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Modified Axillary Crutch for Unilateral Transradial Amputee: A Case Study

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ABSTRACT

After the world war, the demand and innovation in the field of prosthesis and orthosis have increased. Even though we are moving towards the digital world, the rural population of India constitutes nearly 70% of the total population. Crutches are being used more commonly in rural areas of India where there is no access to the latest technologies. The injuries challenge rehabilitation professionals who work in rural areas with many technical problems. One such challenge is to treat the person who sustains upper limb amputation and lower extremity impairment or injury which needs to be offloaded while walking. The purpose of this study is to ambulate a unilateral transradial amputee with ipsilateral side leg impairment by which the subject can be socially, psychologically, vocationally acceptable. With a standard axillary crutch, the subject found it difficult to lift the crutch and progress forward. The visible difficulty was to have a proper hold on the crutch. This is addressed with the modified crutch by an extra attachment that allows the subject to grip the crutch with the remaining length of the forearm or stump.

Key Words: Transradial amputee, Modified axillary crutch

INTRODUCTION

Amputation is the surgical excision of a body part. [1] The indications for amputations are most easily remembered as dead, dangerous, a damn nuisance. [2] Dead: peripheral vascular disease accounts for almost 90 percent of all amputations. Severe trauma, burns, and frostbite are all examples of tissue death. Dangerous: disorders are malignant tumors, potentially lethal sepsis, and crush injury. Releasing the compression in a crush injury may result in renal failure (the crush syndrome). Damned nuisance: gross deformity, recurring infections, or significant loss of function, keeping the limb may be worse than not having one at all. When the amputation comes to the upper limb, trauma predominates over other causes of amputation. [3] Compared to lower limb amputation, upper limb deficiency is often relatively more functionally disabling due to the fine motor tasks carried out by the hand and arm. [4] The degree of functional disability, or the effect on quality of life and capacity to do activities of daily living, is mostly determined by the severity of amputation.

Like the upper extremity, a unilateral injury to the lower extremity can render a limb unable to bear weight, which may be worsened by weight-bearing and ultimately reduces the function of the limb and needs assisted mobility. Assisted mobility is usually required in cases of decreased balance/ stability, decreased strength and coordination, lower limb amputation, and fracture/ pain in the lower limb which needs to be offloaded. The crutches are used to eliminate weight bearing through the affected extremity while still allowing ambulation and also providing a stable environment for recovery by allowing the

injured body part in a load-free condition. [5] It is essential that crutches are of the right length to ensure safety as well as efficiency. Height adjustable facility for the overall length of the crutch and handgrip allows the crutch to fit comfortably for the subjects.

There are many reasons – physiological and psychological -why it is good to stand and walk rather than sit and wheeled mobility. Crutch walking provides physiological and psychological benefits that sitting and using wheeled mobility cannot provide. Standing and walking allows for improved growth of bone, improved circulation of blood, reduced bladder infections and reduced pressure lesions, and prevention of contractures and social inclusion. [6]

In unilateral upper limb amputation, human beings adapt very well however and most of the tasks are taken up by the contralateral upper limb, which becomes dominant. But the use of the contralateral side hand is not enough to perform the task of assisted mobility. In this case, the crutch should be modified to meet the needs of the subject to make him/her walk independently.

METHODOLOGY

Case Description:

The subject was a 28-year-old male who had traumatic transradial amputation of the right side. After the road traffic accident (RTA), the pain developed in the ipsilateral hip joint which gets worse while walking, the doctor had advised him to offload the hip joint while walking till the pain subsides. The subject was not having access to the latest prosthetic fitment because of the rural and remote area. A pair of axillary crutches was the option for mobility. But the visible difficulty was to have a proper hold on the crutch as there is no anatomical hand on the right side. As a result, the subject is confined within the home because of the lack of mobility. To solve this problem, the standard axillary crutch is modified with the attachment o ring, bracket, and forearm shell which enables the subject to walk confidently.

Objective of the study:

- To design and fabricate the axillary crutch that must be securely hold by the subject
- To keep the height adjustability provision in the crutch
- Not to make the design cumbersome

Design concept:

A simple crutch modification of the standard axillary type of aluminium crutch, designed for temporary use to suit a person who has lost one of his upper limbs distal to the elbow in addition to one lower limb impairment. At first, a pair of standard axillary crutch was tried for this, but without a right hand, the subject found it difficult to lift up and move the right crutch forward in order to walk. Obviously, the standard axillary crutch was quite unstable for the right side. With the axillary crutch, the main difficulty explained by the subject was to have a proper hold on the crutch. In the modified crutch this is overcome by the extra attachment (fig-1) provided, by which he can have a good hold on the crutch using a forearm stump.

The simple attachment consists of a wooden ring with a bracket and a forearm shell. The wooden ring is well padded with foam and covered by rexine. The forearm shell is padded with ethaflex and two straps are attached proximally and distally to fasten the forearm. The size of the ring is such that it allows the forearm stump to go through it. The ring is fixed with the crutch through the bracket in such a way that it projects outward with its lumen facing forward and backward. The forearm shell is attached to the ring through a bar and two L-shaped plates. A sliding arrangement is provided for the bracket so that the distance between it and the axillary piece can be adjusted for the individual subject.

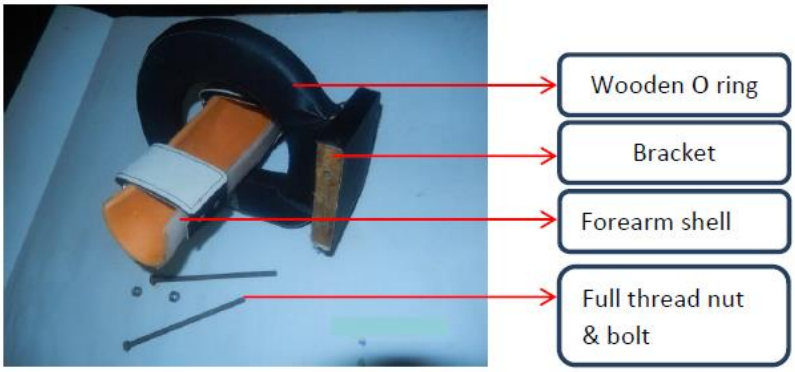

Figure: 1 (Wooden ring with forearm shell)

Fabrication Procedure:

The problem found in the standard axillary crutch was proper grip over the crutch. This problem is solved by a modified axillary crutch. This modified crutch is consisting of a wooden ring, forearm shell, aluminium bar, two L-shaped plates and a standard axillary crutch. The wooden ring is not completely circular; rather it is flat at its lower 1/3rd in both inner and outer borders of diameters 15cm and 22.5cm respectively. The ring was 1 inch thick and 1½ inch wide. A slut of depth of 5mm and width of 20mm has been made on the flat surface of the ring inside which will receive the aluminium bar riveted with a forearm shell. The plastic forearm shell is made over the mold by taking a cast on the subject's forearm. Then all the edges of the forearm shell have been smoothened and well-padded with ethaflex.

An aluminium bar is bent according to the contour of the forearm shell and fixed with it. Two L-shaped plates are riveted with the aluminium bar by keeping a 1-inch clearance for the thickness of the wooden ring in such a manner that it can also get riveted on the wooden ring.

Figure: 2 (Modified axillary crutch)

Figure: 3 (Subject standing with modified axillary crutch)

Another important modification is the height adjustment of the ring. This is accomplished by drilling several co-linear holes at the sides of both uprights of the crutch. And also drill 2 holes at the sides of the bracket which will co-linear with the holes of uprights. The bracket is fixed with the crutch by a pair of nuts and bolts of length and diameter of 6 inches and 6 mm respectively. There will be a provision for height adjustability in every one-inch interval. So that subject can adjust the crutch (Fig-2) according to his height.

With proper gait training, the modified axillary crutch (Fig-3) has been given to the subject to walk. The subject

walked in a three-point crutch gait pattern for 15 minutes. After that, the question regarding comfort and difficulties of using modified axillary crutch ware was asked.

RESULT

The patient is now ambulant with the modified axillary crutch on the right side and a standard axillary crutch on the left side, the gait being a 3point crutch gait. The subject found it comfortable to ambulate with a modified axillary crutch as per the verbal feedback and observation of the gait. In order to advance the crutch, simply he has to lift his forearm. As it is fastened with the forearm shell, the crutch is being lifted and progressed forward easily and placed in front steadied by the axilla. The subject had no complaint about the fatigue of the muscles. In the stance phase, the weight of the body falls on the elbow and the stump thereby preventing pressure on the axilla. However, the subject had complained about the imbalanced weight of the crutch.

DISCUSSION

The new design provides more comfort with an equal level of stability compared to a standard aluminium crutch. The design and padding over the forearm shell and wooden ring made it simple and comfortable to walk. As per the verbal feedback, it reduces the subject's fatigue, relieves weight on the ipsilateral axilla. The bracket with forearm shell and wooden ring attachment helped the subject to have a proper grip over the crutch while walking and made him able to offload the ipsilateral lower leg with 3 point crutch gait.

As the subject had feedback about the imbalanced weight of the crutch, with long-term use not only it may cause fatigue of the shoulder muscles but also may cause neurovascular injury over the contralateral axilla. Further study is warranted to design and develop a modified axillary crutch with the use of the lightweight material to avoid fatigue because of the imbalanced weight of the crutch as well as to avoid imbalanced force transmission to both axillae.

CONCLUSION

The most important thing is now subject is ambulant in the society. Hence it is concluded that the modified axillary crutch is quite satisfactory and comfortable for short-term use as it allows the patient to use the axillary crutch like other amputees and thus improves the quality of life.

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