

Jaipur Foot

- A. P. Deshpande

War & Battles

Wars and battles are going on in the world since ancient times. Two tribes have been always fighting for food, shelter or establishing their kingdom. As the times advanced, the tools and weapons became sharper and more harmful. One who owns most disastrous weapons is regarded as a powerful man. With such tools, the enemy not only gets defeated but also suffers bodily and loses various limbs. The post war scenario witnessed by many, always showed wounded people with bandages, moving with crutches and so on. Getting wounded does not happen only in wars and battles but also in industries. The only difference is, in wars it happens on a mass scale, however in industries it happens sporadically. In earlier days, in mines people used to suffer due to landslides and lose their legs. However until 1968, there was no solution. At the most, people used crutches and manage to walk. But once, one started using crutches, his running was put to a full stop. However Dr. P. K. Sethi, an orthopaedic surgeon from Jaipur, developed a foot, which can be used by people, who lost the leg and can walk without crutches and run as well. During 1968 to 75, he sold 50 limbs to needy persons. This invention was revolutionary and earned an international Raman Magsaysay award. However Dr. P. K. Sethi was not a marketer. Since Dr. P. K. Sethi belonged to Jaipur in Rajasthan and did his pioneering work of developing the foot in Jaipur, the foot is known as Jaipur-Foot. In 1975, it was Bhagawan Mahaveer Vikalang Sahayata Samiti (BMVSS), Jaipur, who met Dr. P. K. Sethi and got his permission to develop it further and market it.

BMVSS

Mr. Ram Chander Sharma mastered the technique, got it developed further and further, so as to make it more and more user friendly and Dr. D. R. Mehta, another orthopaedic surgeon from Jaipur, devoted himself completely to it, got the funding from Dow Chemical, US; and many others and started giving the Jaipur foot free of cost to physically challenged people including landmines. The result of such an effort showed that during 1975 till 2009, i.e. in 34 years time, they could fit Jaipur foot on 3.6 lac of people and 6 lacs of people got calipers, crutches and tricycles across the world. While doing this BMVSS do not discriminate cast, creed, religion, nationality or the economic affordability. To make 9.6 lac handicapped people mobile again is no joke by any measure. On account of this large turnover of BMVSS, it has been the largest organization in the world. BMVSS does the charitable work in India and abroad. BMVSS's devices are low cost, locally produced prosthetic devices. On the occasion of 2500th death anniversary of Bhagawan Mahaveer, Dr. D. R. Mehta, who is a chief Patron, established BMVSS in March, 1975.

In 1969, Dr. D. R. Mehta met with a car accident and his leg got crushed. His surgeon Dr. M. M. Bapna and Dr. Ganga Ram Purohit constantly reminded Dr. Mahta to consider the plight of poor people, who due to lack of money would lose limb. Jaipur

foot was developed by Dr. P. K. Sethi in 1968 and BMVSS got established 7 years later. During that period of 7 years, only 50 limbs were fitted and in the first year itself BMVSS fitted 59 limbs. However now 17,000 to 20,000 limbs are fitted every year. Had BMVSS not been there, Jaipur foot would have got shelved and in limbo by now. BMVSS appealed many donors, experts and social workers and they gladly helped. In fact there are one crore of people in India, suffering from locomotor disability out of a total population of 110 crores. Locomotor disease means paralysis deforming of limbs, loss of limbs, dysfunction of joints of limbs and other deformities. Before 1975, hardly there were one or two institutions in India fitting artificial limbs and providing other aids and appliances. One of them was from Armed forces and only its surplus capacity of few hundred limbs was available to civilians. Thus there was a need to set another institute like BMVSS.

In earlier days, there was a problem of design. In the seventies, only the traditional limbs were being made in India. The foot pieces were made of SACH design (foreign design) and made of laminated wood and rubber. The sockets of such limbs were made of wood. Thus the limbs used to be very heavy and cumbersome in use. The percentage of rejection of such limbs was very high. Besides, the time taken to manufacture a custom made limb was several weeks if not months. Further they were very expensive and beyond the reach of many amputees. Then came Jaipur foot in 1968 and it provided an alternative. It was made of rubber of different types and wood etc. making a multiflex foot, closest to the human foot in functional terms. The socket of Jaipur limb was initially made of Aluminium by replacing the wood, thus making it comparatively lighter. Further Jaipur foot could be made easily and rapidly. (In some cases in a day), using locally available material and craftsmanship.

Despite these developments, Jaipur foot could be fitted on 50 persons during 1968 to 75. What was needed was an organization, which could make artificial limbs in a mass scale and combine the technology with social philosophy value system and patient centric management practice to serve the large number of amputees humanly. It was also needed to upgrade the technology of Jaipur foot by providing technical, financial and managerial inputs. For this a multidisciplinary approach and combination of experts from different fields like orthopaedic, prosthetics, social work and philosophy was needed. BMVSS addressed these aspects and made its presence felt. BMVSS made mass manufacturing and used modern management techniques and a financial support from the public was coupled with proper value system focused on the self respect and dignity of the patients. Then, in the next 7 years i.e. 1975 to 82, over 10,583 limbs were fitted. Patients from all parts of India started coming to Jaipur. Now, every year BMVSS fits 17,000 to 20,000 artificial limbs. Work was spread all over India through its 16 branches. Further almost 40-50 on the spot limb fitment mobile camps are held in a year, reaching the most disadvantaged in the far and distant areas. BMVSS's limbs attract well to do people also because of its quality, but BMVSS's focus is to help the needy poor people. BMVSS's project is a combination of technical, social, financial and managerial skills. BMVSS help 30 limb fitting institutions independently in India by transferring technology and training people.

To reach out the poor patients in rural areas, static institutional approach was supplemented with camp approach for the spot limb manufacturing and fitment which

was not possible with the traditional design and manufacturing process earlier. BMVSS also held camps in 20 countries of Asia, Africa and Latin America and fitted more than 15,000 artificial limbs over time.

Modernisation

One of the reasons for increasing the spread is the constant up gradation in technology. Rubber of different types of well known suppliers is helping. Some structural changes in the design of foot pieces have also been made. For socket, aluminium has been replaced by lighter but high quality polymers. Aluminium is supposed to be lighter among metals but polymer is more lighter than aluminium and more durable too. For the sake of alignment purposes, latest systems like wall frames, laser liners brims etc. have been used. The total contact socket have also been used in Jaipur foot.

It is worth stressing that the blending of the scientific principles of prosthetic science with the rich traditional craftsmanship was necessary and this led to the birth of BMVSS. As a result of this, the product of BMVSS are comparable to those products by commercial organization. This also highlights the social philosophy of BMVSS viz. the poor are being given the products at free of charge, the institution has a greater responsibility to ensure for better quality .

BMVSS also helps with (1) Special shoes and other aids to persons suffering from leprosy, (2) Various types of financial and other support of self employment and social rehabilitation of the physically challenged, (3) Dissemination of knowledge and experience relating to the manufacture of aids and appliances, care of the disabled by providing training to technicians, doctors, etc. by organizing training courses, technical courses, technical workshops, seminars and publication of technical and social books, reports, etc. 4) Collaboration with national and international institutes dealing with handicapped, 5) Some programme for upliftment and self employment of distressed women, whether physically challenged or not.

BMVSS runs satellite centres at Agra, Surat, Bhuj, Vadodara, Palanpur, Rajkot, Jammu, Mathura and Nasik. BMVSS makes limbs and calipers at Jaipur, New Delhi, Hyderabad, Ambala, Shrinagar, Mumbai, Ajmer, Indore and Chennai. Entire BMVSS is patient-centric, friendly management and follows the open door policy. Any patient can visit at any time, any of the BMVSS`s centres for prompt treatment. BMVSS have published manuals on (1) The Jaipur below knee prosthesis high density polyethylene (HDPE) foot, (2) Jaipur artificial limbs, (3) The Jaipur foot, (4) Mahaveer HDPE limb, (5) Rehabilitation of Polio affected children. An informative manual for patients and their parents, (6) A biomechanical comparison of the SACH Seattle and Jaipur foot using ground reaction forces, (7) Jaipur foot ó Challenging convention, (8) Comparative study of biomechanical properties of prosthetic foot from low income countries using roll-over shape, damping ratio and resonant frequency.

Needy disabled persons get appliances free of cost under ADIP scheme with the grant-in-Aid from Ministry of Social Justice and Empowerment, Government of India. BMVSS has evolved a policy and value system which is sensitive, humane and patient caring. The first and foremost concern of BMVSS is that the dignity and self respect of

the patients must be maintained and if possible, enhanced. This aspect has to be specially addressed because of the peculiar characteristics of the patients. The amputees who come to centres of BMVSS suffer not from one but three disabilities. Obviously they are physically handicapped making them dependent on their kin and kith and losing self respect. Secondly they are often poor and below the poverty line. In fact, many of them had been poor before they became handicapped and became poor because they ceased to be economically productive. This also makes them lose their self reliance, self respect and dignity. Thirdly, at least some of them are uneducated. In India it is experienced that large number of patients live in rural or remote areas. Such factors make the problem more complicated. But one common factor is, there is a loss of status and confidence. BMVSS gives appliances, free of cost. Many criticize this policy but BMVSS experiences that their 99% patients are below poverty line and cannot afford even 5% cost. Donors have been requested to donate money as assistance and not as charity. Otherwise the patients feel that they are losing self respect. The assistance is provided with equality without considering cast, creed, religion or region. All patients are treated with respect as human beings. Patients arrive to BMVSS centres any time, even after the closures of the centres or on holidays. They don't have enough money to stay in lodges. Hence BMVSS have made arrangement for their lodge and board. Patients below knee amputees are discharged next day and above knee amputees after 3 days. However, if the case is complicated, patients stay is extended. At other places, people receive limbs after several days or months, however at BMVSS, they leave centre after receiving limbs.

Cost Effectiveness

World over, the administrative cost is 50 to 80 % of the cost of limbs, whereas in BMVSS, it is only 4%. BMVSS served 70,192 patients in the year 2006-07. In 1975, when BMVSS formed, 59 artificial limbs were fitted in a single year, but after 35 years, in the year 2009, every year BMVSS fits 17,000 to 20,000 artificial limbs and 30,000 polio calipers and other appliances. During past 35 years, BMVSS fitted 3,49,324 artificial limbs, 2,99,831 calipers, distributed 70,275 tricycles, 3,56,074 crutches and other aids, 17,302 hearing aids and did 7,264 polio correcting surgeries. Whereas from Afghanistan, to Zambia in 22 countries, 16,783 Jaipur feet were fitted, maximum being 3,051 in Afghanistan.

Beauty of Jaipur foot is that it is light and one can run, climb trees pedal bicycle while it is on and yet it is as low price at 3 US dollars which in US, will cost 2500 US dollars. Limb made with this technology are closet to a normal human limb. Jaipur foot has got the same range of movements which a normal human foot has. It has dorsiflexion inversion, eversion and axial rotation allowing amputees not only to walk comfortably but also squat (sitting on hunches), kneeling, crouching, sitting, cross legged, walking on undulated terrain, running, climbing a tree and driving an automobile. In short, it is all functional, all terrain limb, other limbs with SACH foot cannot have these flexions and functions.

(1) There are some multi axial feet but these allow specific limited flexions and functions. Jaipur foot is cosmetically also closet to the human foot with toes etc.

(2) Once Jaipur foot was developed, many companies in the world added these cosmetic features to their limbs to look like normal foot.

(3) Like other foots in the world, Jaipur foot is also water proof.

(4) Jaipur foot is dual purpose. It may be worn with shoes or without shoes on the desire and need of the user. This feature is crucial for meeting the cultural needs of many regions of the world. For example, most of the modern limbs can be used only with the shoes on with the result that such amputees cannot enter the temples, mosque etc. and cannot pray or perform Namaz.

(5) Normal life of Jaipur foot is 3 years.

(6) Socket of Jaipur foot is made of polymers as being done in case of other modern limbs in the world.

While in the West, co-polymer or other polymers are used for making the sockets. These are used in the sheet form. These are heated and wrapped over the Plaster of Paris positive moulds which are the replicas of the remaining stump. This process leaves the seams or joints in the socket. This also affects the strength. In case of Jaipur foot, the outer socket is made not by using the heated sheets, but by using heated HDPE pipes through a special process with the result that the outer socket is both seamless and strong.

(7) It may also be mentioned here that HDPE pipe unlike PVC pipe (not used in Jaipur foot technology) is inert and nontoxic and biocompatible. It also needs to be mentioned that initially hand beaten aluminium sheets were being used to make Jaipur limb sockets. This was an advancement over the wood and araldite laminated sockets which were very heavy cumbersome. With the availability of polymers in socket making BMVSS shifted to HDPE pipes which are made the fitment modern, better and lighter. For almost a decade, aluminium sockets are not being used at all by BMVSS.

(8) Weight of Jaipur foot below knee for average height person is 1.3 to 1.5 kgs and above knee limb is 2.25 to 2.5 kg.

Jaipur foot was first developed in 1968 and now after 42 years, it is radically different. Particularly socket making in terms of equipment employed modern tooling introduced, new material used, application of modern biomechanical principles, adoption of modern management and production techniques, selection of more qualified human resources etc. is now much superior and more comfortable to the amputees. ISRO is also helping BMVSS in designing, perhaps their experience in Polymer materials and moved by humanitarian ground. ISRO, DOW chemicals of US, Pinnacle Industries, Indore and Liberty Shoes Company, Delhi have made a new polyurethin (PU) foot. This foot is now under field trial and may provide one more choice of the modern foot to the amputees. The Ministry of Social Justice and Empowerment, Government of India has sanctioned a project to BMVSS and Dr. Mathur, Chief Consultant and BMVSS for the development of this new foot. One more research project regarding the development of the indigenised energy storing foot (synergy foot) is also under way. This is also a project sanctioned by the Ministry of Social Justice and Empowerment, Government of India to BMVSS on which Mr. Sanjeev Kumar, Manager BMVSS, New Delhi and Mr. Dharmendra Kumar, Director NIPH, New Delhi (National Institute for the Handicapped in India) are working.

One of the principle objectives of BMVSS is to remain committed to R & D so that the patients get more advanced aids and appliances.

Sudha Chandan Proves it...

The idea of making Jaipur foot was first conceived by Dr. P. K. Sethi, then it was improved by Mr. Ram Chander Sharma. To improve it further, contact socket system have been incorporated in below knee prosthesis. For the above knee prosthesis designs have been changed from quadrilateral socket to Ischial containment socket (ICS) using IOPS brims and total contact sockets. All these improvements have been possible because of the Research and Development work supported and promoted by BMVSS, which is working under the leadership and guidance of Dr. D. R. Mehta and because of his management background, this research work could be organized. ISRO dealing with Space research and products has signed an agreement with BMVSS for the development of PU foot instead of vulcanized rubber. Already field trials and mechanical, laboratory tests are underway and the results up till now are quite encouraging. Jaipur below knee prosthesis is indigenously designed and fabricated from locally available and durable high density polyethylene sheets and HDPE pipes and fitted with world famous Jaipur foot. It became highly functional prosthesis with a total contact socket. It looks like a normal limb, has good range of movement required for normal human locomotion. Total contact socket provides better sensory feedback to the wearer. It helps in preventing edema at the lower end of the stump and helps in improving venous return a great advantage in the immediate post surgical fittings. It allows scientific weight distribution over large surface area of the stump, provided facility for easy alignment changes.

Sudha Chandran, a dancer and actor, lost her limb in 1982 and was fitted with Jaipur foot. She was then able to dance in Telugu film, 'Mayuri' in 1984 and 'Nache Mayuri' Hindi film in 1986. In these films, she danced with Jaipur foot on. What more proof of Jaipur foot is needed?
