Mini Review

Jaipur Rehabilitation Technology (Jaipur Foot and Polio Calipers)

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ABSTRACT

Jaipur food designed and developed by Dr. P.K. Sethi is second most widely used foot piece in the world after SACH foot (Solid ankle cushion heel). SACH foot was designed for use in colder climate of western countries. The work on culture specific innovation, The Jaipur foot started with the modification of SACH foot. Jaipur foot made up of microcellular rubber and wooden ankle block with iron bolt held together by using varieties of rubbers used in making automobile tyres at different locations and assembled in a metal die to vulcanize the rubber by autoclaving.

Keywords: Catholic diocese of Jaipur, alocholism, de-addiction

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INTRODUCTION

SACH foot is single axis foot with a rigid, wooden keel extending from ankle to metatarsal region. This wooden keel prevents dorsiflexion at ankle so squatting is not possible in SACH foot. It does not allow cross legged sitting also because forefoot adduction, supination twist and hind foot inversion is not possible in SACH foot.

Jaipur foot allows the amputee to follow floor sitting culture by permitting squatting and sitting cross legged due to flexibility it has at ankle and metatarsal region.

Presence of rigid wooden Keel in SACH foot prevents any transverse rotation of the foot in relation to leg thus transmits the ground reaction at the stump causing lot of discomfort. This is not so in Jaipur foot.

Walking on uneven terrain is painful with SACH foot due to excessive pressure felt at the stump as it allows inversion and eversion movements in a very limited range.

Jaipur foot permits inversion and eversion movements so patient can negotiate uneven terrain comfortably.

Jaipur foot can be used with or without shoes with equal ease so user can enter religious places like Temple, Mosque and Gurudwara etc.

Water proof exterior in Jaipur foot allows the farmers to work in fields. Jaipur foot has more contact area with the ground so amputee feels more stable in comparison to SACH foot.

In India SACH foot with adapter costs nearly four times as compared to Jaipur foot.

To the best of my knowledge no other institution in India is doing any effort to improve Jaipur foot.

Jaipur foot is in use since last 47 years, increasing in demand globally from low and middle income population.

The major drawback of Jaipur foot is its heavy weight, lack of standardization of raw materials and fabrication process due to which quality control cannot be maintained effectively.

In the absence of product standardization and biomedical comparison with other foot pieces, it could not attain the status of a global product. Our efforts are on to overcome various drawbacks and make it a well standardized global product. First we tried to replace the rubber with polyurethane, in a project funded by Department of Science and Technology, Government of India in collaboration with Indian Institute of Technology, Mumbai and National Chemical Laboratory, Pune from 1991-1998.

In the first phase of the project we replaced the heel, forefoot, toes and wooden ankle block with polyurethane blocks supplied by NCL Pune and retained other rubbers and

outer covering with the same skin colour rubber used in conventional Jaipur foot. In the second phase we used phase first foot piece made up of polyurethane inserts and encapsulated it with polyurethane elastomere. We conducted clinical trials and results were not encouraging. Durability of the foot piece got severely compromised. Outer coating of polyurethane elastomere was very slippery which increased incidence of falls. Shelf life of foot pieces was reduced as the outer cover started disintegrating in six to nine months' time. All these were not acceptable [1].

We no more use polyurethane in making Jaipur foot.

Pre mature breakage of ankle bolt made up of iron was taken care by substituting it with stainless steel bolt.

The claim of Jaipur foot being a cheaper and satisfactory alternative to other prosthetic feet has not been investigated bio mechanically. This has remained unnoticed even after being used in several developing and underdeveloped countries for nearly 45 years.

One of them reported in English literature Arya and Klenerman [2] has investigated some biomechanical properties of Jaipur foot but failed to reach to any conclusion.

The second one reported by Arya, et al. [3] from Liverpool, UK and published in POI 1995, 19, 37-45. In this study, Jaipur foot, SACH foot and Seattle foot were selected for comparison as they not only belong to the same group of non-articulated ankle foot assemblies but also represent the most widely used designs of the prosthetic feet in general.

It was concluded that the performance of Jaipur foot is more natural and nearer to normal foot as compared to SACH and Seattle foot.

The other area where we worked is for substituting wood and metal conventional calipers with low weight, total contact thermoplastic calipers for paralytic poliomyelitis. This project was funded by Department of Science and technology,

Government of India from 1990-1999. Majority of these calipers we designed to permit swing phase knee flexion while walking thus reducing energy consumption significantly. They allowed the patients to use shoes of their choice. Walking on uneven terrain improved significantly. Since these are total contact orthosis, they can be worn inside the cloths and are not visible from outside. 90% rejection rate converted to above 95% acceptance rate.

The calipers initially designed for poliomyelitis were successfully used in many other paralytic and musculoskeletal conditions like-cerebral palsy, spinal injury, Nerve injuries, head injury, stroke, myopathies, spina bifida, fracture bracing, non-union, delayed union, congenital deformities, LGB syndrome, diabetic foot etc.

Floor reaction orthosis (FRO) is one such appliance we evolved for use in patient with stable hip and quadriceps muscle paralysis. In FRO ankle is held in artificially induced equinus which helps in stabilizing flail knee. This improved gait of so many patients who were walking with hand on thigh gait.

Articulated Lehneis KAFO evolved at our centre helped hundreds of patient having genu recurvatum deformity. It allows the patient to walk with swing phase knee flexion leading to energy efficient socially acceptable gait.

New designs of ischial weight bearing KAFO and total contact PTB orthosis used in failed, open reduction and internal fixation of fracture femur and fracture leg bones has shown very good results.

In 1994 International committee of red cross (ICRC) selected our centre for promotion of polypropylene prosthetic technology evolved as amalgamation of Jaipur rehabilitation technology and ICRC technology. International society of prosthetics and orthotics (ISPO) conducted a workshop at our centre. We trained teams from Vietnam, Angola, Mozambique, Bangladesh and many from India.

We worked with Department of Mechanical Engineering Michigan Technological University, USA from 2012-2014 and tried to replace microcellular rubber blocks by EVA blocks in Jaipur foot. Four rounds of Pugh analysis were conducted in which EVA emerged as the best option to replace MCR. EVA was used and we were able to reduce weight of the foot piece but compromised durability and stability was not acceptable. Foot piece remained un-vulcanized from inside and EVA was clearly seen separating from other rubbers used to enclose structural blocks. Idea of using EVA was dropped.

In 2014 National Science Foundation, USA granted us a research project in collaboration with Malviya national institute of technology (MNIT), Jaipur and Ohio State University, USA. Their six member team stayed with us for 10 weeks. We have started working on standardization of raw materials and fabrication process. This will continue up to 2017.

Team from Jiv Daya Foundation, Texas, USA visited our centre and observed simple, low cost effective, appropriate, sustainable technology. They decided to fund one project for three years to do in depth evaluation of effectiveness of services, we are providing and are impacting lives of persons with severe locomotor disability at personal, family, social and professional level. This is still going on.

Ganesh Jangir Engineer by profession innovated "Jaipur belt system for body support". Later he joined hands with us and we further upgraded the belt funded in a project by TePP scheme of DST through Delhi IIT to make it light weight and easy to use. This is still under evolution and likely to come us preventive as well as therapeutic device for back pain and other spinal problems.

Recently Jaipur belt-Spinal brace project has been selected for funding by US, India, Science and technology endowment fund (USISTEF).

Jaipur foot is environment friendly product and all the rubbers and wood used in it are biodegradable [4]. Jaipur Rehabilitation Technology is the most cost effective prosthetic and orthotic technology in the world. Tremendous increase in locomotor disability all over the world makes this technology more relevant due to its simplicity and low cost. Even with severe form of locomotor disability, per day cost of walking is around five rupees, with energy efficient, socially acceptable gait.

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