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Development of an Adjustable Pylon for Lower Limb Prosthesis: A Prototype

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ABSTRACT

Amputation of a limb is always perceived as a catastrophe. The principles underlying creation of a stump adapted to modern prosthetic fittings must be fully understood and the patient managed by a multidisciplinary team. In paediatric patients, managing the prosthetic limb length is a crucial point that should be maintained according to the expected growth potential of the child. The main problem with child amputee is the heel height and adjustment of height of prosthesis during change of foot wears and bare foot walking. Children with congenital amputation and congenital anomalies need special attention for the prosthetic fitment. As children are in the growing age, the prosthetic device is required to be changed frequently. The major constraint in frequent change of prosthetic device in developing country is lack of special prosthetic kit, paediatric prosthetics components, skilled prosthetists and low-income group of amputees. To face this challenge, we have designed and developed a new adjustable prosthetic pylon for lower limb prosthesis.

Keywords: Prosthesis, Component development, Prosthesis, congenital anomaly, Adjustable pylon.

INTRODUCTION

Pylon is defined as THE GATEWAY TO PATH (oxford dictionary). Therefore, it is of mechanical importance to produce a mechanical or mobilization or translation. In fact, in technology of prosthetics pylon is used to connect the socket interface to foot devices that means it is an intermittent device. Vis-a-vis it is also responsible for adjusting the individual's height in response of body equilibrium. It is also pertinent to appreciation that some time a minimal discrepancy in height can make great variations in normal gait cycle and induced a very intolerable pain within the knee and hip complex. Therefore, keeping such complexity in mind my involvement with the device i.e., adjustable pylon is no doubt a better solution to such effect. The design incorporated with maximum adjustability of 50mm at an interval of intermittent limitation 1mm. thus such minimal adjustment facility not only refining the gait cycle also response good accumulative efforts by the amputee itself. Design is very versatile and simple. Such

that a simple torque can change the alignment to high proximity value[1].

In the present situation of India, there is no such design to suit children of lower limb amputation. Internationally also percentage of Trans Tibial Amputees (TTA) is more [2]. Most of the existing designs are of general type to fit all age group in lower limb. At the growing age in children there is a need of change of prosthesis after 6 months or even earlier to keep the force distribution equal in both limbs and to avoid limb length discrepancy[3]. The height adjustment & cost of prosthesis are also factor in low-income group to do frequent change in children. So, we have developed an indigenously designed adjustable pylon for paediatric trans-tibial prosthesis. The said adjustable pylon has been used for both TTA and congenital limb deficiency for making extension prosthesis in case of growing children. The design is very simple and innovative.

MATERIALS AND METHOD

SUBJECTS

The patient was a 9-years-old girl who was a trans-tibia amputee. She was a student and was come to the SVNIRTAR OPD for prosthetic management. She was referred to the Department of Orthotics and Prosthetics in the Swami Vivekananda National Institute of Training and Research (SVNIRTAR), for the provision of a suitable management. The patient gave a written informed consent form to participate in the study, and appropriate approval was also obtained from the Institutional Ethical committee. A detailed assessment was performed with demographic data, medical history, radiographic image, and functional outcome.

METHODOLOGY

This new and innovative design generally needs a proper design blueprint along with an empirical thought process. A proper blueprint led to a better device with less error. This is made up of aluminium, mild steel. This design was fabricated from the following components such as:

1. Aluminium pylon tube of length 200mm.
2. A thrust bearing of outer dia. 30mm and inner dia. 15mm.
3. A fix adapter of outer dia. 35mm and inner dia. 25mm.
4. An adjustable adapter of outer dia. 40mm and inner dia. 35mm.
5. A 90mm length and 15mm dia. nut and bolt.
6. 4 pieces of 5mm dia. and 15mm length bolt.

We have taken a solid mild steel rod of outer dia. 45mm and machined the solid to make an adjustable adapter and fixed adapter. The fix adapter is of length 35mm and outer dia. is 35mm, inner dia. is 25mm. On the middle of the adapter, we have made a groove of 5mm diameter. On the upper portion of the adapter, we have placed the thrust bearing. Two holes are made on the lower portion of the adapter to fix bolts over the pylon tube. An adjustable adapter was made which was snugly fitted over the fixed adapter. The length of the adjustable adapter is 45mm. the inner dia. 35mm and outer dia. is 40mm. The nut is fixed rigidly over the adjustable adapter. The bolt is attached in the middle of these adapter and bearing. The adjustable adapter has two holes on the lower portion on which two bolts are attached which is placed over the grove of fixed adapter. These bolts are attached in such a way that it is not restricting the rotation of adjustable adapter over fixed adapter only restrict the longitudinal motion. Two longitudinal groves are made on the pylon tube and one smaller bar is attached on the lower of the bolt. This bar is fixed by these groves and moves up and down inside the grove. This restricts the rotation of the bolt. After fixing these components when we rotate the adjustable adapter anti-clock wise the height of the pylon increases and when we rotate it clock wise the height decreases.



FIG-1 **FIG- 2** **FIG- 3**

- **FIG-1: Developed adjustable pylon**
- **FIG- 2: Coronal view of adjustable pylon fitted in trans-tibial prosthesis**
- **FIG- 3: Sagittal view of adjustable pylon fitted in trans-tibial prosthesis**

RESULTS AND DISCUSSION

This adjustable pylon is mostly useful to trans-tibial endo-skeletal prosthesis. By this component we can adjust height of prosthesis as required to the amputee. It is easy to adjust the height during static alignment. The amputee also can adjust his height just by rotating the adjustable adapter. This is most effective in growing adults. By using this we can't change the prosthesis in 6 months. Also, we can use this in case of congenital limb deficiency cases. This has easy mechanism, low cost, easy to use. This can be used in all trans-tibial modular prosthesis and congenital limb deficiency patients. It is easy to use and amputee can adjust his height him/her self-up to 2 inches. This is a simple mechanism with low cost & low weight.

CONCLUSION

The development of prosthetics & orthotics from the era of iron and ironmongers to an era of light and ultra-light artificial devices is the result of innovation in inclusion of materials, designs and concepts. The application of all these no doubt improves the quality of lives. The modular concept is one of the highly fine-tuned concepts in akin to human skeleton that it reduces the effort of everyone who are the part of the rehabilitation process. The application of adjustable pylon in modular concept is another amazing mechanism which sequels the mechanical realm in connection with height adjustment. The making of this universal adjustable component opens the door for various options of the disabled. Therefore, we have tried to develop this adjustable prosthetic pylon which successfully adjusts the height up to 50mm or as per requirement. Thus, we can conclude that this concept is helpful for the disable and also for the prosthetist in a very fruitful manner.

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Parthasarathi Swain. All the clinical service delivery to patients and research study was carried out in the premises of SVNIRTAR, Odisha.

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