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IJPMR 2010; 21 (1):1-4 *Technical Note*

Temporary Upper Limb AIIMS Prostheses - A New Design

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Abstract

Amputation of upper limb causes immediate disturbance in the body image during postoperative period. Early fitting of the prosthesis helps to incorporate the prosthesis in the body image, reduction of stump edema, stump pain, promotion of two-handed activities, prevention of muscle wasting, scoliosis and more acceptance of permanent prosthesis. First four to six weeks of post-operative period are considered to be the golden period to achieve better success in upper limb amputee rehabilitation. Not much has been done in the field of upper limb temporary prosthesis in the last twenty five years. To address this gap a new temporary upper limb prosthesis was designed and fitted to six patients. The design is simple, low cost and functional. It can be fitted immediately after surgery. It is also helpful in cases with open wounds and stump neuromas.

Introduction

The loss of upper limb represents an extreme disability particularly because the sophisticated manipulative functions of hands are lost. There is a lot of divergence of prosthetic functions compared to the upper limb functions. Majority of the patients with upper limb amputations belong to a younger age group. Commonly, amputation is a result of trauma and thus patients do not go through any pre operative stage to prepare them better for the prosthesis fitted later. The limb loss is visually more apparent which attracts attention of others. This altered body causes a series of psychological reactions including anxiety, depression, poor self-esteem and reduced life satisfaction.

Amputation requires a revision of body image. It is hypothesized that there is a relationship between the perception of body image and their psychological well-being of the amputees. Successful adjustment for the amputee appears to be in the incorporation of the prosthesis into his body image as soon as possible. It has been shown that early fitting results in better incorporation of prosthesis into the patient's body image, better adjustment to the amputation and more acceptance of the prosthesis. Success rate for adult upper limb amputee rehabilitation varies from 7-50%[1-7].

Berlemont reported the first immediate fit prosthesis for lower limb amputation in 1958 [8]. In 1965, Burgess et al [9] achieved accelerated rehabilitation, increased acceptance of the prosthesis and less psychological trauma when immediate fitting was performed in lower extremity amputation. The other advantages of the use of immediate post operative prosthesis (IPOP) and early prostheses include promotion of wound healing, decrease in stump pain through control of post operative edema, reduction in phantom pain, prevention of atrophy of muscles and scoliosis because of imbalance, earlier fitting of definitive prosthesis and improvement in patient's general condition by preventing mental depression secondary to limb loss[1,10,11].

The concept of immediate fitting of prosthesis is not widely used in case of upper limb amputations. Only a few studies have been done in this field and a few options are available for immediate postoperative fitting of prosthesis and that too with limited experience[1, 4, 10-12]. We did not come across any studies done on this aspect over the last twenty five years. To address this gap we have designed a low cost temporary prosthesis that is simple, functional and can be made from locally available materials in a short time period.

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Material and Methods

A total of 6 upper limb amputees who attended Department of Physical Medicine & Rehabilitation, All India Institute of Medical Sciences (AIIMS), New Delhi between 2004-2005 were included in this study. There were four male and two female patients in the age group of 20-42 years; the average age was 29.3 years. One female patient was in the post-partum period and at that time was required to be breast-feeding. Level of amputation included one through wrist amputation, three above elbow (all short stumps) and two below elbow amputations. The etiologies for amputation were trauma in two patients, following tumour ablation in three patients and surgery for peripheral vascular insufficiency in one patient. All these patients underwent surgery in the departments of General Surgery and Orthopedics at AIIMS. The patients were referred to the department of PMR for rehabilitation. The prosthesis was fitted to the amputees between five to 15 days (average 9 days) after surgery. Training for use of the prostheses in activities of daily living was given by the occupational therapists for four hours a day for six days after fitting of the prosthesis.

Concept and Design of Prostheses

Suspension: Consisted of figure-of-eight harness.

Socket: In the above elbow amputation cases the socket was made of laminated polyresin with open distal end. In two cases the socket was made of polypropylene, it was kept open distally and medially.The difference in the circumference at various levels was accommodated by the use of velcro straps (Fig 1).

Arm and Forearm pieces: Metal uprights on the medial and lateral aspect were used for arm and the forearm pieces. These were connected to together with metal bands and were covered with leather. The terminal device was attached distally with one U shaped band of mild steel (Fig 2).

Elbow joint: A pre-fabricated drop ring knee joint manufactured by Artificial Limb Manufacturing Corporation of India (ALIMCO) was used for elbow joint. The ring lock was dispensed with. Only flexion - extension was allowed. Hyperextension was restricted with the help of stopper.

Control cable: It extended from the harness to the terminal device and was guided along the metal uprights.

Wrist joint: Wrist joint was used only in one case. It was made of rounded plates of polypropylene proximally secured to the forearm piece at the U shaped bar. These plates acted like constant friction joint and could be rotated to the desired degree.

Terminal device: Voluntary opening hand covered with cosmetic glove was used.

Cosmesis: Proximally and distally hollow spaces were covered with ethalex cylinder. The distal forearm piece was covered with nylon stockinet for better cosmesis (Fig 3).

Weight: The prosthesis weighed about 400 grams.

Results

After training the patients with activities of daily living (ADL), the patients could perform the bilateral hand activities like the use of the prosthesis in assisting the normal hand in holding newspaper, kitchen work, opening and closing door, folding of bed clothes etc. The patients were using this prosthesis for about 5-8 hours a day for 8 weeks till the permanent prosthesis was delivered. The open wounds healed well while the patients were using the prostheses. There were no complications related directly to the use of prosthesis. The female amputee in post partum period used to breast feed the neonate with the support of the prostheses. All the patients were happy with their body image and the prosthesis was cosmetically well accepted.

Discussion

Many patients having the upper limb amputation prefer not to wear a prosthesis. Multiple factors influence the acceptance of the prosthesis and its use. One major reason for this is that the patient quickly learns to compensate the loss by the use of the contralateral normal upper limb. It often occurs to such a degree that the apparently cumbersome prostheses is not accepted and frequently abandoned. A study done by Vitali et al[13] reported a 67% rejection rate for standard below elbow prostheses. Recent study done by Biddiss et al[14] showed a mean rejection rate of 45% and 35% in the literature for body-powered and electric prostheses respectively in pediatric populations. The scenario in India is entirely different with not many fitting centers for prostheses and poor knowledge of the doctors and patients about the availability of prostheses leading to poor prescription ad rejection due to late fittings.[15] In adults rejection for body-powered prosthesis was 26% and the electric one was 23%[14]. The average incidence of non-wear was similar for pediatric (16%) and adult (20%) population[14]. To prevent this rejection and to promote the wearing of prostheses, early use of upper limb prosthesis is helpful. With early fitting, learning bilateral hand activities immediately after surgery can be instituted few days after amputation so that single handed patterns of activities do not get established early or are prevented to be developed.

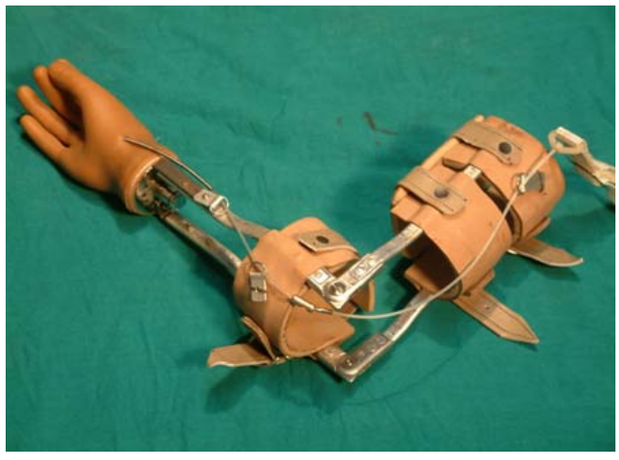

Fig 1. Basic design of the prosthesis.

Fig 2. Below elbow amputee having open wound fitted with prosthesis.

Fig 3a. Above elbow amputee in the early post-operative period having sutures in place.

Fig 3b. Above elbow amputee fitted with the prosthesis without cover (top) and with cosmetic cover (bottom)

The present prosthesis can be fitted despite the presence of open wounds and it is not a deterrent to the temporary prosthetic fitting and early prosthetic training.

Robinson KP et al[10] reported three patients, two with above elbow and one with through wrist amputation that were fitted with immediate prosthesis on the operating table with plaster of Paris cast attached to a hook. In all the patients function was rapidly established. The patients did not become single-handed and they continued their prosthesis throughout their working hours. In another study reported by Burkhalter et al[1], the results of immediate and early postoperative prosthetic fitting in 96 upper limb amputees were reviewed. Initially 11 patients with below elbow amputation plaster of Paris cast was applied to the arm with a hook attached to it within 4-5 days of surgery. Later on, they put the cast in two parts, one above and another below the elbow connected by a polycentric hinge joint. This design caused swelling at elbow joint because of constriction. So they used silastic insert between stump and socket for wound protection.

Because of volume fluctuation frequent changes of insert were required. No local wound complications were noted. Twelve out of 96 patients rejected the prosthesis.

Rate of prosthetic acceptance was high in cases of early fitting. The deficits in these designs were that there were chances of pressure necrosis with plaster of Paris cast and total contact socket, along with increased chances of infection. Plaster of Paris cast with fixed hook can cause discomfort to the patients during sleep and other activities of daily living. In the above studies, the prostheses were not fitted with wrist joint or hand as terminal device. The above shortcomings have been addressed in our design. The main advantages of our prosthesis are as follows:

1. Simple design, low cost prosthesis with adequate suspension

2. Adjustable distal open socket is useful in stump neuromas, open wounds and in patients with sensory deficit. The prosthesis can be used with sutures or dressing in situ.

3. Easy to make and requires very little time for fabrication.

4. Use of different terminal devices is possible

5. It was cosmetically acceptable to the few patients fitted.

6. The prosthesis or parts of the prosthesis can be reused; sliding bars can be used for limb length adjustment

7. This design can be used as a prefabricated prostheses for training.

8. Light weight with total weight about 400 gm.

9. The total cost for the parts of the prosthesis is less than Rs 1000.

Conclusion

The new design of the prosthesis is feasible for use without the complications of fluctuating girth of the healing stump after surgery as well as for stumps with open wounds. It is easy to make with locally available materials. With our limited experience of fitting, it appears to be accepted well and has a scope of wider use in improving the rehabilitation outcome in upper limb amputees.

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Comparative Study of Laminated Exoskeletal versus Modular Endoskeletal Below Knee Prostheses

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Abstract

The purpose of this study was to compare the endoskeletal modular below knee prosthesis and the exoskeletal laminated below knee prosthesis for their acceptability, durability and cost effectiveness. Forty unilateral below knee amputees between 15-55 years using laminated below knee prosthesis (n=20) and endoskeletal modular prosthesis (n=20) for more than 6 months were interviewed regarding period of gait training, architectural barriers, need for repair, stability, comfort, cosmesis, ease with activities of daily living (ADL) and patient's satisfaction. It was found that modular below knee prosthesis was superior in terms of ease of fabrication, shorter hospital stay, less expensive, stable and comfortable as compared to the laminated below knee prosthesis

Key Words – Below Knee Prosthesis Endoskeletal, Exoskeletal, Modular.

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Introduction

The word Prosthesis, the proper name for an artificial limb derives from the Greek word which means "to place an addition". The earliest reference to lower extremity prosthesis is from the Rig Veda from the period 3500-1800 B.C. It gives the account of a militant queen who lost her leg in a battle, had it replaced with iron prosthesis and subsequently returned to combat[1]. The prototype of modern prosthesis was finally developed in 16th century. The most significant prosthetic design of transtibial prosthesis was introduced by the Dutch surgeon Verduyn. This became the prototype for functional transtibial prosthesis until the introduction of the patellar tendon bearing (PTB) prosthesis in 1961 by Charles Radcliffe and James Forte at the University of California at Berkeley[2]. The fabrication of this prosthesis is cumbersome and time taking. The Patient has to stay for a long time in the hospital or make repeated visits for complete fabrication and fitting. Over the years, an endoskeleton modular prosthesis was developed. The present study was done to compare the laminated exoskeletal and the modular endoskeletal prostheses for their ease of fabrication, cost effectiveness, durability and acceptability along with functional evaluation of amputees using these prostheses.

Material and Methods

Forty unilateral below knee amputees between 15-55 years using laminated exoskeletal below knee prosthesis (n=20) and endoskeletal modular prosthesis (n=20) for more than 6 months were selected for the study. Each group consists of 17 males and 3 females. Period of study was between Jan 2003 to June 2005 in Physical Medicine and Rehabilitation Department of the Swami Vivekananda National Institute of Rehabilitation Training and Research (SVNIRTAR), Cuttack. Consent of the amputees was obtained. They were clinically examined and interviewed regarding period of gait training, architectural barriers, need of repair, stability, comfort, cosmetics, ease with ADL and patient's satisfaction after using laminated prosthesis. Fabrication, cost and weight of both the fabricated prosthesis was ascertained. Examination at the end of six months was conducted in the out patient department and workplace of the patient.

Observations and Results

The socket of the prosthesis and its interface were made up of resin[3] by pouring over the positive cast. It took 2 days for complete setting. In case of modular prosthesis, socket was prepared from 12 mm polypropylene sheet over positive mold by vacuum forming technique[4]. It took on an average three hours to prepare the polypropylene socket along with top plate.

Suspension mechanism and prosthetic foot was available as raw materials for both the prostheses.

Alignment for the laminated prosthesis was done by wooden block attachment to the socket. It took three days for proper alignment. In case of modular prosthesis alignment was done by prefabricated aluminum pylon with detachable aligner.

The average fabrication time was one working day for modular prosthesis and five working days for the laminated prosthesis. Gait training period and re-alignment adjustment took approximately 15 days in case of laminated below knee prosthesis and 7 days in case of modular below knee prosthesis .

Cost of both the prostheses was calculated from the cost raw materials, cost for the fabrication and patients' expenditure to procure the prosthesis. The cost of the raw materials were calculated as the fixed rate of Rs 2910 at SVNIRTAR for both the prostheses. Average daily pay of senior qualified prosthetics (government set up) in our hospital was Rs 275/day. The average time spent in fabricating the laminated exoskeletal below knee prosthesis by prosthetics was 5 working days. The cost of Fabrication of laminated PTB prosthesis was Rs 1375. The average period of gait training in case of laminated prosthesis was 15 days. The minimum wages were Rs 70/day in our state. Therefore in case of laminated prosthesis the average wages loss to a patient was Rs 1400. In case of modular endoskeletal prosthesis the average fabrication time was one day and gait training period was 7 days. Therefore the cost of fabrication of a modular PTB prosthesis was Rs.275 and average wages loss was Rs 560. Overall cost of fabrication of below knee laminated prosthesis and modular prosthesis was worked out as Rs 5685 and Rs 3745 respectively. Administrative and manufacturing overheads were not included .

Mean weight of the exoskeletal laminated prosthesis was 1.8$\pm$ 0.3 kg and the endoskeletal modular prosthesis was 1.5 $\pm$ 0.2 kg.

Functional evaluation was done for all the amputees subjectively. Thirteen amputees using laminated below knee prosthesis and 15 amputees with modular below

Index	Entity	No of patients	
		laminated	modular
Duration of fabrication	1-2 days	0	40
	3-5 days	2	0
	>5 days	38	0
Period of gait training	5-10 days	8	33
	11-15 days	28	7
	16-20 days	4	0
Cost of	Raw materials	Rs2910/-	Rs2910/-
	fabrication	Rs1375/-	Rs275/-
	Patient expenditure	Rs1400/-	Rs560/-
Weight of prosthesis	1-2 kg	34	40
	2-3 kg	6	0
Durability	0-6 month	0	0
	6-12month	12	6
	12-24 month	28	34
Functional Subjective evaluation by questionnaire			
Threshold in doorway	disturbed	6	2
	undisturbed	34	38
Performing stable ADL activity	Fully stable	26	30
	Stable with walking stick	12	9
	unstable	2	1
cosmetic	acceptable	20	32
	unacceptable	20	8
problems	heaviness	12	8
	cumbersome	8	2
	Ill fitting	4	2
	pain	8	4
	Skin reaction	1	2
	none	7	22

Table 1. Key differences between the prostheses.

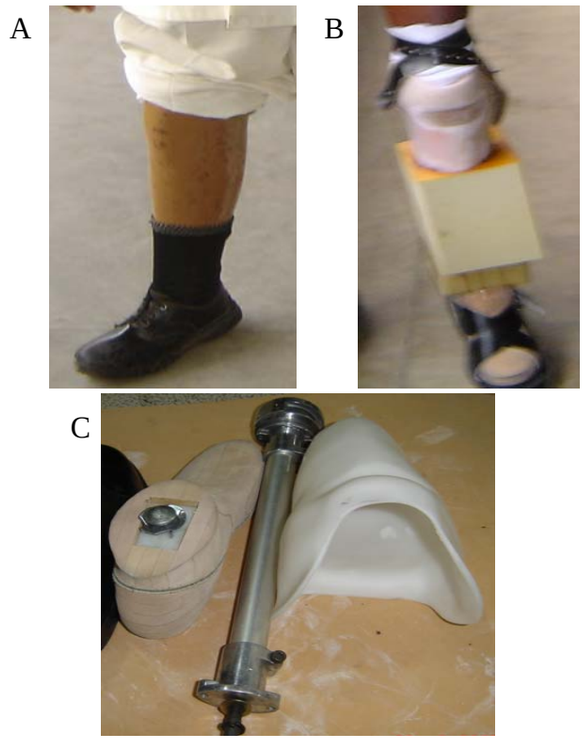

Fig. A. Laminated Prosthesis. B. Laminated prosthesis with alignment blocks. C. Components of modular endoskeletal Prosthesis.

knee prosthesis performed ADL activities independently and walked without any ambulatory aid. Rest of the amputees took help of a walking stick or a pair of axillary crutches for walking. Modular below knee prosthesis was cosmetically acceptable to 16 amputees where as the laminated below knee prosthesis was acceptable to 10 amputees. Difficulty in negotiating the threshold at the door way was found in 3 amputees using the laminated exoskeletal prosthesis and 1 for amputees using the endoskeletal modular below knee prosthesis respectively. There was no problem found in 4 amputee using laminated below knee prosthesis and 11 amputee using modular prosthesis. No breakage was reported for any prosthesis during their six months of usage.

Discussion

In the present study there was substantial difference in the cost of the prosthesis. Laminated prosthesis was approximately Rs. 2000 costlier than the modular prosthesis. Pithawa[5] reported that the carbon fiber endoskeletal prosthesis costed Rs 6010 at the Artificial Limbs Center, Pune. It was nearly equal to the amount of laminated below knee prosthesis. But in our endoskeletal model by using aluminum shank, the cost of the prosthesis reduced to half of the above. The cost of the prosthesis is an important parameter in the developing country like India for acceptability of prosthesis. Sapp[6] cited that the overall gait training time for a transtibial amputee was 44.0+-26.5 days. However, in our study the gait training period was approximately 7 - 15 days in both types of below knee prosthesis. Unlike in western countries, amputees in our study did not want to spend more time to stay in hospital, despite its importance stressed by professionals. This was probably due to the loss of wages of the patients or their care-takers while being away from work and patients wanting to return home faster and continue their training unsupervised. Most of the amputees were satisfied to use the modular below knee prosthesis due to lesser period of gait training. In our study weight of modular prosthesis was found approximately 300gm less than the laminated prosthesis. Mathur[7] reported that the mean weight of the Jaipur prosthesis was 1.6 kg. Energy consumption is directly proportional to the weight of the prosthesis, so heavier the prosthesis, more energy is consumed in the walking and lesser distance covered in the single stretch. Stability with Prosthesis was comparable for both the Prosthesis and there was no significant difference. Cosmetics of the Prosthesis have been an important factor for its acceptability. In the present study laminated prosthesis was cosmetically unacceptable in 50% and modular prosthesis in 20% of amputees. In 1999-2000, Kiba[8] reported that 65% of patients felt that the laminated prosthesis was cosmetically inferior compared those patients using high density polyethylene socket prosthesis. In our study Modular below knee Prosthesis (80%) was cosmetically more acceptable due to finishing by cosmetic stockinet . The discomforts like heaviness, cumbersome, ill-fitting, skin reaction were noted among the amputee using laminated below knee prosthesis. Nielson[9] found that 52% of their patients fitted with lower limb prosthesis were concerned about comfort. In our study the amputees using modular below knee prosthesis were more comfortable than the amputees using laminated below knee prosthesis.

Conclusion

Modular endoskeletal below knee prosthesis was superior to the exoskeletal laminated below knee prosthesis in terms of ease of fabrication, shorter hospital stay and being less expensive. It was also found that the endoskeletal modular below knee prosthesis was functionally better accepted than the exoskeletal laminated below knee prosthesis.

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Gait Comparisons of Trans Tibial Amputees with Six Different Prosthetic Feet in Developing Countries

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Abstract

Gait study in amputees using prosthetic foot ankle mechanisms used in developed countries have been addressed by many authors however very few have been done in the developing countries. The objective of this study was to compare gait parameter in six different prosthetic feet in trans tibial amputees, commonly used in developing countries. The stride parameter, vertical ground reaction force, gait efficiency and quadriceps muscle activities were studied in different feet using Computer Dynography (CDG) gait analyzer. The raw data of force and electromyogrpahy (EMG) sensors of gait analyzer were filtered, processed and analyzed with help of MATLAB 7.0. A blue tooth enabled heart rate telemetry system was used for calculating gait efficiency in terms of physiological cost index (PCI). Seven young and active male trans tibial amputees were recruited in this study and each of them were tested with each of the following prosthetic feet: Solid Ankle Cushioned Heel (SACH), Dynamic (Ottobock), Ranger, Jaipur, Greissinger and Regal. Results indicated that sound limb was exposed to more ground reaction force than the prosthetic foot irrespective of the foot type. However, velocity, cadence and gait efficiency was higher in Dynamic foot. The results of EMG analysis in quadriceps showed that the subjects using Greissinger foot mimic the muscle action of normal human locomotion.

Key Words: Gait Analysis, Ground Reaction Force, EMG, Prosthetic Foot, Trans Tibial Amputee.

Introduction

Basic requirement of lower limb prosthesis is to restore appearance and lost functions in individuals with amputation. Prosthetic foot is an important component of trans tibial prosthesis. Load bearing, leverage, shock absorption, stability and protection are the functions of feet in lower limb prosthetic management[1,2]. New prosthetic materials and designs have broadened the range of prosthetic feet available in the market, thus it is becoming more difficult for prosthetist and prescribing physicians to select appropriate foot to suit an individual amputee. Prescription of prosthesis for lower limb amputees is primarily based on empirical knowledge and subjective experience of physicians, therapists and prosthetists[3, 4], however ideally the prescription should based on functional requirements of amputees[5]. Linde et al discussed the complexity on the precise prescription criteria in different feet in a review of literatures[6].

In developing countries selection of a prosthetic foot depends on many factors: amputees' physical and psychological attributes, financial resources, availability and maintenance of feet. John Craig reported in his study that in low-income countries financial resources are quite limited and the functional demands on prosthetic feet are extreme[7]. In the consensus of International Society for Prosthetic and Orthotic (ISPO) conference regarding appropriate orthopaedic technology for low-income countries, Poetsma summarized that foot is still the weakest part of the prosthesis and improvement required in terms of durability without losing properties is needed for good gait[8]. Gait analysis has been considered as a useful tool for evaluating an amputee's prosthesis by providing objective measurements that characterize the walking pattern[9]. Many experiments on quantification of gait parameter and energy cost have been extensively studied on dynamic and energy storing foot in amputees

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from developed countries[18-20,23]. Pamela et al suggested Flex foot increases biomechanical efficiency in comparison to conventional foot piece and demonstrated minimal difference in energy cost when walking at slow speed[10]. In a pilot study comparing mechanical efficiency of SACH, Seattle and Golden Ankle Prosthetic feet, it was reported that Golden Ankle feet store and retrieve more energy than SACH and Seattle foot and the time to reach foot flat was less in Golden ankle than SACH and Seattle[11, 17]. Powers et al explained the role of prosthetic foot design on sound limb loading and also found relation to gait velocity[13]. Most of the studies on prosthetic feet were carried out on costly dynamic and energy storing foot. Due to economic constraints, manufacturers and voluntary organizations attempt to copy the models of feet like SACH foot. Unfortunately some of these feet develop problem due to the use of inferior material or poor manufacturing techniques. Few investigators have reported gait studies on prosthetic feet used in developing countries. The clinical field trial of Jaipur prosthetic technology for trans tibial amputees has been extensively studied by Jensen[14] but gait studies done to compare Jaipur foot need to be reviewed. The purpose of this study was to compare the gait parameter and PCI[16] in low cost prosthetic feet (SACH, Jaipur) and relatively costlier dynamic feet (Dynamic (Ottobock), Ranger, Jaipur, Greissinger and Regal) available in the developing countries in randomly selected rural and urban young active male persons with trans-tibial amputation.

Material and Methods

Seven active male unilateral traumatic trans-tibial amputees (31±3.3 years of age) were randomly selected for this study. A case history format, questionnaires as per published PEQ[15] (Prosthesis evaluation questionnaires) were filled up for each and the consent form was duly signed. All the subjects were give a general health check up and counseling in addition to the proposed gait study. The details of subjects are given in Table 1. The inclusion criteria were:

1. Age between 25 to 35 years.
2. No residual limb pain, swelling or pressure sores.
3. No major gait deviations
4. Stump length of 40% to 60% of normal segment length
5. No musculoskeletal abnormality
6. Not using assistive device

[Please insert Table-1 here]

The above criteria were to minimize gait variability due to amputees' condition. A height adjustable endoskeletal stain less steel pylon with both socket and foot adapter was fabricated for each subject. Similarly a polystyrene resin with cotton and fiberglass laminated patellar tendon bearig (PTB) socket and a liner were made using low cost polyethylene foam for each subject by an experienced certified prosthetist. The details of the subjects' prosthetic history and cause of amputation is given in Table 1. During the prosthesis fitment process socket, suspension and adjustable pylon were kept the same in each subject, only the feet were changed and tested in a random order. The study compared 6 prosthetic feet belonging to different classes of foot-ankle assemblies as follows:

Amputees	*Age/Sex*	*BMI*	*Cause of Amputation*	*Prosthesis History and total number since amputation*
S1	25/m	17.29	Traumatic	2 yrs using PTB with SACH foot, 1st
S2	35/m	17.36	Traumatic	18 yrs using Jaipur Prosthesis, 8th
S3	30/m	23.67	Traumatic	4 yrs using PTB with SACH foot, 2nd
S4	34/m	26.50	Traumatic	13 yrs using PTB with SACH foot, 3rd
S5	32/m	21.45	Traumatic	14 yrs using PTB with SACH foot, 4th
S6	32/m	24.42	Traumatic	11 yrs using PTB with SACH foot, 3rd
S7	30/m	23.16	Traumatic	2 yrs using PTB with SACH foot, 1st

Table1. Characteristics of the subjects, prosthesis history and foot type.

1. SACH – non articulated
2. Dynamic – non articulated
3. Ranger – non articulated
4. Jaipur foot – non articulated
5. Regal – single axis
6. Greissinger – multi axis

The first three of the above are based on the SACH design with different foam combinations and marketed by different companies mentioned in end notes[1-4]. After each foot fitting, subjects were given four weeks time to get accommodated to the individual socket alignment and feet. The prosthesis alignment was rechecked before testing with the gait analyzer. The same protocol was maintained for all subjects and each subject was evaluated for gait once a month for a total period of six months.

The gait analysis system used for data collection was Computer Dynography (CDG), which was supplied by Infrotronics Medical Industrial Engineering[24-28.] Each subject was made to wrap the micro-controller called ultraflex unit around the waist and a pair of foot sensors or CDG shoes of approximate size, that were put inside the shoes below the normal and the prosthetic feet to collect normalized force distribution. The skin of areas to which electrodes were attached was cleansed thoroughly

with cotton soaked in isopropyl alcohol. Disposable surface EMG electrodes were placed on both the thighs corresponding to quadriceps muscles (Vastus Lateralis, Medialis and Recctus Femoris) to record the EMG Signals. Seven electrodes on each quadriceps including ground reference electrodes were placed. Preamplifier cable of EMG electrodes and cable of CDG shoes were connected to the ultraflex unit. The foot sensors data and EMG data were digitally acquired at a sampling frequency of 100 Hz and 1000 Hz respectively and stored in Memory stick of Ultraflex unit. The Ultraflex unit is a protable battery operated microcontroller unit storage facility for off-line analysis. A portable lightweight blue tooth enabled CHR- 100, 200 LAPS heart rate transmitter was secured with elastic adjustable belt at chest level and the receiver was secured at the wrist. The electrocardiography (ECG) system was used to record heart rate at rest and at load. The gait data of all the subjects was evaluated in gait and biomechanics lab of National Institute for the Orthopeadically Handicapped, Kolkata, India.

The basis for the use of this technique is explained as follows. Gait efficiency is conventionally measured by oxygen uptake. Physiological Cost Index (PCI) is the most simple and suitable method to calculate index of gait efficiency in indirect calorimetric method as reported by Butler[34] et al and the same were also used by Nelson[21] et al to compare conventional and flex foot. PCI was calculated by dividing the velocity in Km/hr to the difference of heart rate (heart rate was measured after a fixed time of 20 sec walking on plane surface and at rest) using heart rate transmitter.

All the data was analyzed in CDG software and MATLAB 7.0. The digitally collected EMG raw data was rectified, integrated and stored as percentage of maximum peak amplitude of individual gait in each sub phase of the gait cycle. The same data was also compared to visual interface of CDG software. Differences between six feet were determined by univariate repeated measures analysis of variance (ANOVA) with a single group factor for normally distributed data and two ways ANOVA for data not normally distributed. An alpha level of 0.05 was adopted for determining statistical significance. The Pearson's correlation coefficients were also determined for calculating correlation between stride parameter. The significance level was set at $p<0.05$.

Results

Stride Characteristics: A total of 15 stride parameters were calculated (velocity, cadence, stride length, gait cycle duration, double support, single support, stance duration, step duration prosthesis, step duration normal, swing duration prosthesis, swing duration normal, symmetry stance, symmetry step duration, symmetry double support, symmetry swing), out of which significant differences were found in velocity ($p=0.016 < 0.05$) and cadence ($p=0.018 <0.05$) as shown in Table 2. The velocity and cadence with Greissinger foot was found to be the highest among all the feet and significantly greater than the SACH foot and the Jaipur foot. There was no statistical difference between stride lengths using any of six foot. The symmetry of step length (Step length prosthetic side/ step length sound limb) was high in Greissinger foot (94.982 %) and less in jaipur foot (87.93%) followed by SACH foot (88.47 %).

Foot Type	*Velocity (m/min)*	*Stride Length (m)*	*Cadence (steps/m)*
SACH	52.68 ± 13.48	1.14 ± 0.199	90.5 ± 11.95
Jaipur	54.83 ± 14.10	1.13 ± 0.24	91.87 ± 10.07
Ranger	54.63 ± 16.43	1.12 ± 0.26	96.53 ± 11.47
Regel	60.15 ± 11.23	1.18 ± 0.17	101.04 ± 7.96
Ottobock D	56.91 ± 13.13	1.11 ± 0.15	91 ± 11.40
Grissinger	64.27 ± 11.34	1.23 ± 0.18	103.72 ± 11.50
Normal	66.7 ± 9.46	1.30 ± 0.149	102.8 ± 7.155

Table2. Gait Parameters during plain surface walking at self selected velocity.

Force Sensor data: The force at loading response and toe off were calculated in each subject with different feet at the self selected velocity. The mean and standard deviation of velocities of different feet is given in table 1. Peak vertical force was arithmetically averaged for each subject for total loading response with each foot at initial stance, mid stance and push off. No statistical significant difference was found with loading response of different feet in prosthetic limb ($p= 0.07$) and normal limb (0.4875). However a significant difference was found with the Jaipur foot when compare to Greissinger foot ($p= 0.047$). The load in sound limb during initial stance was made as reference axis. Figure 1 shows the loading response results in different prosthetic limbs by comparing to the sound limbs. The loading response of Jaipur found was found better compared to all other feet. Similarly the push off action of different feet compared to the sound limb is shown in figure 2. A significant difference was found in the push off action of the prosthetic limb with different feet, $p<0.05$ ($p= 0.013$) however no statistical difference was found in the normal limb of the subjects using different prosthetic feet. ($p=0.591$). A significant difference was found in the mid stance (30% of gait cycle) in the prosthetic limb ($p= 0.0018$) but there was no difference in the sound limb ($p= 0.451$).

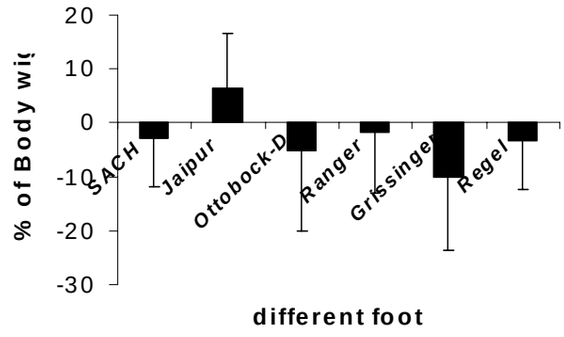

Fig 1.Loading in prosthetic limb compared to the sound limb.

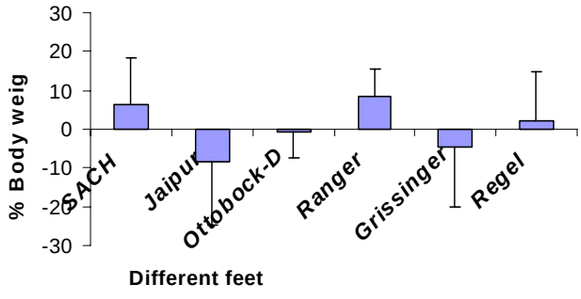

Fig 2. Push off action in prosthetic limb compared to the sound limb.

Electromyography Data: The largest and strongest component of quadriceps is the Vastus Lateralis[31]. In this study the EMG data of Vastus Lateralis (VL) were taken to verify the impact of different feet in quadriceps muscle activity. The data normalization was carried out by adopting the mean maximum value of each subject's EMG over the stride period as the reference value[29] (100%). Each stride was divided into 10% intervals and the average peak amplitude of ten strides for each subject was given a value of 100%. Similar normalization was adopted by Knutsson and Richards[30]. Each sub phase (10% of gait cycle) was expressed as a percentage of mean peak amplitude. The average value of amplitude expressed in percentage of maximum gait contraction (MGC) for seven subjects was calculated for each 10% of gait cycle. The EMG pattern of Vastus lateralis of both normal and prosthetic side with six different feet is shown in figure 3 and 4. There was statistically no difference between normalized amplitudes of EMG in the sound limbs (p= 0.656) but significant difference was found in the prosthetic limbs (p=0.011) in all the six feet. The comparison between the sound limb and the amputated limb did not show any statistical significance at any sub phase of gait cycle in an individual prosthetic foot. During the loading response of sound limb at 10% of gait cycle, maximum peak (70 to 100%) occurred with Greissinger and Ranger feet, low peak (20 to 50%) in Ottobock Dynamic and Jaipur Feet. The results showed

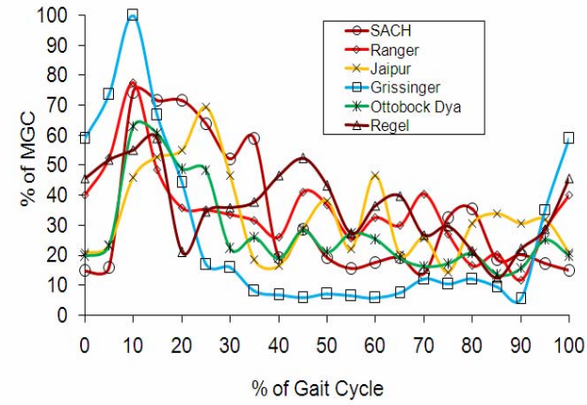

Fig 3. EMG pattern of Vastus Lateralis in sound limbs.

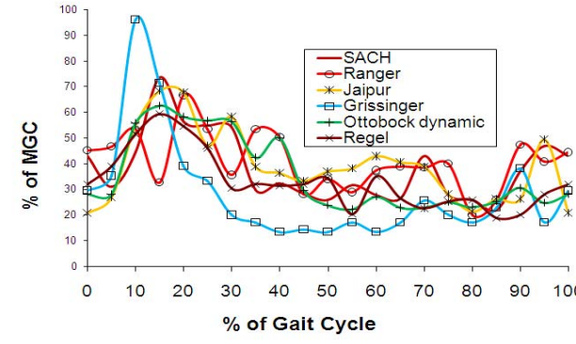

Fig 4: EMG pattern of Vastus Lateralis in prosthetic leg.

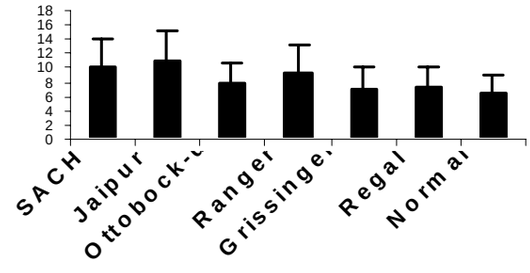

Fig 5. Physiological Cost Index of different feet in self selected velocity.

EMG activity of VL of both sound and amputated limb in Greissinger foot are similar to muscle action of normal human locomotion as reported by Winter[32,33].

PCI data: Energy efficiency was the least with the Jaipur foot when compared to all the other feet. The PCI in patients wearing all the six feet are given in figure 5. SACH foot was found better in terms of energy consumption compared to the Jaipur foot.

Discussion

Temporal-spatial parameters are useful measurements for prosthetic evaluation as they provide fundamental information about gait. The results of the study indicated that self selected walking velocity of normal subjects was

in the range of 66.7±9.46 m/min but it has been reported to be approximately 70 to 90 m/min in subjects from other studies[12] and similarly a higher cadence was also reported. This difference in normal subject is due to anthropometric variations. Velocity provides a better indication of person's walking ability than any other gait parameter and should be considered in selecting a prosthetic foot[36]. Wagner indicated that self-selected walking velocity of both dynamic and SACH foot ambulation was below the normal values, which were in agreement with our findings[22]. The mean velocity of SACH foot and other dynamic feet were reported 80% and 90% of normal respectively[37], the similar results were found in our study. The other stride characteristics did not show any statistical difference in the two way ANOVA study by taking both subjects and feet in groups, similar finding were reported in the other gait studies[37,38]. It has been suggested that symmetry between the sound and prosthetic limb is the best method to evaluate different prosthetic feet[12], however our study did not show any statistical difference on the symmetry parameters but performance of different foot in terms of symmetry was differentiated.

The results of forces data indicated that sound limb faced more load than amputated limb irrespective of the feet type, same results was also reported by Powers[13] et al and Snyder[38]. As reported by Chao[39] et al the initial peak of vertical force in normal subject is 11% more than the body weight. The results showed that the Jaipur foot loading response (7% of the body weight) was more close to normal and similar findings were made in a biomechanical comparison between SACH, Jaipur and Seattle foot Arya[40]et al. Powers[13] and colleagues discussed that the prosthetic foot design played a significant role in contributing to the sound limb loading due to dorsiflexion range of motion of dynamic foot. Jaipur foot was found to transmit 9% less body weight in the push off phase due to it high flexibility and mobility. As reported by subjects during training session in our laboratory that they prefered to walk on the heel in Jaipur foot and they put more weight on heel than at toe at toe off. It was theorized that increas in the terminal stance dorsiflexion reduced the need to heel raise for tibial progression, thus minimizing the elevation of body centre of gravity and thus consuming less energy in comparison to the other feet, however as per PCI results Jaipur foot had higher energy index in comparison to all other feet expect SACH foot. The weight factor of Jaipur foot in comparison to all other feet may be responsible for high energy consumption.

The results of EMG analysis of sound limb in two ways ANOVA with a group factor of foot showed no significant difference p= 0.656 but with a group factor of phase 0 of the gait cycle showed a significant difference p= 0.0041. The EMG analysis is important in the analysis of the role of the prosthetic foot in different phases of the gait cycle by putting the duration (Gait Cyle) and amplitude of muscle activity. The EMG patterns of quadriceps muscle in contra lateral limb of the amputee subjects were not affected by changing different feet and similar results were found in the EMG analysis by Cuham[41] et al. The EMG pattern of Greissinger foot showed consistence in both the sound and the amputated limb EMG activity. Perry[24] also supported the results of peak amplitude of quadriceps in the sound limb at the initial phase of gait cycle that the primary shock absorption mechanism during the loading response was maintained by knee flexion and quadriceps function eccentrically to restrain the knee flexion.

Conclusion

The results of this study indicate that sound limb takes more load than the prosthetic limb during loading response irrespective of the type of terminal device which has already been established by many literatures as discussed, however, the results of the second peak of ground reaction force or push off concluded that push off action is poor in Jaipur foot. The symmetry of SACH foot was found better than the Jaipur foot but was less than the other dynamic feet. Greissinger foot mimics more natural gait with respect to symmetry, velocity, energy consumption and muscle activity. The amplitude EMG of quadriceps in different phases of gait cycle is found to be a better method to differentiate dynamic function of the prosthetic foot. Two way analysis of ANOVA in group factor foot and subjects showed variation of gait parameters in the individual subjects, which shows that the biomechanical character of prosthetic feet is not the only criteria for selection of the foot type but the subjects acceptability, habitat, activity and psychosocial condition may also be a factor in selecting the foot type.

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Suppliers

1. **SACH foot**: Artificial Limb Manufacturing Corporation of India, GT Road, Kanpur -208016, India. www.artlimbs.com
2. **Jaipur Foot**: Bhagwan Mahaveer Viklang Sahyata Samiti, Swai Man Singh Hospital, Jaipur- 302004, India. www.sms.com
3. **Greissinger Foot** (1A30), **Dynamic-Ottobock** (1D10): Ottobock Health Care India Pvt. Ltd., Behind Fairlawn Housing Society, Sion-Trombay Road, Chembur, Mumbai-400071. www.ottobockindia.com
4. **Ranger Foot**, Regal Single Axis Foot: Endolite India Limited, A-4, Naraina Indl Area Phase-1, New Delhi 110028. www.endiliteindia.com

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Fatigue, Physical Function and Quality of Life in Relation to Disease Activity in Established Rheumatoid Arthritis

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Abstract

Objectives: This study was intended to find out the relationship of fatigue, functional disability and Health-Related Quality Of Life (HRQOL) with disease activity in adult patients with active rheumatoid arthritis (RA) and to observe the effect of rehabilitation programme on these parameters.

Material and Methods: 106 patients participated and 96 completed the study. Disease Activity Score-28 (DAS-28), visual analogue scale for pain and fatigue, Multidimensional Assessment of Fatigue Scale (MAF), Health Assessment Questionnaire (HAQ), American College of Rheumatology revised criteria for functional status classification, World Health Organization Quality Of Life instrument (WHOQOL-BREF) were administered. A comprehensive rehabilitation programme comprising pharmacologic and non-pharmacologic therapy was continued for 6 months.

Results: Mean VAS fatigue, DAS28 & HAQ scores were 45.68, 5.14 and 1.16 respectively. Significant correlation (Pearson's r =0.82, $p<0.05$; r=0.75, $p<0.05$; r=0.85, $p=<0.05$) between the disease activity and the value of the VAS Fatigue, Global Fatigue (MAF) and HAQ score respectively and inverse co-relation between quality of life (QOL) domain scores and disease activity were observed. Similar results were also found in the final visit. Comprehensive rehabilitation reduced the disease activity, fatigue, functional disability and improved QOL.

Conclusion: High fatigue level, disability, pain and decreased QOL characterized RA disease activity. Reduction of DAS, Fatigue, HAQ scores with treatment improved QOL.

Key words: Quality of life, Disease activity, Rheumatoid Arthritis

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Introduction

Rheumatoid arthritis (RA) is a chronic disabling condition with unpredictable course and wide variation in severity[1]. Management requires regular assessment of disease activity. The current gold standard for assessment is the 28 joint disease activity score (DAS28)[2].

Although the joints are the major loci of disease activity, fatigue is a common extra-articular symptom that exists in all gradations of RA[3, 4]. Fatigue is typically defined as extreme and persistent tiredness, weakness or exhaustion mental, physical or both. Subjective fatigue has been defined as a sense of extreme tiredness or exhaustion[4, 5]. In fact an estimated 80-93% of individuals with RA experience fatigue[3, 6] and in one sample of RA patients 57% reported that fatigue was the most problematic aspect of their disease[4, 7]. Despite this, fatigue has typically been ignored in the assessment of symptom severity or outcome in many of the diseases in which it is found including RA.

In recent years there has been a broadening of focus in the measurement of health, beyond traditional health indicators such as mortality and morbidity to include measures of the impact of disease and impairment on

multiple aspects of the patients' life including Quality of Life (QOL). The World Health Organization defined QOL as "the individuals' perceptions of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns"[8].

RA is a chronic inflammatory and disabling disease, causing disruption to the daily lives of patients. Self reported measures of functional ability are important indicators of health status in patients with rheumatoid arthritis (RA). Published in 1980, Health Assessment Questionnaire (HAQ) was among the first instruments based on patient centered dimensions and has established itself as a valuable, effective and sensitive tool for measurement of health status in RA[9]. Its component Health Assessment Questionnaire- Disability Index (HAQ-DI) specifically measures disability and physical function. Validated Indian version of HAQ was published in 2002. This can be self-administered in English or Hindi[10].

Aim of our study was to find out the correlations of fatigue, physical function (disability) and QOL with disease activity score-28 (DAS28) and to see changes of these parameters with disease activity after 6 months of treatment.

Patients and Methods

Following written informed consent, patients with RA were enrolled during the period of April, 2007-July, 2008 at the outpatient department of Physical Medicine and Rehabilitation and Rheumatology, IPGMER and SSKM Hospital, Kolkata. The study was approved by the Institutional Ethics Committee.

RA patients were selected on the basis of fulfilling the "Revised American Rheumatology Association Criteria" (1988)[11] met two eligibility criteria: age range 16-70 years and being able to read.

Of the 135 RA patients approached, complete data was available for 106 patients (78.52%) who were included in the study. Fifteen patients with missing data like radiographs, ESR, etc were not included in the final analysis of the study, since in the absence of this clinical data, calculation of Disease activity Scores (DAS) was not feasible. Eleven patients were deliberately excluded as they took more time to fill up the questionnaires and sought help almost in every question and three refused to take part in the study.

First 20 consecutive patients (fulfilling the criteria), attending the Rheumatology OPD (weekly) were included in the study. Follow up was done as per schedule. DAS score were calculated on every visit and treatment (Rx) was given according to that.

After 6 months a total of 96 patients (10 patients missing) attended our OPD with reports of prescribed investigation. During the 6 months' period patients were given pharmacological and non-pharmacological management. Monthly monitoring of drugs, exercise classes, physical modalities and counseling was done for each patient. Phone numbers were taken from each patient so that we could contact them when needed. Missing 10 patients could not be contacted because of incorrect addresses and phone numbers.

Out of 106 patients (at baseline), 80 patients were referred from other centers. Out of these, 60 patients did not take any disease modifying anti-rheumatic drugs (DMARDs). 20 patients took DMARDs and/or steroid according to their physician's advise. Other 26 patients were old follow up patients. All of them were on DMARDs with 15 patients taking more than one DMARD.

After assessment, every patient was prescribed at least two DMARDs and /or steroid as needed. All patients were advised not to take any NSAIDs before coming to the next visit for at least 24 hours.

Therapeutic exercises in the form of range of motion exercises, strengthening exercises (Isometric/ Isotonic), aerobic exercise like swimming, relaxation techniques were told to all patients. Splints, gait aids and assistive devices were given as needed by the patient. Patient education on the disease course, joint protection techniques and energy conservation techniques was also given.

DAS28 was calculated for the current disease activity according to 28 swollen (SJC28) and tender (TJC28) joint counts from the formula DAS28 = 0.56*sqrt (TJC28) + 0.28*sqrt (SJC28) + 0.70*Ln (ESR) + 0.014*patient global 0 to 100[12]. DAS score can range from 0 to 9.4. A DAS28 above 5.1 means high disease activity, 3.2- 5.1 moderate disease activity whereas a DAS28 below 3.2 indicates low disease activity[2].

Information on pain (100mm VAS), fatigue (100mm VAS and Multidimensional Assessment of Fatigue Scale[13]), functional disability (Health Assessment Questionnaire-Disability Index / HAQ-DI; Indian version)[10], functional classification (ACR1991 revised Global Functional status scale)[14] were recorded in all cases. The QOL was assessed using WHOQOL- BREF questionnaire to all patients. Raw scores were calculated and converted to a 0-100 scale.

In the treatment response studies, the clinical assessments were done before and after 6 months of treatment. During the 6 months period pharmacological and non-

pharmacological interventions were done according to the need of the patients. Necessary adjustments in the dosage were done monthly.

Statistically, the data was entered into Microsoft Excel and analyzed by Statistica Version 6 (Stat Soft Inc, Tulsa, Oklahoma, 2001). The data was been summarized by visual descriptive measures mainly mean and standard deviation of various groups and subgroups. Numerical variables were compared between groups by unpaired- t test while categorical variables have been compared by Fisher's exact test. Changes of numerical variables from baseline were assessed by Paired t test. The Pearson's correlation coefficient r was used to associate various numerical parameters with WHOQOL- BREF domains. All analysis was 2 tailed and $p < 0.005$ was considered statistically significant.

Results

Demographic Characteristics: The study group comprised 106 RA patients (Table 1).

Disease Activity: (Fig 1). Most of the patients were in the moderate to higher disease activity group. 48 patients (45.28%) had moderate disease activity, 49 patients (46.23%) had higher disease activity and only 9 patients (8.49%) had low disease activity. The mean DAS28 scores were 5.14 ± 01.34. Pearson's correlation coefficient r showed that DAS28 scores were significantly correlated with VAS pain ($r = 0.88$, $p < 0.05$). Seropositive RA had higher mean DAS score than that of seronegative RA. We did not find any association with disease duration and gender.

	RA Patients (n=106)	Control (n=49)
Sex (F/M)	71/35	34/15
Mean Age (years)	44.32+10.27	45.55+9.81
Education <Junior High High School >College	 14 68 24	 5 28 16
Mean Duration (years)	4.95+3.33	
Rural background	61	27
DAS 28 Low (<3.2) Mod (3.2-5.1) High (>5.1)	 9 (8.49%) 48 (45.28%) 49 (46.23%)	NA
HAQ - D1 Scores 0-1 Scores 1-2 Scores 2-3	 48 (45.28%) 53 (50%) 5 (4.72%)	49 (100%)

Table 1. Profile of cases and controls at initial visit

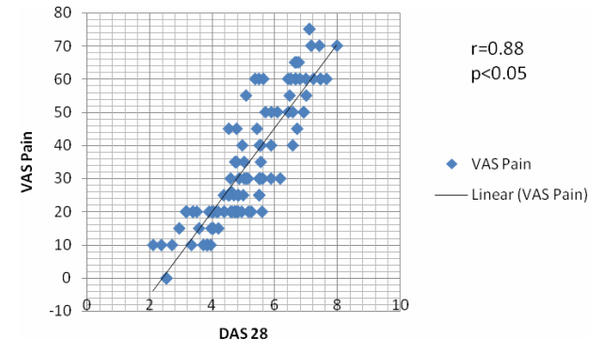

Fig 1. VAS Pain with DAS28 at baseline visit.

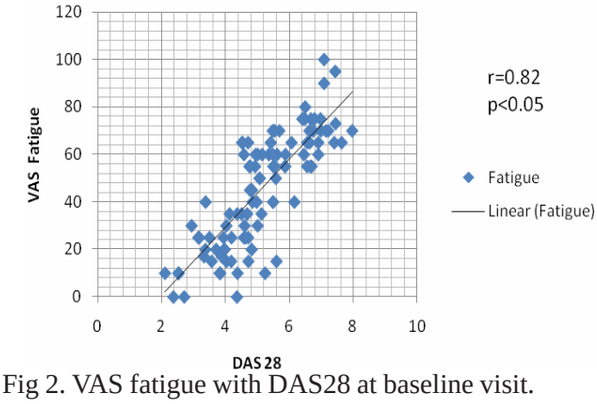

Fig 2. VAS fatigue with DAS28 at baseline visit.

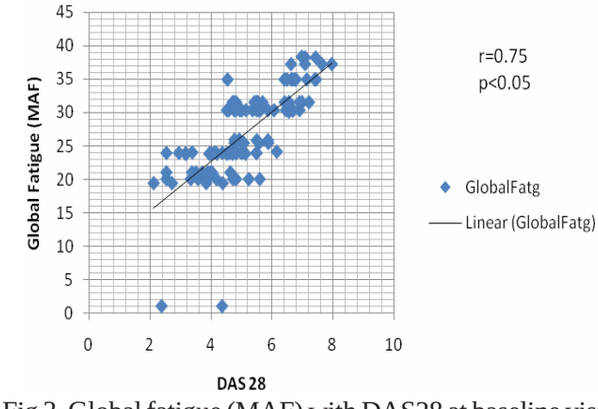

Fig 3. Global fatigue (MAF) with DAS28 at baseline visit

Fatigue: (Fig 2-3) The study revealed that 83 patients (78.30%) had clinically relevant fatigue (VAS score > 20mm) and 52 patients (49.06%) had high fatigue scores (VAS score > 50mm). Fatigue was also assessed using Multidimensional Assessment of Fatigue (MAF) scale (range 1 to 50). Higher the score the more severe was the fatigue. The mean global fatigue score (MAF) was 26.95 ± 6.56. The mean score (MAF scale) was slightly higher in female patients. Mean fatigue score (VAS scale) was also reported to be higher in female patients (46.49) than that of male patients (VAS 44.06) but no statistical significant difference was found in either parameters. Gender and rheumatoid factor did not show any significant role in fatigue scores. DAS28 and VAS fatigue showed

significant association, using Pearson's correlation coefficient r (r = 0.82, p < 0.05**).** Similar result was obtained when disease activity DAS28 was correlated with global fatigue scores (MAF) (r = 0.75, p < 0.05).

Fatigue was inversely correlated with the QOL domain scores, especially in physical health and psychological health. In these two domains, VAS fatigue was inversely correlated (physical health, r = "0.72, p < 0.05; psychological health, r = "0.74, p < 0.05). In MAF scale, similar results were obtained.

Functional Status: Patients' functional status estimation was done using ACR 1991 revised Global functional status scale. Maximum number of patients were in ACR functional class II (52 pts, 49.06%), followed by 26 patients (24.53%) in class I. The study revealed that maximum patients had HAQ-DI scores in between > 1-1.5 (36 patients = 33.96%) followed by scores > 0.5-1 (25 patients = 23.58%). Higher the score, more severe was the physical disability. The mean HAQ-DI score was 1.16 ± 0.60.

Significant co-relation was found between between DAS28 and functional disability (HAQ-DI, r = 0.85, p < 0.05). Moderate to strong inverse co-relations were found between the QOL domain scores and functional disability (HAQ).

Quality of Life: The mean WHOQOL domain scores of RA patients were as follows: in physical health (43.70 ± 16.75), psychological health (44.82 ± 19.48), social relationship (61.02 ± 11.99) and environmental domains (50.51 ± 10.21) at the initial visit. Among the domain scores, mean physical health (43.70 ± 16.75) and psychological health (44.82 ± 19.48) were comparatively lower than the other two domains.

Association study revealed that there was significant inverse co-relation between disease activity and Quality of Life domain scores (Physical r = "0.74, p < 0.05; psychological r = "0.74, p < 0.05; social r = "0.54, p < 0.05; environmental r = "0.58, p < 0.05). VAS pain was inversely correlated with QOL domain scores. In follow up visit similar results were obtained.

Treatment Response: Over 6 months, mean DAS-28 score had dropped from 5.10 ± 1.31 to 4.58 ± 1.25 (p value < 0.001) when the patient population completed the study was taken into account (n = 96). Documentation of the DAS scores is important to estimate the intensity & duration of therapeutic exercise to be prescribed as part of rehabilitation.

Over 6 months, fatigue scores decreased from a mean of 45.00 ± 23.46 to 37.46 ± 22.14 in case of VAS and 26.7 ± 6.54 to 23.27 ± 7.90 in case of MAF. At baseline,

Score	Initial Visit	Final Visit	p- value
DAS28	5.10 ± 1.31	4.58 ± 1.25	< 0.001

Table 2. Treatment response- disease activity

Grade	Initial Visit	Final Visit	*p*- Value
DAS Low (≤3.2) [n = 9]			
VAS Pain	9.44 ± 8.08	8.89 ± 8.21	= 0.73
VAS Fatigue	13.33 ± 10.90	10.67 ± 11.74	= 0.54
Global Fatigue	19.58 ± 7.25	12.02 ± 10.53	= 0.14
HAQ	0.29 ± 0.12	0.32 ± 0.14	= 0.35
ACR	1.22 ± 0.44	1.11 ± 0.33	= 0.59
DAS Medium (3.2-5.1) [n = 44]			
VAS Pain	24.23 ± 9.21	19.75 ± 9.21	**< 0.001**
VAS Fatigue	34.70 ± 17.35	28.86 ± 17.85	**< 0.001**
Global Fatigue	24.08 ± 5.28	21.51 ± 6.26	**< 0.001**
HAQ	0.92 ± 0.33	0.85 ± 0.35	= 0.10
ACR	1.68 ± 0.60	1.27 ± 0.54	**< 0.001**
DAS High (> 5.1) [n = 43]			
VAS Pain	49.07 ± 15.82	39.30 ± 15.91	**< 0.001**
VAS Fatigue	62.16 ± 16.92	51.86 ± 17.68	**< 0.001**
Global Fatigue	30.88 ± 4.72	27.43 ± 5.63	**< 0.001**
HAQ	1.58 ± 0.52	1.42 ± 0.52	**< 0.001**
ACR	2.53 ± 0.59	1.93 ± 0.80	**< 0.001**

Table 3. Improvement in pain, fatigue and functional status in Patients with different grades of disease activity

49.06% of the patients had high fatigue level (VAS scores > 50 mm), which came down to 40.63% after treatment. This fall in VAS fatigue and global fatigue scores was correlated with improvements in DAS 28 (p < 0.001).

Mean changes from baseline in the HAQ-DI score was "0.10 and that was "0.47 in ACR functional scale. Improvements in physical function were statistically significant (p <0.001) in both scales.

VAS pain scales, ACR functional class scores showed a consistent pattern of decrease in their mean scores in three groups. Statistically significant improvement was found in DAS medium and high group (especially in HAQ, pain score and ACR functional class). In low DAS group clinical improvement was found but it was not statistically significant. In HAQ-DI scores no statistically significant improvement found in DAS low and medium group though in high DAS group, both clinically and statistically significant improvement was found.

Following 6 months rehabilitation, WHOQOL Domain scores increased significantly except in social relationship domain. These results are consistent in all three groups

WHOQOL Domain	*p*- value
Physical health	= **0.001**
Psychological health	= **0.001**
Social relationship	= 0.25
Environmental	< **0.01**

Table 4. Treatment response: quality of life

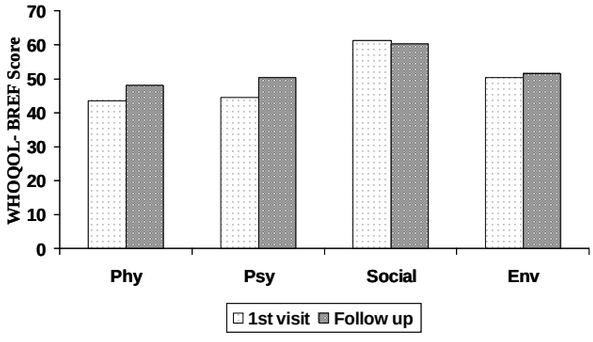

Fig 4. Effect of rehabilitative management on different domains of WHOQOL. Phy: Physical health; Psy: Psycological health; Social: Social relationship; Env: Environmental.

Discussion

The characteristics of the patient population in terms of mean age, gender and duration of symptoms were similar to those previously reported in Indian studies[15-17].

Fatigue is a dominant symptom in RA. Reduction in fatigue accompanied decrease in disease activity and pain. The fall mirrors decreased in DAS score and pain[18]. Similar to the previous reports[13], our study also showed that patients with active RA reported more fatigue. Fatigue score reduced from higher to lower value when active RA patients were treated with DMARDs and non-pharmacological management. VAS fatigue scores are simple and reproducible; however, multidimensional assessments may provide a more complete picture and improve our understanding of the clinical relationships of fatigue[18]. We found similar results using VAS scores and MAF scores. According to National Rheumatoid Arthritis Society the disease process (chronic inflammation of joints and other tissues) is the main cause of fatigue. They also found close relationship between fatigue, disease activity and the level of markers of inflammation such as the ESR (erythrocyte sedimentation rate) or the CRP (C reactive protein).

Although Huyser et al[4] found that subjective fatigue was not strongly related to greater RA disease activity, the strong association between disease activity and fatigue found in our study can be explained by the fact that when disease activity is high, other symptoms such as pain, depression, decreased endurance and psychological stability, physical disability etc. become more pronounced. These factors may be the reason for increased fatigue. Disease activity has been shown to adversely affect physical and psychological QOL in earlier studies[15, 16]. Our study established strong association not only between disease activity and physical health and psychological health domains of QOL but also between disease activity and factors like pain and functional disability (HAQ).

It has been reported that the fatigue level falls in RA patients after 12 weeks of therapeutic exercise programme[19]. Our study showed that this fall in fatigue accompanied decrease in disease activity when non-pharmacological therapy including exercise programme and energy conservation technique was coupled with pharmacologic therapy based on DMARDs.

The self reported total HAQ assesses fine movements of the upper extremities, locomotor activities of the lower extremities, and activities involving both the upper and lower extremities and trunk. HAQ is an important outcome measure in clinical trials and in the documentation of patient status in clinical care. RA significantly compromises functional capacity and increases functional disability. Our study revealed that mean scores of functional disability as measured by HAQ-DI was significantly associated with disease activity. This kind of information was quite predictable in view of the recent work involving both HAQ and other related instruments[20, 21]. Pain is a major symptom in rheumatoid arthritis and is the leading reason for patients seeking medical care[21-24]. In this study, high degree of disability as expressed by increased HAQ score can be attributed to pain along with synovitis and decreased mobility due to higher disease activity.

QOL instruments, such as the Health Assessment Questionnaire (HAQ) Disability Index and the SF-36, have proven validity and sensitivity for assessment of changes in QOL in clinical trials of disease-modifying anti-rheumatic drugs (DMARDs). However, these instruments are rarely utilized in clinical practice, and patients have reported that the actual clinical assessment alone does not address important parameters, such as fatigue and disturbed sleep, which significantly affect QOL[25]. A few studies assessing either non-pharmacologic therapies or DMARDs have incorporated these parameters[26-28]. In our treatment response study we assessed the combined effect of both pharmacologic and non-pharmacologic agents on these parameters. It was found that after 6 months of comprehensive management, mean HAQ-DI scores and ACR Global functional status score reduced significantly. These are consistent with the findings of previous studies using either of the two different kinds of modalities[26-28].

The WHOQOL-BREF has been validated against the original WHOQOL-100 and was found to have good test-retest reliability[29]. Our study revealed that RA had significant compromise in their QOL (measured by WHOQOL-BREF) when compared to -age-gender matched normal healthy population. Our results corroborate with other studies which employed the WHOQOL-BREF as well as other validated instruments to compare QOL in patients with RA and healthy controls[20, 21, 29- 31]. RA causes pain and physical and psychological impairments, and in many patients these impairments result in moderate to severe disabilities. Of all QOL domains, physical health was affected most. Despite physical disability, there was relative high score of social relationship and the environmental domains of QOL. The strong family support and joint family system in India could be a contributor to the relatively high scores in social domain. This is in keeping with other studies in the literature[15,16]. Pain and fatigue were inversely correlated with QOL domains. Co-relation studies also showed a significant effect of functional disability (HAQ-DI) and disease activity on QOL, with functional disability having the greatest strength of association.

Over 6 months of treatment, all QOL domain scores except social relationship domain increased significantly with improvement of disease activity. This can be explained by the fact that the social relationship domain in WHOQOL-BREF contains only three questions and has been considered less responsive to change than other domains and also because the initial value in this domain was already reasonably high possibly due to the strong family support system of India.

Depression, anxiety, other co-morbidities like fibromyalgia, diabetes mellitus, and cardiovascular, pulmonary and renal diseases can affect fatigue, QOL and HAQ irrespective of DAS28. Further studies incorporating these factors, collecting data on educational and socioeconomic status could throw light on this matter in a better and more comprehensive way.

Conclusion

Demographic parameters of our study population are similar to that of rheumatoid arthritis patients of this country as evidenced by the information gathered from the previous Indian studies. Six months treatment resulted into statistically significant reduction in disease activity. High fatigue level is related with the disease activity. Reduction in fatigue is accompanied by decrease in disease activity and pain. Treatment with combination of DMARDs and non-pharmacological management leads to reduction of fatigue score. The health related quality of life scores were significantly lower while HAQ scores were significantly higher with high disease activity, clearly indicating compromised quality of life and increased functional disability with increased disease activity status in these patients. Apart from pain and fatigue, HAQ score was also significantly associated with disease activity. Pain, fatigue, HAQ score were inversely co-related with QOL domain scores. Comprehensive rehabilitation comprising of pharmacotherapy and non-pharmacotherapy reduces functional disability and improves quality of life.

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Prolonged Coma in Cervical Myelopathy with Dysautonomia

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Abstract

The term dysautonomia is used when there is a derangement in the reflex mechanisms of the limbic system resulting in improper control of pulse and blood pressure and even syncope sometimes. Cervical myelopathy may be complicated by dysautonomia and may rarely cause syncope; however, prolonged coma as a result of autonomic dysfunction in traumatic cervical myelopathy has not been described in the literature. We describe two patients with cervical myelopathy with dysautonomia who had prolonged coma, one of whom had to intubated multiple times and kept on ventilatory support.

Key words: Cervical myelopathy, Coma, Detrusor muscle dysfunction, Dysautonomia, Syncope.

Introduction

Dysautonomia is the dysfunction of the autonomic nervous system resulting in the derangement of the reflex mechanisms in the limbic system of the brain and brainstem resulting in improper control of pulse, blood pressure, intestinal motility, and sometimes syncope[1]. The fault may lie in the brain, brainstem, or in neurotransmission in the peripheral distribution of autonomic nerves. Postural hypotension as a result of autonomic dysfunction has been reported in patients with spinal cord injuries and tumor[2], syringomyelia[3] and acute transverse myelitis[4]. Cervical myelopathy may be associated with dysautonomia, but cervical myelopathy with dysautonomia leading to prolonged coma is a very rare event. Here, we describe two patients with severe traumatic cervical myelopathy with autonomic dysfunction presenting as prolonged coma requiring ventilatory support.

Case reports

Case 1: A 47-year-old quadriparetic, Chinese gentleman was brought to the hospital complaining of drowsiness of a few hours' duration. On further questioning the family told that the patient felt giddy initially and progressively became drowsy over a few hours. He was brought to the hospital, unconscious. According to his caregivers he had similar episodes in the past but on a few occasions he recovered spontaneously at home. On examination he was unconscious, afebrile, his pulse rate was 30/min, systolic BP was 60 mm Hg and he maintained normal oxygen saturation at room air. Neurologically his GCS was 3 (E1V1M1), pupils were equal and reactive, he was hyperreflexic and hypertonic in all four limbs, power in the upper limbs 3/5 and Lower limb 1/5 (MRC grade). In his previous admissions to our hospital he had similar events with variable severity, however, the most consistent findings noted were unconsciousness (GCS varying from 3 to 6) with bradycardia and hypotension.

Many years ago he had a traumatic cervical cord injury which resulted in quadriparesis. Since then, he is bed ridden with an indwelling catheter, but has normal mentation. His general condition is good without any signs of malnutrition. As he was deeply comatose in accident and emergency department, he was intubated to protect the airways and subsequently investigated in detail for possible metabolic causes that could account for his recurrent episodes of unconsciousness. The investigations revealed a normal hematological, biochemical and endocrine profile that included epinephrine, metanephrine, cortisol, thyroid profile and synacthen test. An initial EEG

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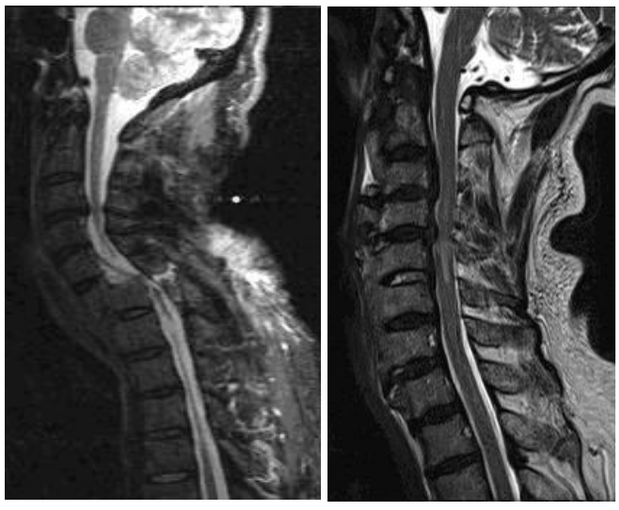

Fig 1. MRI Cervical Spine, Case 1 (left), Case 2 (right)

done at his presentation, revealed mild to moderate diffuse encephalopathy (suggestive of hypoxic or metabolic encephalopathy) and a repeat EEG after he regained full consciousness showed normal brain waves. The 24-hr Holter cardiac monitoring and the 2-D echocardiography were normal. DSE was negative for cardiac ischemia and MRI/MRA/DWI/FLAIR brain was normal. In all his previous hospitalization he had the same sequence of events: presenting initially with drowsiness followed by unconsciousness that required intubation and ventilation. After a few days with general supportive measures he became hemodynamically stable and regained consciousness. On reviewing his previous case notes it became obvious that the most probable cause of his repeated coma was autonomic dysfunction. This was subsequently proved with autonomic nerve testing which showed sudomotor dysautonomia. He could not complete autonomic nerve testing as he was not able to perform stand-up/tilt test. However, the temporal relation of hypotension with bradycardia and unconsciousness with reversal of mental state in presence of normal blood pressure and heart rate was in favor of dysautonomia as a cause of cerebral hypoperfusion leading to unconsciousness. During hospitalization, it was noted that manipulation and/or change of urinary catheter somehow improved his hemodynamic and mental status: his blood pressure and pulse rate improved with subsequent improvement in his level of consciousness. Urodynamic studies revealed detrusor instability. A therapeutic sphinchterotomy was performed with improvement of urine flow. Three years after sphinchterotomy he is symptom free and heamodynamically stable.

Case 2: A 68-year-old Malay gentleman was admitted with a history of dizziness which progressed to drowsiness and coma over a few hours. He was previously in good health and had a normal diet when he suffered from a road traffic accident leading to cervical cord injury 2 months ago. MRI of the cervical spine showed severe cervical spondylosis and cervical myelopathy with cord edema as a result of acute injury at C3 to C6. He underwent cervical laminoplasty of C3-C6 vertebrae. His weakness improved and his sensory loss resolved after the spinal surgery. However, about a week later he started having several episodes of hypotension with bradycardia requiring intravenous fluid challenges and inotropic support. He remained only mildly symptomatic throughout the episodes. He was subsequently maintained on salt supplements and fludrocortisone which was changed to Midodrin as he developed fluid retention. Following a period of rehabilitation, he was discharged with a urine catheter. However, two weeks after discharge, he was brought back to hospital in a state of stupor. He was found to be hypotensive and bradycardic. Neurological examination revealed a state of coma with upper motor neuron quadriparesis and urinary retention. He was investigated for possible cardiac, neurogenic, septic and metabolic causes of coma. The investigations revealed a normal hematological, endocrine and metabolic profile. The blood cultures were negative. The serial ECGs, cardiac enzymes and the 2-D echocardiogram were normal. General supportive measures with IV fluid resuscitation were started. Atropine was given and an indwelling catheter was inserted. A good hemodynamic response was noted; however he remained drowsy and unresponsive for more than 36 hrs. An MRI brain (stroke protocol) was done, DWI and ADC showed a faint diffusion restriction in both thalami and left mid brain (PCA territory) and MRA showed severe stenosis at the tip of basilar artery which was suggestive of a subacute 'tip of the basilar' syndrome. The transcranial doppler scanning of anterior and posterior circulation up to level of insinuation showed normal flow and velocities. The autonomic test later confirmed severe sudomotor dysautonomia by testing sympathetic skin response and inconclusive cardiovascular autonomic testing as he could not complete stand-up/tilt test due to severe weakness in the lower limb. The diagnosis of brainstem ischemia from hypoperfusion, secondary to autonomic dysfunction from a post-traumatic central cord syndrome was made. His mental status gradually returned to normal though he had weakness in all four limbs from previous insult to cervical cord.

Discussion

The cases described above show the occurrence of prolonged coma in the presence of autonomic dysfunction in two patients with traumatic cervical myelopathy. In the first patient, the state of prolonged coma was likely

due to failure of cerebral autoregulation as a result of autonomic dysfunction from cervical cord injury. The detrussor muscle instability caused retention of urine which subsequently resulted in worsening of dysautonomia. The dysautonomia improved after sphincterotomy. In this particular case the presentation of coma in the accident and emergency department was invariably followed by intubation. The coma resolved with inotropic support and catheterization of the bladder. If the initial condition of the patient was known it was possible that bladder catheterization and inotropic support only could have averted the invasive interventions. Laskari et al[5] described a patient with recurrent syncope in the context of a chronic dysautonomia but unlike our patient, neither was it associated with cervical myelopathy nor was there prolonged coma[5]. Symptoms of myelopathy had been present for the past several years, but the patient recently became severely symptomatic due to autonomic dysfunction that became worse with detrusor instability. Assessment of the autonomic function revealed impairment of circulatory reflexes and bladder instability which was consistent with pyramidal dysfunction.

In the second case, there was a stenosis of the tip of basilar artery which could have been a contributory factor to his prolonged coma, though Doppler study of posterior circulation was normal up to the level of insinuation. It is difficult to assess the contribution of a partially blocked catheter to coma, but the rapid improvement in mental status following bladder catheterization and improvement in hemodynamic status is suggestive of an association.

Other common conditions such as alcoholism, diabetes, uremia and associated malignancies can result in peripheral neuropathy and autonomic dysfunction. Amyloidosis can also result in prominent autonomic dysfunction in association with peripheral neuropathy.[6] Lack of vitamin B1 can exacerbate symptoms of dysautonomia that may improve with addition of vitamin supplementation. Mitral valve prolapse also can contribute to dysautonomia[7]. All these conditions were absent in both the patients described above.

Conclusion

These two cases highlight the importance of urinary retention as a cause of stupor and coma in patients with cervical myelopathy and autonomic dysfunction. Unblocking the urinary catheter /sphincterotomy and general supportive measures can be very useful in avoiding unnecessary investigations and invasive treatment such as intubation.

Take Home Message: Blocked urinary catheter can trigger dysautonomia in patients of traumatic cervical myelopathy. Prolonged coma as a result of autonomic dysfunction can easily be treated by just unblocking the catheter or by sphincterotomy which is a new observation. Hence it should always be taken into consideration to avoid unnecessary investigations and invasive treatment.

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Resorption of a Sequestrated Cervical Disc

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Abstract

In literature cervical disc extrusions are considered by most neurosurgeons a definitive indication for surgery. This approach may stem from a fear of disc fragment migration with neurological deterioration. We report a rare case of cervical disc sequestration with a seldom prognosis which resolved spontaneously in a 2 month follow up on magnetic resonance imaging, emphasizing the efficacy and applicability of conservative treatment in cervical disc herniations. Even with the basic conservative treatment methods we observed the prominent decrease in symptoms and spontaneous total resorption of the sequestrated fragment. Conservative treatment in sequestrated cervical discs with no neurological deficit can be an alternative therapeutic approach with the guidence of MRI.

Key Words: Conservative treatment, Cervical disc sequestration, Magnetic resonance imaging.

Introduction

Cervical disc herniations typically cause compression of cervical root and/or spinal cord presenting with radiculopathy and/or myelopathy. The spontaneous resolution of herniated discs in the lumbar region, frequently sequastration type lesions, have been documented[1]. However, the conservative management of patients exhibiting magnetic resonance evidence of cervical disc herniation, with follow up magnetic resonance scans has received less attention in the literature. This may be due to potential risc of the patient developing permanent neurological deficits secondary to myelomalacia and possible cord atrophy[2]. In this report we present a case of sequestration type cervical disc herniation showing spontaneous resorption on magnetic resonance imaging upon two month follow up with conservative treatment.

Case Report

A 54 year old white man presented with a 2 month history of neck pain radiating to left shoulder, and numbness in the left hand. He was a retired teacher. He had no history of trauma and weakness. He stated an increase of symptoms with cold exposure. His past medical history included upper gastrointestinal bleeding (twice), multiple lumbar disc protrusion, nephrolithiazis and surgery for squamous cell carcinoma of the lower lip.

On physical examination left lateral flexion of the neck was painful. There was no muscle weakness on manual muscle strength testing. Deep tendon reflexes were preserved in ankle, knee, wrist and elbow. Patient had no sensory deficit, no fasciculation, atrophy or upper motor neuron signs. Physical examination of the shoulder was normal. Tests for carpal tunnel syndrome were bilaterally negative.

Magnetic resonance imaging of the cervical region revealed a mass like lesion in the epidural space at the C6-7 level. There was also posterior protrusion at the level of C5-6 disc without neural compression (Fig 1).

Conservative treatment was started including local heat application, nonsteroidal anti inflamatory drugs and myorelaxant pharmacotherapy, isotonic and isometric exercises for neck. He was advised to use soft cervical collar when long term neck flexion and extension was needed.. He was followed up by two week intervals routinely.

On the follow up visits neck pain and numbness showed a gradual improvement. The need for analgesics decreased from everyday to once every 3-4 days on the second visit. The detailed neurological examination was in normal range on each visit. At the end of the second month he had no more numbness. Neck pain was still present in a much weaker intensity, but he had no need for analgesic treatment. Taking in account the risk of myelopathy due to the compression of the sequester,

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follow up magnetic resonance imaging scan was performed just 2 months later.The control MRI revealed that the sequestrated disc fragment was almost totally resorbed (Fig 2). There were paramedian protrusions of the C5-6, C6-7 discs, and newly formed diffuse bulging at the level of C7-T1. Two years later control magnetic resonance imaging showed total resorption of the sequestrated fragment and multiple protrusions at C5-6, C6-7, C7-T1 levels (Fig 3).

Discusssion

In 1945 Key first documented spontaneous resorption of herniated disc by myelography[3]. Forty years later Teplick and Haskin demonstrated resolution of a herniation by computed tomography[4]. However similar studies generally focus on lumbosacral region. Very few cases of spontaneous resorption of cervical disc herniation have been documented by magnetic resonance imaging[4]. Bush et al have documented spontaneous resorption of cervical disc herniation on 12 of 13 patients on magnetic resonance imaging presenting with cervical radiculopathy. They reported that these patients were treated with serial periradicular and epidural corticosteroid injections and needed a mean of 12 month follow up (range 4-31 months). No such injections were needed in our patient.

Federico presents spontaneous regression of cervical disc herniations on magnetic resonance imaging in four patients. The shortest documented time of resorption in this clinical study was 10 months, being 24 months for two of the patients and 36 months for the other. The follow up MRI after 10 months showed resolution of the disc with residual disc bulge remaining. Almost total resorption of the sequester just in the second month was observed in our patient. Federico also emphasized that spontaneous regression tends to occur in relatively young patients especially below 45[2]. Our patient was 54 years old which was an older age to expect for a spontaneous regression, making this case more peculiar. Mochido et al have reported spontaneous regression of cervical disc herniations on magnetic resonance imaging in 40% of 38 patients[5]. They stated that the tendency toward regression might be more active in the early stages, because at this stage herniation may include the expanded nucleus pulposus, haematoma and adjacent tissue reaction. Regression in part might result from dehydration of expanded nucleus pulposus and resorption of haematoma. However non of these 38 patients were clearly outlined as sequestration type cervical herniation, unlike this case. When previous studies are compared, it can be said that the tendency for cervical disc herniation lesions to under go regression is less than that for lumbar disc herniation[5,6]. One reason for this difference may be different percentage of sequestration type lesions in lumbar and cervical regions. Another reason may be the difference

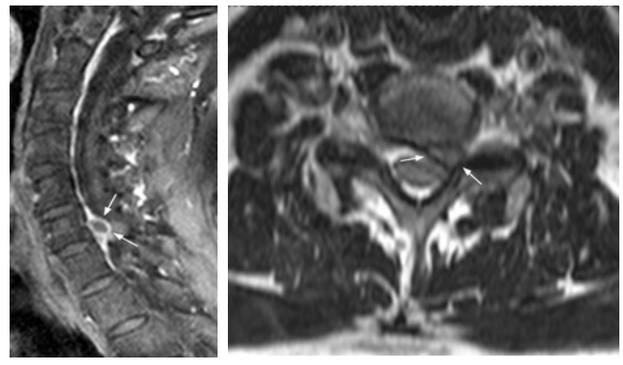

Fig 1. Left: Peripheral enhancement on contrast enhanced T1-weighted sagittal image showing sequestration (arrow). Right: T2-weighted axial image shows the lesion isointense with the nucleous pulposus and spinal cord (arrow). There is obliteration of subarachnoid space, left mediolateral cord compression and narrowing of left neural foramen.

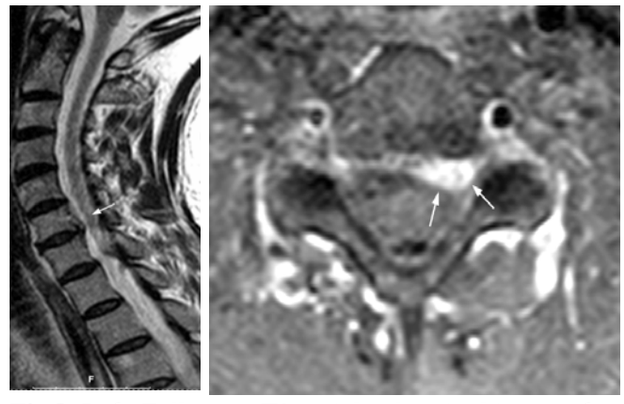

Fig 2. Left: Follow up T2-weighted sagittal image after 2 months shows prominent regression in the mass like appearence of the sequestrated disc in the subarachnoid space (arrow). Right: Two months later follow up contrast enhanced T1-weighted axial image represents almost total resorption of the sequestrated fragment (arrow).

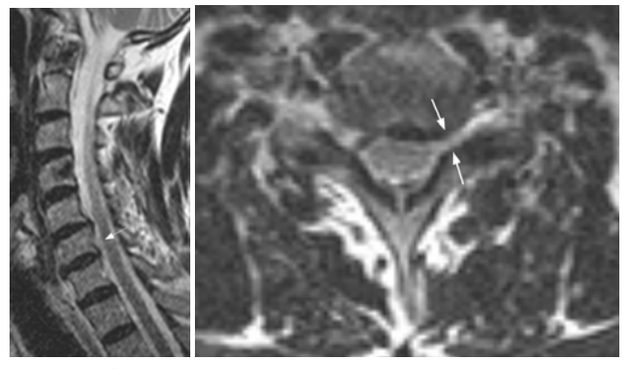

Fig 3. Left: Follow up T2-weighted sagittal image shows complete resorption of the sequestrated disc (arrow). Right: Follow up T2-weighted axial image after 2 years demonstrates the left paracentral protrusion at the C6-7 level causing narrowing of subarachnoid space and ipsilateral neural foramen (arrow). No compression on spinal cord is observed.

in composition of herniated discs. The histologic characteristics of cervical disc herniations probably differ from that of lumbar disc herniations. Most cases of cervical disc herniations include end plate cartilage mainly composed of hyaline in addition to nucleus pulposus. Carreon et al found that resorption of end plate cartilage was really hard[7]. However in our case we observed complete resorption of sequestrated cervical disc lesion in two months duration which may be accepted relatively and unexpectedly short.

Takui et al conducted a study on surgically removed lumbar disc sequestration fragments. Their study revealed that the main histologic feature common to epidural free fragments of herniated disc was macrophage infiltration and vascularization. When compared with cadaveric disc fragments it can be suggested that most of the vesssels present in the sequestrated disc had newly formed after herniation, probably in continuity with the epidural vasculoconnective tissue. In addition fibrous scarring was not observed in the fragments examined suggesting that a process of organization is not the main course of regression. Instead a kind of absorption process is predominant[8].

Conservative treatment is a common choice for treatment of patients with lumbar disc herniations and success rate is very high, by contrast there have been few reports regarding conservative treatment of cervical disc herniations . Matsumoto M. et al demonstrated that conservative treatment was effective in 63% of patients. 59% of the patients who were treated conservatively experienced spontaneous regression of disc herniation with concommitant resolution of their neurologic symptoms. Moreover there were no signs of difference in the final results between the patients who were initially treated conservatively and those who underwent immediate surgery[9].

Documented cervical disc extrusions are considered by most neurosurgeons a definitive indication for surgery. This approach may stem from a fear of disc fragment migration with neurological deterioration[2]. Manabe reported the results of surgical treatment for 22 patients having cervical disc sequestration.He stated that indication for surgery in his study was progressive worsening of clinical status in spite of conservative treatment. However no details about the content and duration of the conservative treatment were present in the article[10]. Even with the basic conservative treatment methods we observed the prominent decrease in symptoms in our patient. No invasive method including epidural injection were needed.

A full symptomatic regression was not achieved in this case despite resorption of the sequestrated fragment. It was reported recently that chemical mediators and inflammatory agents associated with disc herniation play a role in mechanism of nerve injury as well as in mechanical compression[11]. Moreover our patient had multiple disc herniations at other cervical levels. These may be the possible reasons of a lacking complete recovery. This case demonstrates the important role of magnetic resonance imaging in diagnosis and follow up of sequestration type of cervical disc lesions.

In summary we report a rare case of cervical disc sequestration with a seldom prognosis, which resolved spontaneously in two months follow up on magnetic resonance imaging, emphasizing the efficacy and applicability of conservative treatment in cervical disc herniations. This case is also important in the fact that despite a sequestrated disc fragment causing compression on spinal cord, patient never experienced neurological deficits.

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Transient Osteoporosis of the Hip During Pregnancy

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Introduction

Transient Osteoporosis is a well organised form of regional osteoporosis, though rare. It affects the activities of daily living by its extended course of the disease and disproportionate pain of the affected joint, even though it resolves spontaneously with a benign course. If not recognised, the presentation can be alarming both clinically and radiologically[1]. Curtis and Kincaid[2] introduced the term "transient demineralisation of the hip" referring to a rapidly developing, painful local osteoporosis of limited nature but of unexplained patho-physiology. Later on, Lequesne[3] coined the term, transient osteoporosis of the hip in 1968.

Transient osteoporosis can occur at any age, and in either sex, but most commonly occurs in women during the third trimester of pregnancy and in middle-aged men[1]. Hip is the most commonly affected joint, though migratory pattern may affect the contra-lateral hip joint or the ankle and foot joints. Higher incidence of transient osteoporosis has been reported in patients with osteogenesis imperfect. Here, we report a case of transient osteoporosis affecting the hip joint during the third trimester of pregnancy.

Case Report

A 37 year old female reported to our OPD with complaints of pain both hip joints (right side > left side) in September 2009. She was walked with a limp /antalgic gait brought to the clinic supported by the attendants. She had given birth to a healthy female baby about two and half months back by lower segment caeserian section, which was uneventful. On further enquiry, she reported noticing the pain at her hip joint during the last trimester of pregnancy, insidious in nature with no history of trauma or fever. Pain was aggravated by movement and weight bearing and increased in intensity during the last one month.

When observed, she was walking with support and she could not bear full weight on her right lower limb due to pain in right hip. On examination, range of motion of the right hip was reduced (Flexion 60^0, abduction / adduction 30^0 each and external and internal rotation 15^0each) and hip was tender. Left hip was clinically normal. Power of the muscles around the hip was good. Lumbo-sacral spine was clinically normal.

Investigation reports showed: Hb 12.0 gms%, TLC 5400/ cu.mm, ESR 42 mm/1^{st} hr, serum calcium 11.0 mg%, serum phosphorous – 3.5 mg%, Serum Alkaline phosphatase 165 IU/L (49 IU/L for bone specific fraction), Mycodot for Koch's antibody for IgG and IgM were both negative). MRI of the hip showed discrete reduced signal intensity changes on T1-weighted image and high signal intensity changes in the femoral head, neck and acetabulum on the right side, on STIR sequence film.

She was managed conservatively with protected weight bearing, analgesics. Active assistive ROM exercise of the hip was also advised within the limits of pain. Intravenous bis-phosphonate (3 mg Ibandronic acid) was given along with oral Calcium supplementation.

Discussion

Transient osteoporosis is an uncommon cause of hip pain which is characterised by self limiting transitory clinical nature, osteopenia on radiograph and bone marrow edema on MRI[4]. Transient osteopororsis typically affects women, exclusively during the third trimester of pregnancy and middle-aged men. There were no known predisposing factors except pregnancy in this case. However, the risk of acquiring transient osteoporosis is reported much higher in patients with osteogenesis imperfecta than in general population. Probably, a pathological micro-fracture in such patients might have been the triggering factor for transient osteoporosis [5].

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Fig 1. Showing T1 weighted image of the hip joint; right femoral head shows discrete reduced signal intensity changes hip while left hip joint and femoral head shows normal signal intensity.

Fig 2. STIR sequence showing increased signal intensity of the femoral head and neck with signs of mild effusion around hip joint.

It has been suggested that transient osteoporosis is a form of non-traumatic variety of reflex sympathetic dystrophy, because of the diffuse variety of involvement around the affected joints and migratory involvement of other joints[3,6]. However, the absence of classical signs that are pathognomonic of sympathetic reflex dystrophy did not support the patho-physiologic mechanism of transient osteoporosis.

Symptoms and radiological changes of transient osteoporosis usually lasts an average of 8-12 months. Its typical clinical presentation has three phases[1]. The first phase (rapid aggravation phase) lasts one to two months with acute onset of pain and increasing functional disability. The second phase (maximal intensity) lasts another two to three months with signs and symptoms reaching a plateau. Radiographs show diffuse osteopenia without loss of joint space. There is no evidence of sub-chondral fracture, dense sclerosis or degenerative changes which are the hall-mark of osteonecrosis. The third phase (regression phase) lasts another four to six months. Radiographs show reconstitution of normal bone density while the symptoms subside to complete clinical resolution.

The diagnosis of transient osteoporosis is usually made by exclusion. The differential diagnosis includes septic arthritis, osteonecrosis and malignant infiltration[7]. Differentiation between transient osteoporosis and osteonecrosis may be difficult at early phase, but MRI has been shown to sensitive to differentiate between the two at an early stage. Lesions of osteonecrosis show focal lesions typically in antero-lateral aspect of femoral head, demonstrating decreased signal intensity on both T1 and T2 –weighted images on MRI whereas MRI finding of transient osteoporosis is characterised by diffuse bone marrow oedema in upper femur and acetabulum, with ill-defined intensity in T-1 weighted image with a matching area of increase intensity in on T-2 weighted images[8].

Treatment of transient osteoporosis is directed towards protected weight relief and analgesics for pain control [9,10] and active and passive range of motion exercises as tolerated is prescribed to prevent contractures and deformities when the course of illness is prolonged[9]. Use of second- and third-generation bisphosphonates has been the recent medical strategy for management of transient osteoporosis[11].

We have presented the case because of its rarity and uncertainty of the underlying etiology, as well. Transient osteoporosis may be confused with a variety of conditions and perhaps, with avascular necrosis as the most common misdiagnosis. Conservative management will suffice, but with due assurance and patience, as the course is a benign and self limiting one and also to avoid sinister complications like fractures and collapse of the femoral head during the initial phases as outlined above. Transient osteoporosis in pregnancy deserves special attention as traumatic fractures of the femoral neck and stress fractures have been reported in pregnant women.

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Technomedicine

The other day I was reading an article on the advent of technology and the humanity. These are two parallel sides akin to the railway tracks going parallel but never meeting at any point except when crossing over. One can't parallel an example cited in one of the editorials about the care given to a very sick person in a high tech ICU in an upcountry compared with that in the hands of an angel like Mother Teressa who picked up a dying man from a gutter in Kolkata full of maggots in his wounds being taken care of by the Missionaries of Charity. Both died, the difference was the one in ICU died a lonely death amidst the caring but still unconcerned score of nurses around 'some patient' whose family was waiting in the waiting or waiting for the ultimate news unburdening them or waiting for the little glimpse or the care be extended through them in the ICU from which they were kept away; compared to the one who was a abandoned by the family, society (whatever remained of that) to die in the gutter but cared for by the 'angels' making the journey to the other world a peaceful and most wanted one. Both aspects can't be ignored.

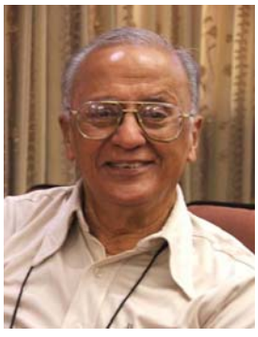
Technology has brought forth a lot. Perhaps the evening bonfire in the middle of the village took the shape of a movie screened once in a while, even if, for family planning, some fifty years ago to the present everyone in the family glued to the satellite TV or the computer surfing the net and now glued to the multifunctinal device wrongly called the cell phone. It does everything you can imagine on this earth and probably beyond that. Can we live without it, perhaps not or maybe better not. Only this evening I was listening to a discussion, if there was no cell phone, would we be able to live, not because our fingers itch to type an SMS or they hurt because we have typed a lot (butter over bread for the physiatrists) or what if there was an emergency, yes, it rings a bell there. Now that we are talking of the 3G which I used to feel that it might be just another gimmick to sell the spectrum and make we people more addicted to SMSing and then video telephony. Think technically, it rings a bell with the phone companies finding another excuse to be in the market earning more or perhaps making the loved son or daughter 'seen' by the loving mother or the lovers making a move to appease the other. But did we think further. The era of the computers, the television and now telemedicine is in. Who says it is a distant dream. It is definitely nearer than the moon or the mission to the moon whenever India is thinking of embarking on one. There is already a weekly clinic going on between AIIMS and the farthest group of islands where people used to be sent for exile until some 60 years ago. People living there are still under the great exile having no doctors willing to work there thinking that the government has sent them for exile. There, a group of field workers and a couple of odd nurses run a health center and interact with the specialists at AIIMS over teleconferencing and are advised by the doctors thousands of miles away making the best health care made available. They say, telemedicine is very expensive, it takes not less than Rs 360 a minute to make a call this far and then requiring lakhs worth of equipment fixed at both ends. Fine. Can we escape it? Perhaps no.

If we ask the modern day post-graduate, what is Index Medicus perhaps he would stop at the most at the Pub Med and five years down the line even the libraries would not have those much in demand books where all post-graduates, researchers and what not would 'bee' around looking for something not so easy to find compared to the modern day click and get much needed articles. Those who did not come forward lost it all. I am not sure if Index Medicus is still printed these days or not. Can you apply for an American visa without the Internet these days? Perhaps not. Then why Index Medicus.

Somewhere we lost the human touch being occupied by the technology. I still give a lot of email support to all my patients having trouble coming in or travelling, seeking appointments, clarifying doubts keeping the technology alive with human touch and care marrying both. May be, when 3G is here and made more popular, the human touch would be better off when patients at an allotted time could 'see' the doctor, show them their progress without having to come all the way to the clinics so far away, specially the one having difficulty commuting due to their restrictions. It won't be as expensive as the present teleconferencing. Can the doctor escape technology? No, better not. Better be net savvy, phone savvy, equipment savvy but never ever leave the most wanted savvy-ness, being patient savvy marrying technology with the human touch. The day is not far when you would have exclusive net conferencing clinics going cheap with the patient with their 3G phone at one end with interface devices making you hear their heart and lungs not to mention their cries but also watch them them demonstrate the signs and you advising them over the air with their fee deposited straight into your (or the hospitals) accounts using their mobiles making you and the patients need lesser mobility, a boon to those who are short of that. Be a missionary like Mother Teressa with the gadgets, let's not just run after one track, let's make the two meet in the name of technomedicine with a healing touch, don't run away from it.

Dr U Singh,Editor

Stop Press



Dr WG Rama Rao
1915-2010

It would be hard to find a post-graduate in PMR who would not have been amazed at the zeal with which Dr WG Rama Rao used to come in smiling and talking with them, teaching, asking questions, telling them how to study, demonstrate signs, refer to what came up recently in the literature and the least to tell them the importance of the speciality. I was taken aback the first time I was reading a paper on 'Gait Analysis in Hemiplegia' at NIRTAR in 1982. Dr Rama Rao had remarked, if a person with hemiplegia can walk is good enough, it does not matter how he walks. At that time being young and over enthusiastic and new to the speciality, I was eager to come out with an anecdote that won't it be nice if he could walk better. Now with years gone into rehabilitation, I realized, how true and practical he was. He was not pulling my leg that I thought at that time but teaching me the realities of rehabilitaton.

Everytime Dr Rama Rao entered our department, he would carry a load of journals, he used to be the editor of two, and requested us to please have those delivered to the persons nearby. I used to wonder why does he have to carry such a load all the way from Mumbai, now I realize after being into this how much effort and money is saved which is always short to publish and post a journal. He had showed me his room filled with journals, papers, old envelopes he used to keep to be used for rough work not very different from Mahatma Gandhi's ideologies of not to waste a thing. True to have the great man's name "Gandhi" in his own.

Even though he came into PMR much later in his life, he devoted more than his full attention to it in addition to being an active member of the IOA and founder member of IAPMR. Formulations of rules and regulations of IAPMR to the memorandum of association was all a gift of Dr Rama Rao. He was the know all person for any dispute or a dilemma and would be able to cite the rule straight out of his memories. That is the reason he was always looked up to for any constitutional matter in the association.

How many of us write to fellow members or to any governmental or other organizations about what we feel strongly about. Dr Rama Rao never ever missed an opportunity he had or any thing that he felt needed to be changed or brought about. He would seek an appointment with any conceivable person and say what needed to be done for the speciality, for the association or a member of the association. Earlier days, his famous Inland Letters were a treasure. In the recent years, changing with times, he moved over to the modern method of communication over the emails. Not many even younger to him could adapt to that change though with great humility he would say that he just knows how to press a button and reply.

Love for the young ones and any one was ample right from his heart. We hardly offer to drop our seniors or friends off to a place if they are visiting us. The last time I visited his place a couple of years ago, he came down from his building to say good bye to me but instead ended up dropping me off to the Railway Station in his car while saying that his dear wife does not allow him to drive during the night but it is all right once in a while since it was getting late for me and the station far off. He himself used to walk over two kilometers to Dadar Station from his home and encouraged me to do that a few years ago while I was about to hail a taxi.

We stick on to the worldly things and never ever think of sharing. His love of traveling to various centres and love for those new to the speciality to learn more did not make him think twice before traveling himself to all the corners of the country on his own and interact with everyone but also made others go around at his cost by initiating such a novel fellowship, Dr WG Rama Rao's Fellowship, to enable young physiatrists to go around and gain knowledge and spread knowledge. Most of us have availed that. Donating a huge amount of money, more than a hundred times the salary of a PG at that time was donated by him to the association. How many can ever think of doing that leave aside even setting aside a month's salary for this kind of purpose or any philanthropic cause..

Such a great human being did not wish to bother even his family running around the hospital knowing very well that his time had come, he had to suffer any way but he did not wish anyone in his family to suffer along with him. He chose his right to be at home and right to not being investigated or treated against his will. He wanted to be at home, at peace, with his family. Prayers poured in from all corners of the world for his recovery. He did recover fully, from his pains and sufferings and had a wonderful end to his most wonderfully fulfilling life people only dream of having. Rightly called the 'Bhishma Pitamah' of IAPMR.The 'Physiatrist of the Century' would be remembered not only for centuries but probably for ever. IAPMR salutes this great personality with a heavy heart..

Dr U Singh
Editor