizing a fixed pick-up walker, the wrist joint was then placed in a neutral position to reduce joint strain.

Owing to an outbreak of COVID-19 clusters, rehabilitation programs were suspended or reduced between weeks 21 and 23 after the amputation.

At 25 weeks after the amputation, joint pain in both upper limbs tended to be mild without deterioration. The lower limbs also showed no pain, and in the MMT, muscle strength improved to 5 during hip flexion and 4 during extension, abduction, and adduction in the bilateral hip joints. Through improvements in physical function and repetition of movement exercises, the patient achieved independence in activity by changing body position and transferring with handrails, wheelchair driving, and self-care, except for bathing. Furthermore, the patient maintained standing on one leg with handrails, which allowed prosthesis gait training to be started. With the support of medical assistance, which is a type of public assistance, the process of prosthesis fabrication has advanced. At 33 weeks after the amputation, a temporary prosthesis (with a plug-fit quadrilateral socket, suspension belt, turntable, locking knee, and single-axis foot) was prescribed, and prosthetic gait training commenced using a diagnostic socket and components provided by the prosthetic manufacturer.

The prosthesis training started with weight-bearing training of the prosthetic leg and balance training using parallel bars and handrails. Subsequently, the gait training was performed using repeated socket adjustments. The patient was able to wear and remove the prosthesis early using a vertical handrail, and then a temporary prosthesis was fabricated by molding another temporary socket and he ordered the components for himself at 38 weeks after the amputation.

Because wrist pain prevents the use of a cane, a forearm-support walker was selected, and a small-type model was adopted in consideration of locomotion within the home (Figure 5). Simultaneously, stair-climbing training was also started, and while considering joint pain, the training was gradually shifted from the stairs in the training room to the stairs in the hospital ward.

In the predischarge assessment, symptoms of rheumatoid arthritis, including stiffness in the upper limbs and swelling of the bilateral wrist joints, were observed. In contrast, the joint pain generally subsided, and there were no complaints of pain during the rehabilitation exercises or ADL, except when bearing weight in the wrist dorsiflexion position. These observations indicated an improvement in the symptoms.

In the MMT, muscle strength of the bilateral shoulder joint was 4 during flexion, 3 during external and internal rotation, and 3 during bilateral elbow joint flexion and extension, and grip strength was 5 kg on both sides, showing a modest improvement. During the MMT, muscle strength of the lower limbs was 5 on the right side and 5 during left hip flexion, extension, abduction, and adduction in the left stump, showing improvement. The patient maintained one-leg standing for over 2 min using handrails and for 8 s without support. The patient walked independently with a small forearm-supported walker in the ward, with a maximum walking distance of 500 m. Additionally, the patient climbed stairs in an environment similar to

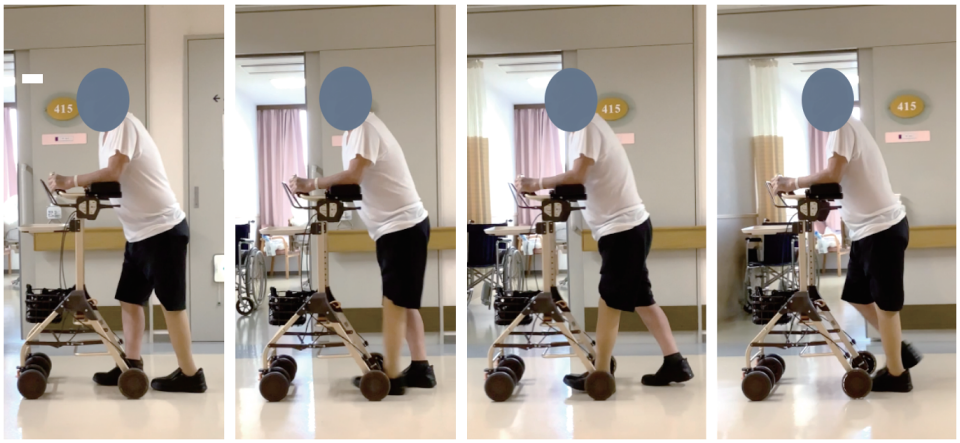

Figure 5. Gait image in this case. A small type forearm-supported walker was used.

his home (without handrails) by climbing along the wall with minimal assistance.

The patient was discharged home at 42 weeks after the amputation, and following the discharge, he was scheduled to utilize home-visit rehabilitation twice a week for training in stair climbing at home and walking around the neighborhood. At the time of discharge, the Functional Independence Measure score was 109 (motor 75/cognition 34).

3. Silicone liner assessment and prosthesis description and fabrication

In this case, there were concerns that the silicone liner might cause skin problems related to the patient's history of atopic dermatitis and difficulty wearing and removing the liner due to finger dysfunction. Therefore, the suitability of the silicone liner was assessed at an early stage in this study. Although no skin problems were observed, the use of a silicone liner was rejected because it was difficult to put on and remove the liner independently.

Considering that the predicted post-discharge lifestyle would involve relatively low activity and the need for stair climbing, a focus on stability led to the adoption of a plug-fit quadrilateral socket, locking knee, and single-axis foot, as previously mentioned. The suspension method used was determined to be waist suspension using a suspension sleeve. The thickness and length of the belt were adjusted to allow for self-donning and doffing according to the patient's finger function. Additionally, to facilitate the locking operation of the knee turntable, the soft foam in the area was removed (Figure 6).

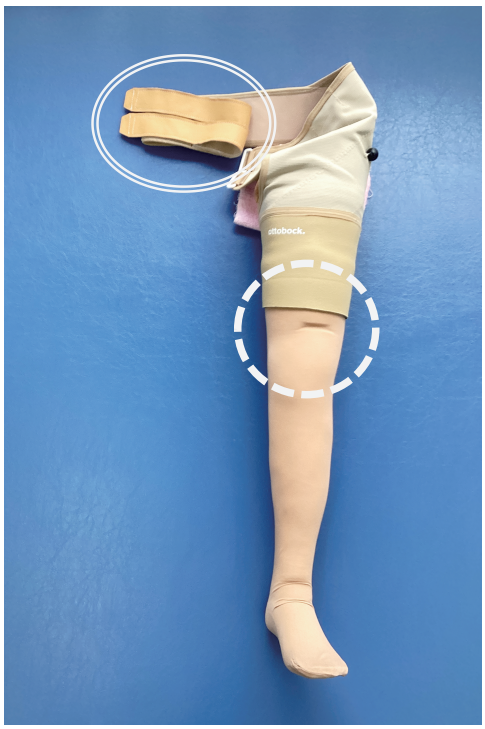

Figure 6. To allow for self-donning and doffing with the patient's finger function, the thickness and length of the belt were adjusted (⬭). To facilitate the locking operation of the knee turntable, the soft foam in that area was remove (⬭).

4. Social support

Information on public assistance and application procedures was provided mainly by a medical social worker, and the patient began receiving public assistance payments at 26 weeks after the amputation.

5. ADL in consideration of the home environment

Regarding the post-discharge housing environment, the patient had lived in a room that required stair climbing without a handrail prior to hospitalization. He applied for relocation to a public housing unit without stairs, but was not selected in the lottery. Consequently, acquiring the ability to go up and down stairs became essential for discharge.

Discussion

This report describes the rehabilitation experience of a left transfemoral amputee in a convalescent rehabilitation ward. The patient developed rheumatoid arthritis immediately after the amputation, therefore,

he had muscle weakness of the limbs and trunk, and reduced exercise tolerance caused by immobilization associated with treatment, resulting in severe disturbances in ADL. Furthermore, the patient had numerous difficulties, including financial hardship and an unfavorable living environment.

There is no standard definition for successful prosthetic rehabilitation, which differs among reports. For example, Munin et al. defined successful prosthetic rehabilitation as the ability to walk ≥45 m with a cane or walker for transfemoral or transtibial amputees [2], and Hamamura et al. classified transfemoral and hip disarticulation amputees who could walk 100 m continuously on level ground without ambulatory aids or with only one cane as successful prosthetic users [1]. In the present case, the patient independently walked a distance of 500 m using a walker in an indoor environment and ascended and descended stairs with minimal assistance in an environment without handrails. Hence, we believe that the patient acquired the minimum necessary and practical prosthetic gait.

Hamamura et al. revealed that the ability to stand on one leg, motivation to walk, adequate physical fitness, and few comorbidities were predictive factors for successful prosthetic rehabilitation [1]. In a systematic review by Sansam et al., cognition, fitness, ability to stand on one leg, independence in ADL, and pre-operative mobility were also emphasized as predictors of walking ability after lower limb amputation [3]. Our patient had muscle weakness of the limbs and trunk, reduced exercise tolerance, left transfemoral amputation, and rheumatoid arthritis. Regarding the patient's physical function at the time of admission, he did not meet the previously mentioned criteria for prosthesis prescription and required significant assistance with basic mat activities and ADL, including maintaining one-leg standing. As a result, he was unable to begin prosthesis gait training. Nevertheless, the patient was young, and his physical activity was preserved until the left transfemoral amputation. Therefore, we speculated that the patient could achieve prosthetic gait by improving physical function under appropriate rheumatoid arthritis control. Therefore, we set the short-term goal of independence in ADL with a wheelchair and the physical function necessary to begin prosthesis gait training. Additionally, we started a rehabilitation program with a focus on approaches to muscle strength and exercise tolerance. Prosthesis fabrication was initiated when achieving these goals was deemed feasible. Prior to this, we determined whether a silicone liner was acceptable and an application for public assistance was made to facilitate a smooth process of prosthesis fabrication. Even in cases where successful prosthetic ambulation is considered difficult at the time of lower-limb amputation, it is important not to easily exclude the patient from prosthesis fabrication by carefully predicting the residual abilities that could be acquired afterward.

Lachmann reported that in 11 lower-limb amputees with rheumatoid arthritis, none of six transfemoral amputees achieved a practical prosthesis gait [4]. However, several recent reports have indicated that transfemoral amputees with rheumatoid arthritis have successfully achieved a practical prosthesis gait [5, 6]. The major factor contributing to this improved outcome is the advancement in rheumatoid arthritis treatment [7]. In the present case, molecular targeted therapy was not administered; however, methotrexate was used as the primary therapeutic agent, and the steroid dosage was carefully reduced considering the load of rehabilitation training, although disease control was maintained. Additionally, pain in the bilateral wrist joints was reduced with the use of a supporter. Matsushita stated that the rapid advancement of pharmacotherapy tended to disregard joint protection. Joint protection in patients with residual joint inflammation enhances the effects of pharmacotherapy and is extremely effective [8]. Furthermore, in the present case, there was no joint pain or deformity in the lower limbs, which provided favorable conditions for prosthesis fabrication.

The present patient had left transfemoral amputation and also complications of immobilization (disuse syndrome) and socioeconomic problems. The patient underwent functional training that took rheumatoid arthritis into consideration and improved his ADL in stages. He started prosthesis gait training, and was eventually discharged home with a prosthetic gait using social resources. In challenging cases of prosthetic rehabilitation, a reasonable team approach based on an accurate prognostic prediction is important.

Acknowledgment

We would like to express our sincere gratitude to the patient who provided consent for this case report. We also extend our appreciation to the members of the rehabilitation team: Mina Ifuku, OTR, Maki Shindo,Ns, Kazue Inoue, MSW and Ayako Kano, PO of Arizono orthopedic Supplies co., ltd, for their invaluable contributions.

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