

Crutch Accommodative Transhumeral Prosthesis for an Amputee with PPRP: A Case Report

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ABSTRACT

Polio affected patients develop lower limb deformities which interfere in ambulation of the patient. The patients become dependent on assistive devices like crutches or orthoses for their ambulation. For ambulation with crutches, the major source is the upper extremities. Amputation of upper extremities leaves no way for ambulation. Though many options are there, patients from low- and middle-income countries cannot afford them and choose not to ambulate rather stay at home. Cost effective modified prosthesis can rehabilitate these patients. A left transhumeral amputee with same side post-polio residual paralysis (PPRP) of lower limb was rehabilitated and made ambulant again by an crutch accommodative prosthesis.

Keywords: Polio, Amputation, Accommodative Prosthesis, Ambulation

INTRODUCTION

Poliomyelitis is an infectious disease caused by an enterovirus infection of the anterior horn cells in the spinal cord [1]. The recovery stage of poliomyelitis lasts for up to 2 years after the onset of the disease. The residual-paralysis stage starts after 2 years of onset of the disease. Deformities occur as a consequence of imbalance of muscle power and poor posture as no recovery of muscle power occurs in this stage. Disuse atrophy of muscles and shortening of the leg are also seen. In neglected cases, gross fixed deformities of the hip, knee and foot occur with severe wasting of muscles. Typical osseous or soft-tissue abnormalities like external rotation of the tibia, excessive valgus alignment ligamentous laxity and genu recurvatum are seen in lower extremity. Localized muscle wasting and weakness of muscle particularly hamstring muscle causes flexion contracture of knee. Pes cavovarus and pronated everted foot

occur due to evertor paralysis and invertor paralysis respectively. All these conditions add complications for ambulation of the patient[2]. In cases of unilateral involvement of lower extremity with severe weakness of muscles and joint contracture the patient takes the help of assistive devices like axillary crutches, elbow crutches or any other modified crutches for the ambulation. Upper extremity amputation specially high end amputation ceases the ambulation of the patient through the crutch. Prosthesis with multiple mechanical joints leads to rejection of the prosthesis as its difficult to operate. Modified prosthetic design can be appropriate for holding the crutches and reinstate the ambulation.

CASE DESCRIPTION

The patient is a 34-year-old male who was affected by polio previously and his left knee is in flexion contracture with ankle in plantarflexion. As affected by polio the

patient has weak quadriceps, muscle wasting and limb length shortening than the other side. The patient was using bilateral axillary crutches for ambulation. He was amputated on his left upper extremity through the humerus followed by an accident. After amputation the problem faced by the patient was holding of the crutches for the ambulation. Due to the unavailability of any option he was bound stay in home. As soon as the patient reported in department prosthetics and orthotics, KAHER-Belagavi he was assessed and prescribed two options, one is a crutch accommodative left transhumeral prosthesis for holding the hand grip by prosthetic hand and the other one is a modified wheelchair which he can maneuver with the help of sound limbs. Due to high cost of modified wheelchair the patient denied for opting it as patient comes from low economical background. The patient was prescribed the left crutch accommodative transhumeral prosthesis without any elbow joint and mechanical prosthetic hand with single control cable system with modified harness.

Objectives of the study

1. To make the subject ambulant and independent again through the modified prosthesis.
2. To make the assistive device with very low cost, simple and less cumbersome to use.

Design concept:

As the patient's left side lower limb is affected by polio and same side transhumeral amputation was done, it was very difficult for him to ambulate by crutches as the anatomical hand was not present to hold the hand grip of crutch and transfer the body weight through it. A modified prosthesis without elbow joints whose terminal device/hand can reach to hand grip of axillary crutch and hold it properly was thought to be designed. Single control cable system was utilized to open and close the hand to hold and release the

hand grip. The control attachment strap of harness was skipped. It was left for the patient to operate it by the sound hand as required body movement will not be available to operate the hand. The prosthetic elbow joint was skipped as it will lead to more mechanical problems during the ambulation and very cumbersome for the patient to use. The harness was modified to provide more stability to prosthesis.

Fabrication

The casting of the left side residual limb was taken similar to transhumeral prosthesis. The residual limb measurements i.e. circumferential and linear measurements were taken for the positive mold modifications. The length of the prosthesis was decided by taking the measurement from the acromioclavicular joint of sound side to the handgrip position of the axillary crutch with the patient holding the crutch in tripod position with 30 degree of elbow flexion^[3]. After fabrication of socket, forearm shell was directly placed over socket according to the measurement taken. The prosthetic hand was attached to forearm shell. The control cable was attached to hand and fixed on anterior side of prosthesis at an anchoring point which will be easier for the patient to operate by the sound hand. The harness was modified so that it will be easier for the patient to don and doff the prosthesis and provide more stability.

RESULT

After the prosthesis was designed the patient could ambulate using the crutches with 3 point crutch gait. There was no limitation for holding the crutch on the left side. The patient can open and close the prosthetic hand by pulling the control cable and can position it on the hand grip of crutch. Ultimately, he was getting support from the prosthesis to move the left side crutch forward and backward by moving the residual limb. The patient felt that he can do ambulation as before as there was no problem in holding the crutch on the

amputated side. The prosthesis is also easier to don and doff due to modified harness.



A. Anterior view, the patient is fitted with left crutch accommodative transhumeral prosthesis. **B.** Posterior view of patient with the prosthesis

DISCUSSION

In most of the developing countries the patients affected by polio uses different types of crutches and orthoses for their ambulation. Patients with Severely affected lower extremity has to use crutches. Amputation of upper extremity leads to cessation of the ambulation of the patients as patient transfers the body weight through the upper extremity to crutches. Transhumeral amputation is even more challenging for this type of case. However, a modified, less energy consuming prosthesis can be beneficial for the patients. Complexity of the prosthesis can lead to rejection and other options like modified wheelchair is economically not compatible for the patients of low- and middle-income countries. After using this modified prosthesis though the patient can easily ambulate through crutches but more compression pressure is felt at axilla than before the amputation which may cause crutch palsy in future. Further study is warranted to eliminate the compression at axilla by modifying the socket and crutch design.

CONCLUSION

The patient is able to ambulate with prosthesis and the crutches and it also acts as cosmesis to hide the amputation. An

accommodative prosthesis can restore the functions as well as the cosmesis.

Declaration by Authors

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