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Review Article

Upper Extremity Prosthesis – What Is New in It?

S. Abdul Gafoor[1], Mohan Raj M[2]

Abstract

Over the past 40 years, technology has dramatically affected the field of upper limb prosthesis. With improvement in the electronics industry, along with advances in the miniaturisation and mass production of electronic components, myoelectrically controlled prosthesis has become reliable and widespread in their use. Compared to lower extremity amputees, the acceptance of prosthetic replacement is less in upper extremity amputees. This may be due to different factors like functional needs, cosmetic factors, motivation of the patient, inadequate training following conventional prosthetic fitment, etc. More and more developments are going on in upper limb extremity prosthesis which will fulfill the need of the upper limb amputees. Such developments ensure better rehabilitation though cost is a limiting factor. This article is an earnest attempt to review the recent trends in upper limb prosthetics.

Key words: **Upper limb amputees, myoelectric prosthesis.**

Introduction:

The human hand is a very sophisticated and beautiful tool. It provides plenty of information and means by which one interact with environment. The hand is also a powerful tool of communication. The hand can be used to augment the meaning and feeling behind the spoken word, or it can sometimes take the place of the word. Hence the loss of hand results, not only in functional ability of that individual, but also ends in profound psychological trauma and apprehension.

The ideal prosthesis has to replace the lost body parts, both in appearance and function. The sensibility, power and grace of the lost body parts should be replaced. Though the idea appears simple, it is very difficult to accomplish. Present technology is far from ideal.

The search for ideal upper extremity prosthesis is continuing. The conventional prosthesis is functionally inferior, cosmetically unacceptable to any individual, who lost their hand, as it is heavy and do not provide any information regarding the texture, shape, temperature and proprioception. However each has advantages within their intended use. eg, body powered hooks are well suited to the demands of manual labour. They are simple and tough in design. Prosthetic hand obviously provides a more natural appearance than hooks and can provide adequate function. Electric hand provides the user with a wide range of gripping force, all with minimal effort by user.

Clinically the most physiologically natural method of controlling an electric hand is through myoelectric control. Myoelectric control is also a dynamically natural appearing system because the act of controlling the prosthesis is invisible in contrast to other control methods that require body motion of more proximal body segments.

History:

The concept of using myoelectric signals to control prosthesis dates back to the 1940's. Reinhold Reiter, a physics student at Munich University created the first known myoelectric prosthesis between 1944 and 1948[1]. This prosthesis was mounted on a bench top, had vacuum tubes in the electronic system and used one muscle for opening and closing the hand (single site control) (Fig1).

Myoelectric systems are commercially available during 1960's. Kobrinski, a Russian became the first person to make a myoelectric hand, which found place in clinical use[2]. This prosthesis was made fully portable by the

Authors' affiliation:

[1] *MBBS, D.P.M.R, M.D, Professor*

[2] *MBBS, D.P.M.R, M.D, Associate Professor*

Department of PM&R, Govt. Medical College, Kozhikode

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Correspondence:

Dr. S. Abdul Gafoor, Professor, Department of PM&R, Govt. Medical College, Thiruvananthapuram, Email: drsagafoor@gmail.com.

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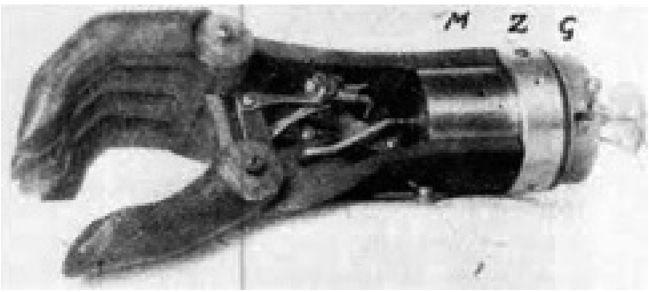

Fig 1: *Reiter's First Myoelectric Prosthesis*

use of transistors, the batteries and electronics, was separately and connected to the prosthesis by cables. During 1957-1960 collaboration between Otto Bock, a German company and an Austrian hearing aid company Viennatone led to the first transradial myoelectric system. Then the developments were rapid. Today myoelectric hands are available in different sizes for both children and adult. Electric elbows and wrist rotators are also available in a variety of sizes. With improvement in the battery technology, myoelectric prosthesis has become lighter. The need for recharge is also less.

Myoelectric Control – Principles:

During every voluntary contraction of a muscle, a small electric signal is generated as a natural byproduct. Myoelectric control (Fig 2) uses the action potentials of the residual muscles to control electrically powered components. Electrodes are generally placed in the prosthetic interface over the belly of the muscle and are oriented along the muscle long axis. It is remembered that the signals produced in residual stump is in microvolt. These signal are amplified, then processed by a controller that switches the motors on or off in the hand, wrist, or elbow to produce movement and function[3]. The myoelectric control may be of two types: a) Dual site control b) single site control.

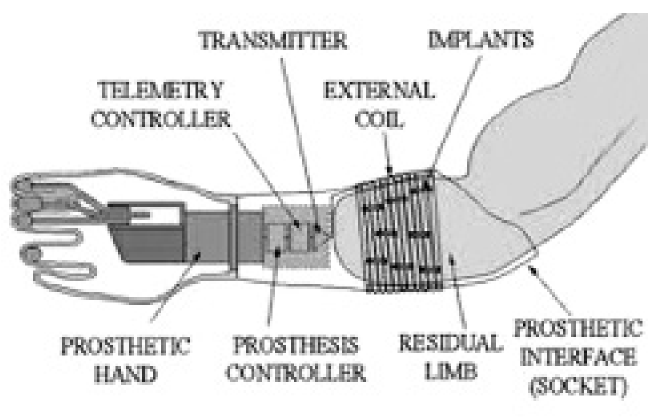

Fig 2- *Implantable Myoelectric Sensors*

In dual site control, two antagonist muscles of the residual stump are used to generate the current for the working of the prosthesis. eg, in below elbow amputee both flexor and extensor group of muscles are used for closing and opening of the prosthesis. In single site control, one group of muscle is used to control two functions. In this type, one type of muscle contraction selects hand closing and another type of contraction select hand opening. Two commonly used types of single site systems are the rate sensitive and amplitude sensitive controls. When the rate or amplitude is slow or small the controller selects hand closing and when the signal is fast or strong hand opening results.

In general, there are two types of control schemes that can be described sequential and dedicated. Sequential control means that two or more components are controlled from a common source. An example of this type is the conventional body powered transhumeral fitting, where the elbow and terminal are controlled by the same body motion like glenohumeral flexion or bi-scapular abduction. In this system, the elbow has to be locked to operate terminal device. Hence simultaneous control is not possible. Examples of sequential control in myoelectric systems are use of two antagonistic muscles for hand operated and wrist rotation or hand and elbow operation. This requires switching between the two components either through myoelectric switching such as rapid co-contraction or operation through a switch. Here also simultaneous control is not possible as in conventional body powered prosthesis[4].

Dedicated control refers to a system where each component is controlled by a dedicated control source; allowing simultaneous control. Example is hybrid transhumeral prosthesis, where hand function is accomplished myoelectrically using two antagonist muscle and a body powered elbow is operated by glenohumeral flexion. Here the two components are controlled independently and simultaneously. Hence the system is more efficient than the sequentially controlled system.

Microprocessors:

The feasibility of using computer chips in prosthesis has led to advanced feature of prosthetic design. eg. the sensor hand manufactured by Otto Bock, which monitors the slippage of an object, which being held in the electric hand. If the objects begin to slip, the microprocessor tells the hand to increase the grip force. This type of automatic control makes the myoelectric hand (Fig 3) easier to operate and move.

Fig 3 - *Myoelectric Hand*

Programmable Controllers:

Advance in microprocessor technology, led to the introduction of programmable control systems in prosthesis. These microprocessors are available with on board field programmable chips. There are dozens of control schemes that can be configured using a programmable controller[5]. Automatic calibration for each activity can be programmed in this system. This feature automatically adjusts the electronic parameter to provide optional function in spite of possible signal strength changes, which occurs in an amputee, who experiences muscle fatigue during the course of the day.

Myoelectic control of upper limb prosthesis has proven to be an effective and efficient means of controlling prosthetic components. This means of control has been extensively used for the last 40 years, during which time the system had become reliable and durable in most situations. Myoelectric control or any other control scheme should not be considered as optional control for the prosthesis but rather as one of the several effective ways of producing desired function. Technology continues to change, bringing new and sometimes better ways of fitting prosthesis. Microprocessor and programmable controllers have opened new horizon for improvement in function of the upper limb prosthesis. There is much work to be done before calling upper extremity prosthesis, as arm replacement, which is ideal for an individual. But progress is occurring towards the goal of replacing the function and appearance of the human arm by an ideal prosthesis replacement.

Indications[6]:

1. The patient has an amputation or missing limb at the wrist or above.
2. Standard body-powered prosthetic devices cannot be used or are insufficient to meet the functional needs of the individual in performing activities of daily living.
3. The remaining musculature of the arm(s) contains the minimum microvolt threshold to allow operation of a myoelectric prosthetic device.
4. The patient has demonstrated sufficient neurological and cognitive function to operate the prosthesis effectively.
5. The patient is free of comorbidities that could interfere with function of the prosthesis (neuromuscular disease, etc).
6. Functional evaluation indicates that with training, use of a myoelectric prosthesis likely to meet the functional needs of the individual (e.g. gripping, releasing, holding and coordinating movement of the prosthesis) when performing activities of daily living.

Advantages[7]:

1. Self contoured.
2. Self suspending.
3. Freedom of motion-can be used over the head, down by the feet, and out to the sides of the body.
4. Comfort.
5. Elimination of harness of conventional prosthesis
6. Superior pinch force of between 15 and 25 lbs. compared to 7 to 8 lbs with a cable-operated hook.
7. Using functional magnetic resonance imaging (fMRI), it is found that enhanced use of a myoelectric prosthesis in upper extremity amputees was associated with reduced phantom limb pain and reduced cortical reorganisation.
8. The below-elbow myoelectric system is well suited for amputees such as sales persons, students, business people and professionals who are engaged in light work.

Disadvantages[7]:

1. High cost.
2. Lack of direct feedback from control regarding

the position, velocity and force of the component controlled.

3. The user must rely on visual feedback for manipulation of prosthesis and environment.
4. Requires more maintenance, including charging, discharging, and the eventual disposal and replacement of the battery.
5. Burns may be seen in children after 2-3 years of use of prosthesis. This may be due to heat generated from electrical failure possibly from ingress of moisture.
6. Potential malfunction of the arm, resulting in costly repairs. Wearers also have to be very cautious around water. Severe damage to the motor and controller can result from water exposure.

The myoelectric unit is not usually recommended for patients involved in heavy work such as farming or construction.

Evaluation:

An evaluation of a rating scale called the Assessment of Capacity for Myoelectric Control (ACMC) was described by Lindner and colleagues in 2009[8]. For this evaluation of the ACMC, a rater identified 30 types of hand movements in patients who performed a self-chosen bimanual task, such as preparation of a meal, making the bed, doing crafts, or playing with different toys; each of the 30 types of movements was rated on a 4-point scale (not capable or not performed, sometimes capable, capable on request, and spontaneously capable). The types of hand movements were variations of four main functional categories (gripping, releasing, holding, and coordinating), and the evaluations took approximately 30 minutes.

Advances:

Targeted reinnervation is a surgical technique developed to increase the number of myoelectric input sites available to control upperlimb prosthesis (Fig 4). Because signals from the nerves related to specific movements are used to control those missing degrees-of-freedom, the control of a prosthesis using this procedure is more physiologically appropriate when compared to conventional control[9].

In humeral disarticulations, a novel nerve transfer procedure can be done to improve the control of a myoelectric prosthesis. The median, radial, ulnar and musculocutaneous nerves are transferred to the segments of the pectoralis major and minor muscles. The nerve transfer to small muscle segments is capable of creating a novel interface for better control of myoelectric prosthesis.

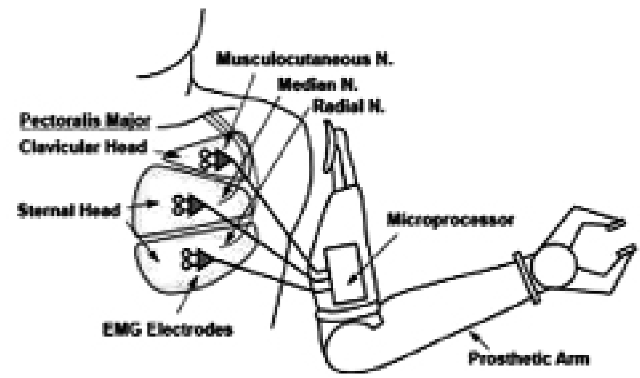

Fig 4 - *Targeted Muscle Reinnervation in Person with Shoulder Disarticulation*

There is great mental effort needed during the initial stages of training with myoelectric prosthesis. A mechanism has been developed to help patients during the learning stages, without actually having to wear the prosthesis[10]. This mechanism is based on a real hardware and software for detecting and processing EMG signals. The association of autoregressive models and a neural network is used for EMG pattern discrimination. The outputs of the neural network are then used to control the movements of a virtual prosthesis that mimics what the real limb should be doing. The results show a very easy-to-use system that can greatly reduce the duration of the training stages.

The Utah Arm (Fig 5&6) is a myoelectric arm for above elbow amputees. It is developed in 1974, at the University of Utah's Center for Engineering Design. The Utah Arm 3 is a versatile, electrically driven arm which provides accurate control of both hand and elbow (simultaneously), and optional wrist rotation.

The Utah Arm 3+ is similar to the original electrically driven Utah Arm 3 but has more advanced function. This arm has Dual Lock System, Silent Freeswing, wireless Bluetooth communication, and total compatibility with virtually all Hands on the market.

Current research findings indicate that people could actually regain perception of hot and cold through prosthetics like the myoelectric arm. Bionic hands differ from mere prostheses by mimicking the original function very closely, or even surpassing it. Dennis

Fig 5- *Utah Arm 3 with Connector Options for Separate Elbow and Hand Inputs*

Fig 6- *Utah Arm 3 +*

Aabo Sørensen was the first person to use bionic finger tip that has the ability to feel. There are electrodes embedded in arm, and touch sensors in a prosthetic hand to stimulate his remaining nerves. With the hand, the user was able to recognise different objects by their feel, and grasp them appropriately (Fig7). Sensors in the silicon finger tip detect changes in the texture of articles and these signals are sent to the remaining nerves of the arm[11]. So now the user knows how firmly they have to grip a fragile object without damage, which is very important.

Now there are advanced myoelectric prosthetic partial hand fingers for individuals with missing fingers eg, i- digits quantum. This gesture controlled prosthesis is very slim, light weight and so it is easy to use. It also has 50% more battery life. Loss of anywhere from one to five digits and palm can be replaced (Fig 8).

With these technological advances on the horizon, the quality of life for amputees is bound to improve.

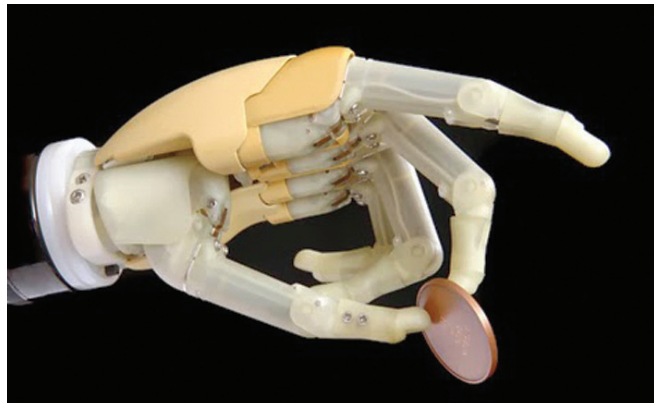

Fig 7- *Myoelectric Prosthetic Hand with Touch-sensitive Fingers*

Fig 8- *Myoelectric Prosthetic Partial Hand Fingers*

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Original Article

Does Radiologic Grading Predict Severity of Osteo-arthritis Knee

Ajit Singh Naorem[1], Jugindro Singh Ningthoujam[2], K Wangjam[3], RK Rajesh[4]

Abstract

Objective: Evaluation of association between pain and functional limitation of osteo-arthritis knee with radiographic features.

Methods: Total of 123 knee OA patients diagnosed on the basis of American College of Rheumatology Classification (ACR) Criteria for knee OA, attended in Physical Medicine and Rehabilitation (PMR) OPD, JNIMS, were included. Pain and disability were measured using Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) and radiological grading by Kellgren-Lawrence (KL) grading from x-ray of weight bearing antero-posterior and lateral views. Correlation between WOMAC score and KL grading analysed.

Results: Sex distribution M:F=9:32, mean age 59.48 (+ 9.8), mean disease duration 4.79 (+ 0.41) months. Correlations of WOMAC pain and KL grading and WOMAC disability and KL grading were insignificant ($p > 0.05$).

Conclusions: There is discordance between radiographic findings and clinical features of OA knee and we should not plan treatment on the basis of radiologic grading rather on the functional status and symptoms.

Key words: **Osteo-arthritis knee, pain, disability, WOMAC score, KL grading.**

Introduction :

Osteo-arthritis(OA) of knee is a major health problem affecting approximately 30% of people over the age of 65 years[1], and is the number one cause of disability among the elderly, and because of the increase in ageing population, the prevalence of OA is expected to increase too[2].

Recently it has become apparent that OA is a disease process that affects the entire joint structure, including cartilage, synovial membrane, subchondral bone, ligaments and peri-articular muscles. But the major feature of OA is considered to be articular cartilage loss, which, together with meniscal pathology contributes to joint space narrowing (JSN) on knee radiographs[3].

Occurrence of OA in 75 years of age is >80%, weight bearing joints are affected more often (but not hip joint), females are more prone to develop OA, and persons with greater BMI has increase risk of OA[4-6].

Almost everyone has structural evidence of OA on radiographs or MR imaging in at least one joint by 70 years of age[5]. Most women in their sixties have evidence of OA affecting one or more hand joints. Nevertheless, many persons with structural OA, even those whose joints have evidence of substantial radiographic disease, do not have any joint symptoms[7].

The diagnosis of OA can usually be made clinically and then confirmed by radiography. The main features that suggest the diagnosis include pain, stiffness, reduced movement, swelling, crepitus, in elderly people (unusual before age 40) in the absence of systemic features (such as fever).Standard objective assessment of pathologic changes in the joint is typically accomplished *via* radiography to evaluate the presence of osteophytes

Authors' affiliation:
[1] MBBS, PMR.
[2] MBBS, PMR
[3] MBBS, PMR.
[4] MBBS, PMR.

Department of Physical Medicine and Rehabilitation, JN Institute of Medical Sciences (JNIMS), Porompat, Imphal, Manipur.

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Correspondence:

Dr K Wangjam, Prof & HOD, Department of Physical Medicine and rehabilitation, JNIMS, Porompat. wangkjam1@yahoo.in.

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and joint space narrowing. Radiographic evidence, however, has been shown to have variable predictive validity as a marker of subjective clinical pain, with some population-based studies[8,9] reporting weak correlations between the two.

On the other hand some studies reports strong correlations between radiographic features of knee OA and pain[10]. It has been documented that there is discordance between the severity of structural disease and symptom occurrence[7,11]. Hence we planned the study to evaluate our experience.

Objective:

Our objective is to evaluate the association of pain and functional limitations of a patient with OA knee with the severity of OA assessed by radiological grades.

Materials and Methods:

The study is a cross-sectional one. One hundred and twenty-three patients with knee pain who attended the PM&R OPD, JN Institute of Medical Sciences (JNIMS), Porompat, Imphal, during January 2013 to December 2014 and diagnosed as OA knee according to American College of Rheumatology Classification (ACR) Criteria and who satisfied the inclusion criteria were included in the study.Inclusion criteria were patient with knee pain in man and woman above age of 40 years, disease duration more than 3 months, and clinically and radiologically diagnosed as OA. These 123 were selected out of 210 patients of OA knee patients, 77 patients were excluded from the study for various reasons.

Exclusion criteria were patients who underwent surgery in and around hip or knee, any history of knee trauma, inflammatory knee disorders and other arthropathies, metabolic bone disease, serious systemic disease, neoplasms, previous intra-articular (IA) injections, etc.

All the patients were explained about the study and informed consent was obtained from each patient before the study.

The presence of OA was assessed at baseline with clinical features and an x-ray of both knees AP (monopodal weight bearing) and lateral (semiflexed) views to support clinical diagnosis of OA and for staging according to Kellgren & Lawrence (KL) Radiological grading of OA. Initial pain and disability were assessed by the western Ontario and McMaster Universities Osteoarthritis Index (WOMAC). WOMAC-A denotes pain, WOMAC-B denotes stiffness and WOMAC-C denotes disability. WOMAC -A scores were subgraded into 4 (GdI 0 to <25%, Gd II 25 to <50%, Gd III 50 to < 75%, Gd IV 75% and above). Similarly WOMAC-C scores were subgraded into 4, (Gd I 0 to <25%, Gd II 25 to <50%, Gd III 50 to < 75%, Gd IV 75% and above).

Again age distribution was grouped into 4 groups; Gr I 40 to 50 years, Gr II>50 to 60 years, Gr III>60 to 70 years and Gr IV>70 years.

Statistical analysis: SPSS 15 was used for the analysis of all the statistical data. Spearman's rank correlation coefficient was calculated to determine the relationship between WOMAC-A and KL grading, WOMAC-C and KL grading separately.

Table1: *Demographic Features, Clinical, and Radiological Characteristics of the Patients*

Age (years) (mean+ SD)	59.48 + 9.8
Gender:	
Female (No of cases; %)	96 (78.05)
Male (No of cases; %)	27 (21.95)
Disease duration (month) (mean +SD)	4.79 + 0.41
Kellgren – Lawrence scale:	
Grade I (No of cases; %)	14 (11.38)
Grade II (No of cases; %)	48 (39.02)
Grade III (No of cases; %)	44 (35.77)
Grade IV (No of cases; %)	17 (13.8)
WOMAC pain score (mean + SD)	8.15 (2.92)
WOMAC functional score (mean + SD)	29.28 (10.85)

WOMAC: Western Ontario and McMaster Universities Osteoarthritis Index

Results:

One hundred and twenty-three patients, with age range of 40 to 80 years (mean 59.48 + 9.8), male 27 and female 96, disease duration 4.79+0.41 months (Table1) ; side involved right 66 (53.7%), left 31(25.2%), and with both sides involvement in 26(21.1%) patients. Swelling was present in 49 patients (39.83%) and absent in 74 patients (60.16%).

Radiographical assessment,was done with KL grading, Gd I in 14 cases (11.38%), Gd II in 48 cases(39.02%), Gd III in 44 cases (35.77%), Gd IV in 17 cases (13.8%). Maximum cases were of grade II and III showing that most of the cases are in mild to moderate radiological features.

The correlation between WOMAC-A (pain) and KL grading was found to be statistically insignificant (r = 0.120) likewise WOMAC-C (disability) was also found to be insignificant (r = 0.325) as shown in Table 2.

Table 2: *Correlation Coefficient between WOMAC and KL Grading*

WOMAC	KL grade (r)
WOMAC-A	0.120
WOMAC-C	0.325

Correlation is significant at 0.01 level

Discussion:

In this study we would like to highlight the association between severity of OA knee assessed with radiological OA changes described in stages according to KL radiological grading of OA. Pain and functional assessment was done by WOMAC Osteoarthritis Index in a population of elderly man and woman attended in the PMR OPD JNIMS, with knee OA.We could not establish any association between WOMAC score of pain and disability and radiologic grading Kellgren-Lawrence grading scale.

KL grading is one of the accepted and frequently used methods of grading OA knee.

Kellgren& Lawrence Radiological Grading of OA[12]

Gd I: Doubtful narrowing of joint space and possible osteophyte lipping

Gd II: Definite osteophytes and possible narrowing of the joint space

Gd III: Moderate multiple osteophytes, definite narrowing of joint space and some sclerosis and possible deformity of the bone ends

Gd IV: Large osteophytes marked narrowing of joint space, sclerosis and definite deformity of the bone end.

The Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) has been a widely used patient reported outcome in OA. Kersten *et al*[13] explored the internal validity and responsiveness of this scale and concluded that WOMAC pain and physical functioning subclass satisfied unidimensionality and ordinal scaling test and ability to transform to an interval scale. In this study we have converted WOMAC cardinal scale to interval scale as mentioned above.In this study we used this two well-accepted tools for the respective evaluations.

OA is the most common joint disorder due to ageing, wear and tear in the joint and causing disability among elderly population. And pain is the most common complaint among patients of knee OA leading to disability[14]. Devis *et al*[15] had commented that disability in a patient increases with the presence of pain. So while planning treatment it is necessary to know the factors that contribute to disability. McAlindon *et al*[16] have demonstrated that knee pain and age are more important determinants of functional impairments in elderly subjects than the severity of knee OA as assessed by radiography. Jordan *et al*[17] also concluded that knee pain severity was more important than radiographic knee OA in disability determination. Our study also shows that severity of knee OA as shown in the radiography is not related with the symptoms and we could not decide the treatment modality to be given on the basis of radiographic findings.

Amberson and Attur[3] and Cushnaghan and Dieppe[18] separately reviewed OA and confirmed that women are more likely to develop OA, more so after the age of 50 years, particularly in the knee, and the cause of this increase is poorly understood. In this study population M:F ratio is 9:32, that is there is strikingly high female patients as shown by others.

In many patients there are radiographic changes of OA but not symptomatic disease and on the other hand early painful OA may be unaccompanied by radiographic change, because changes on radiographs diagnostic of OA tend to occur relatively late in the disease course, after many pathologic changes have occurred in the joint.The severity of symptoms is poorly correlated with the severity of structural disease.

Felson[19] commented, cartilage damage is believed to be the hallmark of OA. However, since cartilage is an avascular, aneural tissue, the mechanisms of pain are likely to be complex and influenced by non-cartilagenous structures in the joint including the synovium, bone and soft tissue. Synovitis and bone marrow lesions, shown by imaging, may mediate pain. Mechanisms of pain perception may include the activation and release of local pro-inflammatory mediators such as prostaglandins and cytokines accompanied by the destruction of tissue, which is mediated by proteases.

However, clinically, there is often disparity between the degree of pain perception and the extent of joint changes in subjects with OA. Felson and Zhang[5] opined that the discordance between the severity of structural disease and symptom occurrence can be because plain radiographs do not image joint structures innervated by pain fibres; cartilage loss, the pre-eminent pathologic feature leading to joint space narrowing on radiographs, is unaccompanied by any pain. And symptoms and structural changes are different phenomena. Pain is a consequence of activities, of psychologic and other causes of distress, and of pain thresholds. In OA, pain and disability also may be related to muscular weakness, which is not reflected in most imaging studies.Larsson *et al*[20] also reported that radiographic diagnosis of OA was not related to functional capacity. Similar to these findings we found no correlation between pain, functional impairment and radiographic features.

Finan *et al*[11] concluded that their findings support the notion that central sensitisation is an endophenotype for chronic pain in knee OA and contributes to the ongoing debate surrounding the variable association of clinical pain and radiographic sverity of knee OA.

Clinical features and radiological findings are important for proper diagnosis and management. But if we depend only on the radiological features for diagnosis and management of knee OA this will lead to unnecessary exposure/intervention to different modalities of therapy and thereby increasing cost of therapy. Patients with radiographic evidence of OA may be asymptomatic at any time and on the other hand in early OA with no radiologically identifiable structural changes extreme pain can be experienced. There are conflicting study reports that shows no association between pain, disability score and radiological findings[7,9] and others with good correlation between knee pain and radiographic features[10,16]. In our study we also found that there is no significant association between OA knee pain, disability and radiographic features.

Limitations of Study:

Study design is a cross-sectional study with less number of patients.We analysed only WOMAC pain and disability. WOMAC stiffness, correlation between age, sex, duration of disease, body mass index and radiological grade not analysed.

Conclusions:

We conclude that radiological grading with plain x-ray for OA knee and pain and functional impairment do not have significant correlation. We should not depend only on radiological features and we should rather consider the functional status while making the treatment decision of OA knee. Further longitudinal research with more number of patients is required.

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Original Article

Study of Effectiveness of Shoulder Elbow Wrist Hand Orthosis in the Management of Glenohumeral Subluxation in Post-stroke Hemiplegic Patients

G. Sonachand Sharma[1], Y. Nandabir Singh[2], Ak. Joy[3], Bimol Singh[4], Alex T Touthang[5], Tamphaleima Devi[6]

Abstract

Objective: Study of effectiveness of shoulder elbow wrist hand orthosis in the management of glenohumeral subluxation in post-stroke hemiplegic patients.

Methods: Design: Randomised control trial.

Setting: Department of Physical Medicine and Rehabilitation, Regional Institute of Medical Sciences (RIMS), Imphal.

Participants: Post-stroke hemiplegic patients (n=120) having glenohumeral subluxation (GHS) as confirmed by x-ray.

Duration: One and half years (August 2010 to January 2012).

Intervention: Control group (n=60) received routine rehabilitation programme for hemiplegic practice in the Department of PMR, RIMS while the experiment group (n=60) received shoulder elbow wrist hand orthosis in addition to rehabilitation programme.

Outcomes: Grade of glenohumeral subluxation using x-ray.

Results: Experiment group showed reduction in the glenohumeral subluxation which is statistically significant when compared to control group ($p<0.001$).

Conclusions: Use of upper limb orthosis in addition to routine rehabilitation programme can effectively reduce glenohumeral subluxation in post-stroke hemiplegic patients.

Key words: **Glenohumeral subluxation (GHS), shoulder elbow wrist hand orthosis (SEWHO), Post-stroke hemiplegic patients.**

Introduction:

A good shoulder function is essential for effective hand function, as well as for performing multiple tasks involving mobility, ambulation, and activities of daily livings (ADL). One of the common sequelae of stroke is shoulder dysfunction subsequently leading to disability. Hemiplegic shoulder pain (HSP) is the one which causes shoulder dysfunction occurring in 16-72% of stroke survivors[1]. Studies reported appearance of HSP as early as 2 weeks with an average occurrence between 2 and 3 months of post-stroke[2].

The glenohumeral subluxation(GHS) is among the commonly cited cause for HSP with a reported incidence of up to 81% in hemiplegic patients[3]. GHS in hemiplegia is defined "as a non-traumatic, partial or total change of relationship between the scapula and the humerus in all directions and in all planes, as compared with the non-affected shoulder, that appeared after stroke"[4]. GHS may have a role in the pathogenesis of HPS by stretching the local neurovascular and musculoskeletal tissues. The possible mechanisms for occurrence of GHS in stroke are: (1) loss of support from the deltoid and supraspinatus to the head of humerus, (2) scapular downward rotation due to paralysis of seratus anterior,

Authors' affiliation:

[1] MBBS, MD PMR
[2] MBBS, MS(Ortho), Professor, PMR
[3] MBBS, MD, DNB, PhD (PMR), Professor and Head, PMR
[4] MBBS, MD PMR
[5] MBBS, Post graduate trainee, PMR.
[6] MBBS, Post graduate trainee, PMR.
Department of Physical Medicine & Rehabilitation, Regional Institute of Medical Sciences (RIMS), IMPHAL, Manipur, Pin-7951004.

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Correspondence:

Dr. Y. Nandabir Singh Professor, Department of Physical Medicine and Rehabilitation, RIMS, Imphal. E-mail: gschandsharma@gmail.com, drynsingh70@yahoo.com.

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rhomboids and trapezius, (3) drooping of trunk towards hemiplegic side due to loss of righting reflex, and (4) downwards traction by the weight of the upper limb. Because the subluxed shoulder is unstable, care must be taken to support the flail shoulder in upright position. Treatment to reduce this subluxation should focus on achieving trunk alignment and glenohumeral joint stability[5].

Objective documentation of subluxation requires radiographs with a patient in upright position. It is suggested that patient showing early radiologic signs of subluxation might be most likely to get benefit from early orthotic intervention[6].

The ideal approaches for treating GHS which have been proposed are:

1. Careful positioning and handling of the paralyzed limb[7].
2. Strapping[8].
3. Use of slings[9].
4. Electrical stimulation[10].

Many authors have studies the effectiveness of different types of mechanical approaches in the management of GHS in post hemiplegic patients. In our present set up, we have been treating the hemiplegic patients only with rehabilitation exercise programmes and proper and careful positioning of the paralysed limb. In our country so far there are limited studies on orthotic intervention. So, this study is designed to see the effect of shoulder elbow wrist hand orthosis (SEWHO) in the management of GHS in post-stroke hemiplegic patients.

Materials and Methods:

It is a randomised controlled trial conducted in the Department of Physical Medicine and Rehabilitation (PMR), Regional Institute of Medical Sciences (RIMS), Imphal, Manipur with study period of 1 year and 6 months. Altogether 120 patients of post-stroke hemiplegia were studied with following inclusion criteria: (1)Stroke patient within 3 months of attack, (2) hemiplegic patient having GHS and (3) age between 18 and 60 years. Exclusion criteria in the study were: (1) patient unable or not willing to give consent, (2) recurrent stroke, (3) comatose patients, (4) recent fracture of humerus/clavicle, (5) severe arthritis affecting shoulder joint and (6) severe comorbid conditions like uncontrolled diabetes, chronic renal failure, coronary artery disease, etc.

There were two groups in the study namely A (control group) and B (intervention group). The group allocation was done by block randomisation method using block of two. The procedure was as follows: (1) A block size of 2 was chosen, (2) possible balanced combinations with C (control) and T (treatment) subjects were calculated as (TC, CT), and (3) blocks were randomly chosen to determine the assignment of all 120 participants[11]. This procedure resulted in 60 participants in both the control and treatment groups.

The routine rehabilitation physiotherapy programme was given to both the groups. It includes:

(a) Positioning: The shoulder to be positioned in 90 degree abduction and external rotation and elbow flexed at 90 degree while the patient on bed.

(b) Range of motion exercise: Passive range of motion exercises of the shoulder in flexion, abduction, internal and external rotations to be taught to the patient's care-giver. This is to be done thrice daily, with 10-20 repetitions per session.

(c) Bed mobility and transfer techniques.

(d) Careful handling.

Group B also received SEWHO which was made in Orthotic Unit of Department of PMR, RIMS, Imphal. In this orthosis, position of upper limb was elbow flexion at 90 degree, forearm in full supination, wrist dorsiflexion at 40-45 degree, thumb in abduction and metacarpo-phalangeal, interphalangeal joints in extension, so called reflex inhibitory position. The SEWHO was made to be applied only when the patient is in upright position ie, sitting, standing and moving around and for a maximum period of 6 months to see its effect.

Outcome Measures and Follow-up:

The GHS was assessed through radiological examination by taking x-ray anteroposterior view of both the shoulders in erect posture with weight of limb working as traction. X-ray was taken at the time of diagnosis of GHS, subsequently at 3 months and 6 months of follow-up to reduce radiation hazard. In the x-ray, the GHS was measured in following 4 grades(Fig 5)[12].

1. V- shaped widening
2. Moderate subluxation
3. Advance subluxation
4. Dislocation

Steps of making SEWHO: Step 1: Making of negative cast [Fig1(a) to Fig 1(c)]

Fig 1(a) - *Negative Cast*

Fig 1(b) - *Negative Cast*

Fig 1(c) - *Negative Cast*

Step 2: Making of positive cast [Fig 2(a) & 2(b)]

Fig 2(a) - *Positive Cast*

Fig 2(b) - *Positive Cast*

Step 3 : Making of final orthosis- SEWHO [Fig 3(a) to 3 (b) & 4]

Fig 3(a) - *SEWHO*

Fig 3(b) - *SEWHO*

Fig 4 - *Patient with SEWHO*

Follow-up of the cases was done at 1st month, 3rd month then at 6th month (Fig 6 & 7).The approval of the ethical committee was taken from the Institutional Ethics Committee, RIMS, Imphal, Manipur.

Statistical Analysis:

All analyses were performed using Statistical Package for Social Science SPSS software 16 version. Chi-square was used for the comparison between the groups. A significant level of 0.05 was used for all comparisons.

Results :

A total of 120 patients of stroke fulfilling the inclusion criteria were studied. The control group consisted of 50 females and 10 males with average age of 54.7 ± 6.9 years while the intervention group consisted of 45 females and 15 males with average age of 56.1 ± 9.4 years. At first follow-up, 5 patients (3 in intervention, 2 in control), at second follow-up, 14 patients (8 in intervention, 6 in control), at third follow-up, 18 patients (8 in intervention, 10 in control) and at last follow-up, 21 patients (11 in intervention, 10 in control) were lost subsequently for the complete follow-up. There were no statistically significant differences between groups in terms of baseline characteristics as shown in Table1. Males were 25 (20.8%) and females were 95 (79.2%). Majority of the patients, 27 in intervention and 31 in control were having post-stroke duration less than 1 month at the initiation of study. Cerebral infarct constituted 80% in intervention, 75% in control groups whereas haemorrhage constituted 20% in intervention and 25% in control group. Majority of the patients ie, 45 (80%) in intervention group and 44 (73%) in control group had left sided hemiplegia. Majority of cases, 43 in intervention and 39 in control had HSP. GHS with grade 3 was present in 54 patients in intervention and 52 in control group. At the 1st follow-up, majority of intervention group were in GHS grade 1 (36.8%) and 2 (59.6%) while in the control group maximum number of patients were in GHS grade 3 (79.3%). This difference was found to be statistically significant (p=0.001) (Table 2). At second follow-up, majority of interventiom group (75.0%) was in GHS grade 1 while the maximum of control group (92%) were in GHS grade 2 and 7(13.5%) of intervention group did not have GHS, however no patient of control group achieved neither grade 0 nor 1 GHS. This finding was found to be statistically significant (p=0.001) (Table 3). At 3rd follow-up, maximum number of patients in intervention group (75.0%) were in GHS grade 1 while majority of control group (86%) were still in GHS of grade 2 and the finding was found to be statistically significant (p=0.001) (Table 4). At the end of last follow-up, majority (69.4%) of the intervention group were not having GHS (grade 0) while maximum (82.0%) of the control group were still having GHS grade 2 and the finding was found to statistically significant (p=0.001) (Table 5). The proportion of participants who did not have GHS (grade 0) were more in the intervention group as compared to those in the control group at all the levels of duration of hemipleia. This difference was statistically significant at all the levels except when the duration was 1-2 months (Table 6). Majority of intervention with infarct were not having GHS (grade 0) while maximum of control group with infarct were in GHS grade 2. And maximum of patients with haemorrhage did not have GHS in the intervention group while in control group, majority of patients with haemorrhage were in GHS grade 2. These differences were found significant (p < 0.001) (Table 7).

Table 1: *Baseline Characteristics of the Study Groups*

Variables		No of cases		P-value
		Intervention (n = 60)	Control (n = 60)	
Sex:	Male	15(25%)	10(16.6%)	0.261
	Female	45(75%)	50(83.3%)	
Duration:	≤ 1 month	27(45%)	31(51.6%)	0.709
	>1 to ≤ 2 months	7(11.6%)	5(8.3%)	
	>2 to ≤ 3 months	26(43.3%)	24(40%)	
Side of limb involved:	Right	15(25%)	16(26.6%)	0.835
	Left	45 (75%)	44(73.3)	
Type of lesion:	Infarct	48(80%)	45(75%)	0.521
	Heamorrhage	12(20%)	15(25%)	
HSP:	Present	43(71%)	39(65%)	0.432
	Absent	17(28.3)	21((35%)	
GHS grade:	0	0(0%)	0(0%)	0.552
	1	0(0%)	0(0)%	
	2	4(6.6%)	7(11.6%)	
	3	54(90%)	52(86.6%)	
	4	2(3.3%)	1(1.6%)	

P-value <0.05 is taken as significant

Table 2: *Difference in Outcome between the Groups at 1st Follow-up*

GHS grade	No of cases		P- value
	Intervention (n = 60)	Control (n = 60)	
0	0(0.0)	0(0.0)	0.001
1	21(36.8%)	0(0.0)	
2	34(59.6%)	12(20.7%)	
3	1(1.8%)	46(79.3%)	
4	1(1.8%)	0(0%)	
Total	57	58	

P-value <0.05 is taken as significant

Table 3: *Difference in Outcome between the Groups at 2nd Follow-up*

GHS grade	No of cases		P- value
	Intervention (n = 60)	Control (n = 60)	
0	7(13.5%)	0(0.0)	0.001
1	39(75.0%)	0(0.0)	
2	5(9.6%)	50(92.6%)	
3	0(0.0)	4(7.4%)	
4	1(1.9%)	0(0.0)	
Total	52	54	

P-value <0.05 is taken as significant

Table 4 : *Difference in Outcome between the Groups at 3rd Follow-up*

GHS grade	No of cases		P - value
	Intervention (n = 60)	Control (n = 60)	
0	7(13.5%)	0(0.0)	0.001
1	39(75.0%)	6(12.0%)	
2	5(9.6%)	43(86.0%)	
3	0(0.0%)	1(2.0%)	
4	1(1.90%)	0(0.0)	
Total	52	50	

p-value <0.05 is taken as significant

Table 5 : *Difference in Outcome between the Groups at the Last Follow-up*

GHS grade	No of cases		P - value
	Intervention (n = 60)	Control (n = 60)	
0	34(69.4%)	0(0.0)	0.001
1	14(28.6%)	8(16.0%)	
2	0(0.0)	41(82.0%)	
3	1(2.0%)	1(2.0%)	
4	0(0.0)	0(0.0)	
Total	49	50	

P-value <0.05 is taken as significant

Table 6: *Outcome Measure of GHS in the Study Groups at Last Follow-up by Duration of Hemiplegia*

Duration	Grades of GHS	No of cases		Total	P - value
		Intervention (n = 60)	Control (n = 60)		
≤ 1 month:	0	16(69.5%)	0(0)	16	0.001
	1	6(26%)	2(7.6%)	8	
	2	0(0)	23(88.4%)	23	
	3	1(4.3%)	1(3.8%)	2	
	Total	23	26	49	
>1 to ≤ 2 months:	0	4(100%)	0(0)	4	0.30
	1	0(0)	1(33.3%)	1	
	2	0(0)	2(66.7%)	24	
	Total	4	3	7	
>2 to ≤ 3months:	0	14(63.6%)	0(0)	14	0.001
	1	8(36.4%)	5(23.8%)	13	
	2	0(0)	16(76.2%)	16	
	Total	22	21	43	

P-value <0.05 is taken as significant

Table 7: *Outcome Measure of GHS in the Study Groups at The Last Follow up by Type of the Lesion*

Type of lesion	Grades of GHS	No of cases		Total	p – value
		Intervention (n = 60)	Control (n = 60)		
Infarct:	0	28(73.6%)	0(0)	28	0.001
	1	9(23.6%)	6(17.1%)	15	
	2	0(0)	28(80%)	28	
	3	1(2.6%)	1(2.8%)	2	
	Total	38	35	73	
Haemorrhage:	0	6(454.4%)	0(0)	6	0.001
	1	5(45.5%)	2(13.3%)	7	
	2	0(0)	13(86.7%)	13	
	Total	11	15	26	

P-value <0.05 is taken as significant

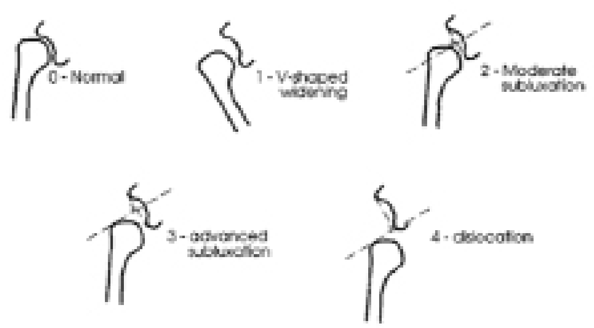

Fig 5 - GHS Measurement

Discussion:

The present study revealed that the mean age of the study population were 56.1±9.4 and 54.7±6.9 (age range 41-70 years) among the intervention and control group respectively. Majority of the patients, 27 in intervention and 31 in control were having post-stroke duration less than 1 month at the initiation of study. Similar finding was noted in the study conducted by Hilde *et al*[13] where mean age was 55.6 years. Pizzi *et al*[14] reported a mean age of 65.5years.

Fig 6 - *Before Intervention*

Fig 7 - *After Intervention*

Cerebral infarct was more common than haemorrhage in both the groups (80% *versus* 20% in intervention and 75% *versus* 25% in control). Majority of the patients 45(80%) in intervention group and 44(73%) in control group had left sided hemiplegia. Similar findings were also noted in the study conducted by Joy *et al*[15].

GHS is a common complication of stroke but, the correlation between GHS and HSP is still controversial. In the present study, out of 120 cases recruited only 82 (68.33%) had HSP at the initiation of study. This finding was similar to the study conducted by Van Langenberghe and Hogan[12]. Another study on hemiplegic shoulder subluxation was conducted by Ikai *et al*[16] where they also concluded that there was no relation between shoulder subluxation and pain. However two mechanisms possible for the correlation between GHS and HSP are: (1) Peri-articular tissue may become overstretched by the weight of the paralysed arm thereby causing pain, since the capsule and ligaments contain high concentrations of pain receptors and (2) overstretching may be the origin of painful ischaemia in the tendons of the supraspinatus muscle and of the long head of the biceps muscle[16, 17].

Radiographic measurements are considered the best method of quantifying GHS[12]. It is suggested that patient showing early radiologic signs of subluxation might be most likely to get benefit from early orthotic intervention. In this study we also used radiographic measurement for grading GHS.

A number of slings and other supports with different characteristics, design, and function have been described in the literature[18-20] but few studies have assessed their effectiveness in reducing GHS.

In a study conducted by Kieran *et al* [21] three different slings were compared in a group of 10 stroke patients the standard hemisling, the Bobath clavicular sling, and the modified vertical arm sling. The hemisling was found to be better in decreasing vertical and lateral GHS.

Patterson *et al*[22] found that, when correctly applied, all five slings used in their study were effective in reducing GHS (Dennison sling, Dumbbell sling, Harris hemisling, Hook hemiharness, and Zimmer Fashion arm sling).

In a study, Brooke *et al*[23] compared the Harris hemisling, the Bobath sling, and an arm trough/lapboard to assess their efficacy in reducing GHS. Even though improved GHS was found in some cases; no sling that was used consistently prevented subluxation in all cases.

Zorowitz *et al*[24] tested the effectiveness of four different slings in reducing GHS. They found that the only sling that significantly corrected vertical asymmetry was the single-strap hemisling, while total asymmetry was corrected mostly by the Rolyan sling.

Moodie *et al*[25] assessed the effectiveness of five external supports. Two supports used in the sitting position in a wheelchair and the triangular sling (in standing) were effective; the Bobath roll and the Hook hemi-harness were not effective in reducing GHS.

The use of upper limb orthosis for the management of GHS is not well mentioned in the literature. In the present study, 90% of intervention group had GHS of grade 3 at initiation of the study but majority of them (69.4%) did not have GHS (grade 0) at the end. The proportion of participants who did not have GHS were more in the intervention group as compared to control group when the duration of hemiplegia was less than 1 month showing effectiveness of SEWHO more in the stroke with duration less than 1 month. Majority of patients with haemorrhage and infarct who did not have GHS were also more in the intervention group as compared to control group showing effectiveness of SEWHO both in infarct and haemorrhagic stroke with GHS. The result was found significant statistically when compared to the control group. The possible explanations for improvement in the grades of GHS may be due to following advantages of SEWHO; (1) it keeps the affected upper limb in reflex inhibitory position thereby enhancing the motor recovery, (2) it realigns the subluxed glenohumeral joint in its anatomical position, (3) it supports the paralysed upper limb during upright position and (4) it keeps the subluxed shoulder joint in a secured position thereby preventing the complications which may arise due to malhandling of the paralysed shoulder during transfer. However, natural process of motor recovery in post-stroke patient may also contribute to the reduction of the GHS.

All the patients who were recruited could not be followed up till the end of the study. A total of 21 cases, 11(17.3%) in intervention and 10 (16.6%) in control were lost for the complete follow-up. The difference was however not statistically significant. On further communication through telephone, 10 were completely alright while remaining 11 died of second stroke and other complications which make them to lose for the follow-up.

To our knowledge, the current study is the first randomised controlled trial study conducted to see the effectiveness SEWHO in comparison with physiotherapy treatment for the management of GHS in post-stroke hemiplegic patients. The use of custom made SEWHO in less than 3 months post-stroke patients having GHS significantly reduce the degree of subluxation when used in combination with the physiotherapy programme and it is effective than the physiotherapy alone in the management of GHS.

The limitations of the current study are; (1) non-blinded study, where neither the patients nor the observer were blinded, (2) small sample size, (3) limited outcome measure, x-ray was the only outcome measure being used in the study and (4) limited statistical tool for analysis. Future work incorporating these factors would enrich our current knowledge regarding effectiveness of SEWHO in the management of GHS in post-stroke hemiplegic patients.

Conclusions:

The custom made shoulder elbow wrist hand orthosis (SEWHO) when use along with routine rehabilitation programmed can effectively reduce degree of shoulder subluxation in hemiplegic patient having GHS during early post stroke period less than 3 month duration.

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Case Report

When a Safety-Valve Became a Ticking Time-Bomb: Fractured Tracheostomy Tube as a Tracheobronchial Foreign Body in a Child

Anand Viswanathan[1], Subbian Esakkimuthu[2]

Abstract

Tracheostomy Tube care is a part of respiratory rehabilitation in acquired brain injury but just tracheostomy tube insertion is not enough. Checking for Pre-requisites including manufacturing details, and regular follow – up is important. Here we present a rare case of fracturing of the tracheostomy tube in a traumatic brain injury which was managed timely.

Key words: **Acquired brain injury, Tracheostomy.**

Introduction:

Tracheostomy tube care is part of respiratory rehabilitation among persons with acquired brain injury and high cervical spinal cord injury[1,2].Foreign body aspiration is a life-threatening complication while on tracheostomy. We present an instance of a part of the tracheostomy tube fracturing and migrating into the tracheobronchial tree.

Case report

A 4 year old male incurred traumatic brain injury following a road traffic accident in 2003 and had residual left Hemiplegia. He needed long term tracheostomy for management of subglottic stenosis. Following a course of inpatient rehabilitation for left hemiplegia, he resumed functional ambulation and independ but daily activities. Three years post trauma, aged 7, he was brought by his family members to the outpatient brain injury rehabilitation clinic with complaints of the tracheostomy tubefound missing since the previous evening. He gave no history of respiratory distress. Based on clinical suspicion, a plain radiograph of the chestwas done. It revealed a part of the tracheostomy tube stem lodged at the junction of trachea and right main bronchus, with no other significant abnormality (Fig 1). He was immediately referred to the Pediatric Emergency Department for management by Pediatric Surgery. He underwent rigid bronchoscopy and removal of the tracheostomy tube fragment. A new metal

Fig 1 - *Chest radiograph revealing fractured tracheostomy tube in right tracheobronchial tree*

Authors' affiliation:

[1] *MBBS; MD PMR**

[2] *MBBS; MD PMR***

*Department of Physical Medicine and Rehabilitation Cochrane South Asia, Christian Medical College, Vellore, Tamil Nadu, India.

**Department of Physical medicine and Rehabilitation Square Hospitals, Dhaka, Bangla Desh

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Correspondence:

Department of Physical Medicine and Rehabilitation Cochrane South Asia, Christian Medical College, Vellore, Tamil Nadu, India. Mob: 09884217395, Email: dranandviswanathan@gmail.com

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tracheostomy tube was inserted via the stoma. Post-procedure period was uneventful and he was discharged from the hospital two days later.Since then, he has been followed up for about seven years, and he has had no complications.

Discussion

While many reports mention only a few of the published literature, we were able to identify at least 35 reports of tracheobronchial tree foreign body due to a fractured tracheostomy tube[3-37].Potential causes that have been ascribed for such fractures include manufacturing/designing defects, corrosion due to alkaline tracheal secretions, repeated boiling[9]. Metal, PVC and silicone tracheostomy tubes have all been implicated[16,18,30].The junction of the stem with the flanges is the commonest site of fracture, though fracture at the level of fenestration has been reported too[22]. Fractures have been reported to have occurred as early as within 8 hours of first use[31]. Complications include but are not limited to respiratory distress, lower respiratory infection, and death19. The boy in our case report was asymptomatic probably because the lumen of the fractured tracheostomy tube was strategically lodged at the junction of trachea and the right main bronchus such that it acted like a stent. It is also possible that presentation to the hospital and therapeutic intervention within 24 hours of aspiration could have precluded sequelae related to delayed inflammatory response.

Respiratory tract pathology being among the leading causes for morbidity and mortality among persons with tracheostomy, it is essential to ensure diligent care. Checking for manufacturing defects prior to insertion, regular follow-up inspections of the tube to detect early signs of wear should be essential part of care. Change of tracheostomy tube at regular intervals should also be considered in order to prevent this rare but potentially fatal complication related tofracturing of tracheostomy tube.

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Case Report

A Rare Indication for Amputation

V.K.Sreekala

Abstract

A forty-two years old housewife came to the outpatient department. She met with a very bad road traffic accident in childhood resulting in a crush injury of left lower limb and a degloving injury on the right lower limb. She had undergone transtibial amputation on the left and skin grafting on the right lower limbs. The scar has been transformed into a large keloid. Now she is ambulant with patellar tendon bearing prosthesis on the left side and a rocky hard, heavy, insensate right lower limb with a grotesque appearance. She requests amputation and prosthetic fitting on the right side.

Key words: **Crush injury, degloving injury, amputation, prosthesis, keloid.**

Introduction:

We know the common indications for amputation of lower limbs like peripheral occlusive vascular disease, diabetic gangrene, malignancy, trauma to major vessels, etc. But when someone cannot walk with her own natural lower limb because of the weight, absence of sensation and cosmetically unacceptable appearance, the only way out is amputation.

This is not an usual indication for amputation.

There are different techniques used by surgeons to reduce scarring following an injury. Hyperbaric oxygen therapy is used by many surgeons to assist healing. Inside a hyperbaric oxygen chamber the patient is exposed to a 100% oxygen environment at twice the normal atmospheric pressure. These intense blasts of pure oxygen can speed up the healing process of skin grafts[1].

Another healing technique is vacuum assisted closure. In this immediate postoperative procedure, the grafted skin is dressed with a porous material and attached to a tube that connects to a vacuum source. The vacuum helps to draw out interstitial fluid and encourage blood flow to the graft. All potentially infectious fluids in a contaminated wound (however meticulous the wound debridement is) are sucked out and disposed[2].Many surgeons leave the tube for up to seven days after surgery without even changing the dressing in between.

Compressive garments are used to reduce scarring especially after healing of burns wound.

Artificial skin is used for full thickness skin replacement nowadays[3].

Case Report:

This lady had a run-over road accident when she was just eight years while walking to school. She had both her lower limbs crushed badly and was taken to the Medical College Hospital. Her left lower limb was amputated below the knee and with earnest efforts, the surgeons could save her right lower limb even though the skin below the knee was totally avulsed.

She narrated the story of going through a series of surgeries including skin grafts, myofascial flaps and procedures for correction of deformity. She lost one year in school. At the end of the ordeal, she had a patellar tendon bearing prosthesis fitted on the left lower limb and a near normal right lower limb with a stiff ankle joint and grafted skincover with partial loss of sensation below the knee. As years passed by, she noticed progressive hypertrophy of the grafted skin over the right lower limb which got transformed into a keloid (Figs 1 & 2).

Authors' affiliation:

[1] *MBBS; DPMR; MS(General Surgery); DNB(PMR); MNAMS*

Dept of Physical Medicine& Rehabilitation, Govt. Medical College, Thiruvananthapuram, Kerala, India.

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Correspondence:

Dr. V. K.Sreekala, Professor & Head, Dept of Physical Medicine& Rehabilitation, Govt. Medical College, Thiruvananthapuram, Kerala, India

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Fig 1- Progressive Hypertrophy of the Grafted Skin with Keloid.

Now she has a deformed right leg and foot which is very hard and heavy with no sensations. It is a hindrance to normal walking. She finds it hard to walk along irregular terrain and to negotiate stairs. Her right lower limb is worse than a prosthesis because of its weight and it is aesthetically unacceptable (Figs3 & 4). Her request for amputation is justifiable.

Fig 2 - Deformed Foot with Keloid Formation

Discussion:

All skin grafts leave scars. Full thickness grafts leave a less noticeable scar because they contain functional blood vessels. Split thickness grafts which lack sweat glands, hair follicles and blood vessels are discoloured and produce unsightly scarring especially if the person has a tendency to form keloids. They need to be moisturised frequently with creams to avoid dryness, scaling and scarring[4].

In the reported case, as the wound was due to a run-over accident on the road, it might have been infected and repeated grafting might have been done. This has resulted in abundant keloid like scar formation[5].

Keloids do not regress with time; hypertrophied scars are not active six months after the injury. As time goes on they become flat, thin and pale[6].Even though keloids and hypertrophied scar morphologically look alike

Fig 3 - PTB Prosthesis on the Left and Huge and Heavy Right Lower Limb

Fig 4 - Posterior View of the Heel

immediately after healing of the wound, as time passes, scar hypertrophy is limited to the boundary of the wound. Keloid encroaches beyond the site of injury into the normal tissue. Histopathologically, keloids contain large and thick collagen fibres composed of numerous fibrils closely packed and there is abundant amorphous extracellular material surrounding fibroblastic cells. This is different from hypertrophic scar, the nodules of which contain fibroblasts and fine,randomly organised collagen fibres.

Intralesional injection of steroids, alpha interferon and laser are used with varying results. Excision , many a times produces a worse scar. But some surgeons still try that.

Conclusions:

The grafted skin, homograft or heterograft especially in a potentially infected wound may undergo unlimited hypertrophy causing unsightly scarring[6]. Most probably in the case reported here,this is what has happened.

As the scar hypertrophies beyond a certain limit, it loses its vascularity and sensitivity and the consistency of the scar becomes hard and the limb becomes heavy[7].

In his eagerness to save at least one lower limb of an eight years old girl, the surgeon might have sutured the avulsed skin after adequate wound debridement. That is the right procedure any surgeon will do.But due to infection, the skin might not have been taken up fully. Probably many surgeries were done to get a skin cover over a large surface resulting in such a bad scar.

Now she finds it difficult to walk with such a limb, she cannot climb stairs, she cannot squat, she cannot negotiate irregular terrain, she cannot move along with her 5 years old daughter, but she can manage her routine household chores including cooking,The only possible solution is to undergo a through knee amputation on the right side.As there is a clear line of demarcation between normal skin and the scar,it is not difficult to decide on the level of amputation. If fitted with a suitable prosthesis she will be able to walk without support. Hopefully she will be able to carry on with her present responsibilities including looking after a five year old child.

So an amputation was necessiated 34 years after an injury!

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PG Forum

REHAB QUIZ

1. **What is Panner's disease?**
   a) Osteochondritis dessicans of trochlea
   b) Traumatic elbow dislocation
   c) Median nerve compression at elbow by lacertus fibrosis
   d) Epiphyseal aseptic necrosis of capitellum

2. **While calculating normal H-reflex all of the following should be taken into consideration except-**
   a) Age
   b) Height
   c) Temperature
   d) Latency of opposite side

3. **A high Q angle of the patella is often associated with**
   a) Varus deformities of the knee
   b) Osteonecrosis of the tibial plateau
   c) A low-riding patella
   d) Recurrent dislocation of the patella

4. **Fitting for a unilateral limb deficiency should occur at what age?**
   a) When the child achieves sitting balance
   b) After the first year
   c) When the child can crawl
   d) When the child can stand

5. **What percentage of patients with an ACL tear has a stable to mild instability of the knee?**
   a) 66%
   b) 95%
   c) 10%
   d) 33%

6. **Deficiency of the enzyme homogentisic acid oxidase causes:**
   a) Kayser-Fleischer rings
   b) Bluish discoloration of urine
   c) Acute transient synovitis
   d) Iron deposition in tissues

7. **Girdlestone arthroplasty is done for –**
   a) Perthes disease
   b) TB hip
   c) Avascular necrosis of hip
   d) Congenital dislocation of hip

8. **A 55 year old patient with moderate to severe headache and nuchal rigidity was found to have SAH. What grade of severity would you give using Hunt and Hess Scale?**
   a) 10
   b) 5
   c) 4
   d) 2

9. **Success rate of non- operative treatment in healing type -1 osteochondritis dessicans of the elbow-**
   a) Poor,<10%
   b) Average,50%
   c) Good,75%
   d) Very good, >90%

10. **A patient with HIV is expected to have NCS-EMG findings as –**
    a) Sensorimotor axonal findings
    b) Sensorimotor demyelination
    c) Sensory demyelination
    d) Motor axonal findings

ANSWERS

Answer of June 2016

1a; 2c; 3b; 4c; 5b; 6b; 7c; 8b; 9b; 10b

PG Forum

REHAB CHALLENGE

A 10 years old boy from urban area and middle socioeconomic status, born from non-consanguineous marriage with history of birth asphyxia and developmental delay presented in our OPD with right upper limb and bilateral lower limb deformity with difficulty in walking and ADL for last 4 years. Patient was previously diagnosed as triplegic CP and got two times botulinum toxin injection along with regular unsupervised physiotherapy. Six months ago he started using KAFO for deformity of lower limb while walking. There was marked improvement after firstbotulinum toxin injection but after 2nd Injection, there wasn't any significant improvement. On examination there was bilateral convergent squint, right upperlimb and bilateral lower limb flexed posture with independent standing and walking for few steps. There was marked spasticity in right biceps, brachioradialis , pronator and wrist dorsiflexor with flexed , pronated forearm with dorsiflexed wrist with inability to move his wrist and supinate his forearm and fully flexed elbow; externally rotated and flexed hip with flexed knee and equines deformity bilaterally with marked tightness in hip external rotator, ITB band, abductor , hamstring and TA bilaterally. X-ray of hip showing externally rotated femur. He was admitted and treated with supervised physiotherapy,botulinum toxin injection in biceps, pronator teres and quadrates and FDP and FDS.Now he is able to move his wrist and fingers and extend his elbow with mild difficulty but there isn't any marked improvement in lower limb deformity and gait due to severe spasticity of the hip external rotator.

Please opine regarding the management of this young boy.


Fig 1


Fig 2


Fig 3

Medical Philately

Issued by Czech Republic, 2014

The origin of the Paralympic Games are credited to Professor Ludwig Guttmann, a neurologist and Neurosurgeon. A new perspective on the issue of rehabilitation for persons with disabilities was influenced by World War II. In 1944, Professor Guttman founded a medical center in the Stoke- Mandeville Hospital (UK) for the treatment of the people with spinal cord disabilities .These games were the model for Paralymic Games. 1960 Summer Paralympics, were the first international Paralympic Games, following on from the Stoke Mandeville Games of 1948 and 1952. The first Paralympic Winter Games took place in 1976 in Ornskoldsvik, Sweden

Country	Czech Republic India
Date	2014
Disability	Paralympic
Theme	11th Paralympic Winter Games, Sochi, Russia 2014

PG Forum

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Rise of the Smart Phone Thumb

Sahibzada Nasir Mansoor

The recent boom of touch screen smart phones has made the users vulnerable to new cumulative trauma disorder involving tenosynovitis of the flexor tendon sheaths. The situation is expected to rise. In these smart phone, one finger use is preferred and mostly the thumb is used for typing and swiping. These repetitive movements done hundreds and thousands of time a day make individuals vulnerable to repetitive strain disorders of the thumb. We report a similar case. Thirty five years old doctor presented with pain and swelling at the ventrolateral aspect of the right wrist for the past 03 weeks. He was right hand dominant. He had a history of excessive use of his newly bought touch screen smart phone for the past one month. On examination he had a soft swelling at the ventral wrist area slightly proximal to the 1st carpometacarpal joint (Figure 1). The swelling was 1.5 by 1 cm, compressible and deep tenderness was positive. There was no history of trauma. Clinically the swelling appeared as tenosynovitis of flexor pollicis longus (FPL). A musculoskeletal ultrasound was ordered to confirm the diagnosis and it revealed tenosynovitis of Flexor carpi radialis tendons sheath in addition to flexor pollicis longus. The patient was advised restriction of the use of thumb and right hand for smart phone use, ice fomentation, thumb spica splint and NSAIDs. The patient was also offered steroid injection into the tendon sheath but he preferred trial of non invasive management The pain and swelling gradually subsided over a period of 06 weeks .

Fig 1- Swelling (tenosynovitis) at the base of right thumb.

Fig 2- Complete resolution after 6 weeks

Authors' affiliation:
MBBS, FCPS, Consultant, Rehabilitation Medicine, Combined Military Hospital, Pano Aqil Cantt, Pakistan
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PG Forum

BOOK NEWS

1. Outpatient Ultrasound-Guided Musculoskeletal Techniques Edited by Evan Peck. Physical Medicine & Rehabilitation Clinics of North America. August 2016 Volume 27, Issue 3, p539-764

2. Peggy Houglum . Therapeutic EXcercises for Musculoskeletal Injuries 4th Edition- June 2016

3. Physical Medicine and Rehabilitation Hardcover, by Esther Henson. Aug 2016

4. Hamstring and Quadriceps Injuries in Athletes: A Clinical Guide, Editedby Christopher C. Kaeding and James R. Borchers, Springer, Sep 2016

5. Return to Play Following Musculoskeletal Injury, An Issue of Clinics in Sports Medicine, (The Clinics: Orthopedics) by Brett D. Owen. Sports Medicine. Clinics of North America. October 2016 Volume 27, Issue 4, p765-1031

ARTICLE NEWS

1. The Effect of Body Mass Index on Fluoroscopic Time and Radiation Dose during Sacroiliac Joint Injections Daniel Cushman, Alexandra Flis, Ben Jensen, Zachary McCormick. *PM&R. August 2016 Volume 8, Issue 8*, p767-72

2. Potential predictors of lower extremity impairments in motor coordination of stroke survivors *Kenia K. MENEZES, Aline A. SCIANNI, Iza FARIA-FORTINI, Patrick R. AVELINO, Augusto C. CARVALHO, Christina D. FARIA, Luci F. TEIXEIRA-SALMELA European Journal of Physical and Rehabilitation Medicine 2016 June;* **52:** 288-95

3. Investigation of Biomechanical Characteristics of Intact Supraspinatus Tendons in Subacromial Impingement Syndrome: *A Cross-sectional Study with Real-time Sonoelastography Kocyigit, Figen; Kuyucu, Ersin; Kocyigit, Ali; Herek, Duygu Tuncer; Savkin, Raziye; Aslan, Ummuhan Bas. American journal of Physical medicine and Rehabilitation. August 2016 - Volume 95 - Issue* 8 pp: 553-627

4. Caregiver Factors in Stroke: Are They the Missing Piece of the Puzzle? Peck-Hoon Ong, Gerald Choon-Huat Koh. *Archives of Physical Medicine and Rehabilitation. August 2016.Volume 97, Issue 8*, p1223-5

PG Forum

BOOK NEWS

1. Outpatient Ultrasound-Guided Musculoskeletal Techniques Edited by Evan Peck. Physical Medicine & Rehabilitation Clinics of North America. August 2016 Volume 27, Issue 3, p539-764
2. Peggy Houglum . Therapeutic EXcercises for Musculoskeletal Injuries 4th Edition- June 2016
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4. Hamstring and Quadriceps Injuries in Athletes: A Clinical Guide, Editedby Christopher C. Kaeding and James R. Borchers, Springer, Sep 2016
5. Return to Play Following Musculoskeletal Injury, An Issue of Clinics in Sports Medicine, (The Clinics: Orthopedics) by Brett D. Owen. Sports Medicine. Clinics of North America. October 2016 Volume 27, Issue 4, p765-1031

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1. The Effect of Body Mass Index on Fluoroscopic Time and Radiation Dose during Sacroiliac Joint Injections Daniel Cushman, Alexandra Flis, Ben Jensen, Zachary McCormick. *PM&R. August 2016 Volume 8, Issue 8*, p767-72
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Correspondence :

Editorial Office :

Prof (Dr) Rathindranath Haldar
Department of Physical Medicine & Rehabilitation,
Institute of Post Graduate Medical Education & Research & SSKM Hospital,
244, AJC Bose Road, Kolkata - 700020.
E-mail:indianjournalofpmr@gmail.com Phone no : 00 91 9830152173

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Correspondence :

Editorial Office :

Prof (Dr) Rathindranath Haldar

Department of Physical Medicine & Rehabilitation,

Institute of Post Graduate Medical Education & Research & SSKM Hospital,

244, AJC Bose Road, Kolkata - 700020.

E-mail:indianjournalofpmr@gmail.com Phone no : 00 91 9830152173

Editorial

PMR In India: SWOT Analysis and Way Forward

"PMR has great flexibility..it will bent rather than break"

Randall L Braddom

Historical Perspective:

Globally PMR began in the fourth decade of the last century in the USA mainly on World War 2 veterans, primarily by Dr. Frank Krusen. In India, the movement started in 1960's after the China war for the war disabled by Prof. Sant, AIPMR, Mumbai

Important Milestones For PMR Education

MCI recognised PMR as optional subject for undergraduate course in medical colleges in 90s followed by including it as optional for internship. MCI recognised MD PMR in 1979 at IPGMER as pioneer institute in India with annual intake of 2

NBE recognised PMR for PG education in 80s and in 2014 prepared a competency based syllabus and is currently developing a syllabus for subspecialty fellowships.

Current Scenario In PMR Education

Out of total 412 medical colleges in India PMR department is present in 27 medical colleges in 23 states and Union Territory. MCI registered faculty is 116 till 2016. Total PG admission capacity is 66: diploma-10, degree-50 and DNB-6

PG as present preference-- Aspirant preference defines professional values (linked to PG training) which in turn are proportional to rank opting for PMR during PG counselling. It has been seen that PMR seats are generally filled after other clinical specialities have been taken up and just before or along with other pre & para clinical seats.

Quality Assurance of PMR education:- Regulatory bodies like MCI/NBE for prescribing standards, universities for maintaining or adoption of these standards, medical colleges for practicing the standards and professional bodies like IAPMR as activist, influences and watch groups. Quality depends on syllabus, teaching technology, faculty development programme, assessment tools/method and UG/PG appraisal.

Strengths, Opportunities and Positive Trends As In 2016

1. Physiatrists are increasing in number and quality with growth of the speciality
2. Public or professional recognition is improving leading to better income and more job opportunities in all sectors.
3. Reimbursement schemes/ health insurance schemes are becoming more PMR intervention inclusive.
4. National/Global policy document mentions Rehab core:- global disability action plan (GDAP 2019-2022),APL (2016), Global alliance for technology assistance GATE(2016) , SDG(2015-2030),MCI action/proposal of NMC,opening of new AIIMS provides enabling environment for growth of PMR.
5 Physiatrists are being promoted to senior positions in health services which would help the future of the subject- there is one PMR special DG who is due for DGHS, there are 2 PMR experts retired from senior positions of Government of India, there are 12 PMR experts retired from senior positions of state government.
6. New income in enhancing areas are opening up like facility owner,manager,group practice,insurance consultancy, universal health coverage packages for PIVD,medico legal services,International health and public health physiatry.

7. Concrete action is going on to ensure that PMR is listed as essential speciality for PG education by MCI at the earliest and at the same time partnership of professional bodies with Ministry of Health and Family Welfare / State Health Department is being thought of for faculty production for 412 medical colleges

Weakness and Threats As In 2016:

1. Legislation- the shift of disease burden from communicable to non communicable disease in India, is increasing the disability burden which requires PMR care, but the government is not prepared till date in spite of national health policy draft 2015& 13 th FYP having decided to allocate funds(3%plan funds) to that effect.
2. PMR education- few medical colleges having PG facility, research facility, lack of assertion by PMR specialist to show cause the value addition of the subject,sole approach by the Physiatrists with lack of partnerships which other specialist and poor publication record and very poor import factor.
3. PMR JOB- resistance to interstate moment for job, where to enter private sector, not much of rehabilitation opportunities outside government sector, interventions mostly not covered by Health Insurance etc.
4. Patient- lack of in-depth knowledge of payment service among individuals, intervention team and unrealistic expectation of patients and unclear understanding of disability and its levels with PMR.

Conclusion:

future belongs not to those who predict it but to those who make it. So ask what future you want for yourself, your family and your speciality and how do you want to achieve it.

R K Srivastava

Ex Prsident IAPMR

Ex DGHS, Govt of India