

Department Of Orthopaedics & Traumatology Queen Mary Hospital University Of Hong Kong Medical Centre Newsletter



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Centre for Paraplegic Walking

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Message from Professor J.C.Y. Leong

The 21st century will be a period of great strides in genomic and proteomic research, with the promise of gene therapy for some diseases. Clinicians of all specialties should be involved in such research. Our Department is actively engaging in genetic research into degenerative disc disease, certain types of bone tumour, and adolescent idiopathic scoliosis.



Nevertheless, clinicians must not lose sight of the enormous importance of applied research, which has much more immediate application to the treatment of patients. In the musculoskeletal arena, we are fully cognizant of such breakthrough as total joint replacement, fixation systems for fractures, re-plantation of severed digits etc. Whilst publications of such

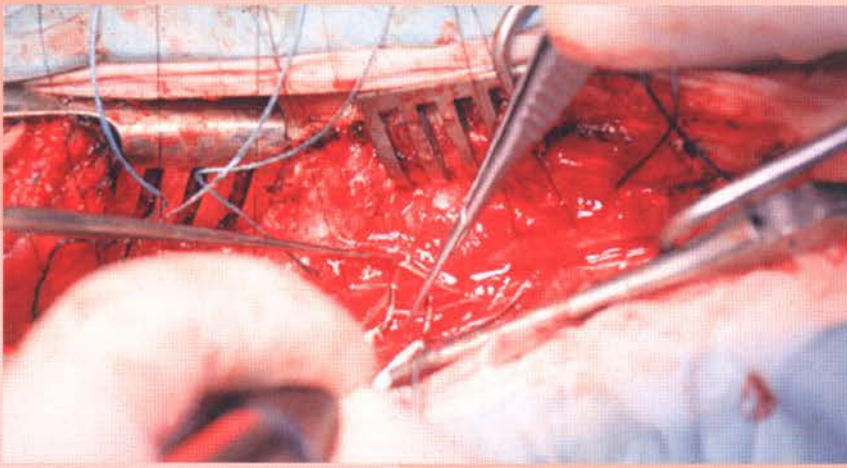
innovations may not reach journals with the highest impact factors, nor will they generate the biggest number of science citation indices, they have benefited millions of patients all around the world.

In this issue we introduce the first and only Centre for Paraplegic Walking in Hong Kong. Despite the abundance of high quality molecular biology research into repair of damaged spinal cords, the solution to this problem is likely to be in the distant future. To an unfortunate person who was leading a completely normal life before spinal cord injury resulting in paraplegia, he or she cannot wait for the miracle of biological regeneration. Some other means to return the function of ambulation, although obviously less than perfect, is necessary.

There is no doubt that the inability of the paraplegics to voluntarily stand up and walk is a major functional loss. Although the wheelchair can provide part of replacement for lost function, wheelchair ambulation requires a lot of modification of the environment. This is usually not feasible in Hong Kong. In addition, it still leaves the patients with a set of secondary problems. Psychologically, the patients cannot stand up and talk to people at face level. The requirement for major modifications of work site may seriously reduce employment opportunities. The ability to stand up and walk decreases the formation of contractures in the lower limbs and avoids pressure sores. Lower

limb spasticity can be reduced and cardiopulmonary functions can be improved. Urinary tract infection occurs less frequently. All these not only improve the well-being of the patients, but also reduce the overall medical expenses. The accompanying psychological effect also has significant positive impact on the rehabilitation process, attempts to gain employment, and family and social life.

By the kind generosity of the D.H.Chen Foundation, a donation of HK\$3.5 million was made available to develop the Centre for Paraplegic Walking at the Department of Orthopaedics and Traumatology at the Queen Mary Hospital. The Centre for Paraplegic Walking was officially opened



Posterior rhizotomy at lumbar spine level can be used to relieve the symptomatic spasticity in spinal cord injury patients.

on 18th January 2002 and the opening ceremony was attended by some very important persons including Professor W.I.R. Davies and Dr William Ho. The primary aim of the Centre is to help the paraplegic patients to gain back their walking abilities. The belief is that if these patients can walk again, they would start whole new lives. The ability to walk again can change their health, jobs and social life. With this belief in mind, a medical team including a doctor, a physiotherapist and an orthotist was sent to the Louisiana State University Medical Centre, USA for training. The advances that have been brought back include the use of Reciprocating Gait Orthosis (RGO), Functional Electrical Stimulation (FES), selective rhizotomy and Baclofen pump.

Many paraplegic patients have spasticity in the lower limbs. Using selective rhizotomy and Baclofen pump, the spasticity can be reduced and thus it can help the paraplegics to walk. Attempts have been made to provide paraplegics with orthotic devices aiming at independent walking in foreign countries for many years. The design of Reciprocating Gait Orthosis (RGO) was a significant achievement. Using the RGO with accompanying Function Electrical Stimulation (FES) further significantly improves walking tolerance. It is the experience of this Centre that the combination use of these techniques has been able to help the paraplegics to achieve the formidable task of independent walking. It is projected that up to 18 paraplegic patients can be trained each year in this Centre.

PROGRAMMES

The programme includes providing paraplegics with RGO devices aimed at independent locomotion. In order to decrease the energy consumption associated with their use, electrical stimulation is applied to some paralysed muscles to assist walking so that the walking distance can be increased. This method is called FES.

Target Patients:

Patients with spinal cord lesions at the level of T4 – T10 are the group with best result and highest successful rate. Lesions below

T10 may benefit from RGO alone. The functional result for lesions between C7 to T3 is not as good as the previous two groups. However, they should also be potential candidates if the patients are highly motivated.

The commonest aetiology of the spinal cord lesion suitable for RGO/FES training is trauma. Other aetiologies include spinal bifida, syringomyelia and tethered cord syndrome. The contraindications to the programme are lack of motivation, severe cardiopulmonary diseases, pregnancy and severe deformities in lower limbs and spine. There is no age limit for patient recruitment provided that they are physically fit for undergoing the training. The interval between the spinal cord insult to the

CENTRE FOR PARAPLEGIC WALKING

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Implantation of baclofen pump can be used to deliver intrathecal baclofen to control the spasticity arising from the spinal cord injury. The method is less invasive than posterior rhizotomy and is reversible if the patient does not like it.



Paraplegic patient walking independently with RGO and FES.



Patient wearing on his waist the electrical stimulator that is used to stimulate the muscles for walking

MUSCLE PRECONDITIONING (FIRST 6 WEEKS)

Muscle stimulation is applied to the quadriceps and hamstrings muscles. The objective is to reverse thigh muscle atrophy, increase strength, and restore aerobic capacity. Patients need to have 3 sessions a week and each session consists of 40 minutes of muscle stimulation.

training programme does not bear prognostic significance. People having spinal cord injury more than 10 years ago can join the programme.

Training Protocol:

PREAMBULATORY TRAINING (FIRST 1 – 4 WEEKS)

The aims are to reduce contractures, maximize the strength and control of any functional muscles, increase the strength of the arms and shoulders, improve tolerance to upright posture and retrain the patients to control the trunk's centre of gravity. Physiotherapists will do the passive mobilization of the lower limbs for the patients and teach them how to strengthen the upper limbs. Tilt table training helps patients to adopt the upright posture. This phase is in parallel with the muscle-preconditioning phase. Patients attend treatment session three times per week and each session lasts about one hour.

RECIPROCATING GAIT ORTHOSIS (RGO) FITTING

The RGO is a hip, knee, ankle and foot orthosis with a unique dual cable mechanism linking to the two hip joints. The cables prevent bilateral flexion of the patient in the standing position. In addition, they provide a reciprocating motion of the two legs during walking. This implies that when one leg is undergoing the swing phase, the contralateral leg is forced by the cable mechanism to undergo the push-off function. All patients will be fitted with a custom made RGO by an orthotist. The RGO uprights and cables are calibrated so that the patient can stand for at least one minute fully balanced and stable without assistance.

AMBULATORY THERAPY (6-9 WEEKS)

Patients learn to don and doff the RGO without assistance. They practise walking on level surface, standing from sitting and

making corner turns. Lastly, patients are trained to walk on grass and gravel up and down ramps and curbs. Further training is given for working in kitchens and bathrooms, going up and down short staircases and getting up from a floor. Home and job site visits will be undertaken if patients agree. The purpose is to suggest detailed modification of the environment so that the patients can fully benefit from RGO/FES walking.

EXPERIENCE FROM OTHER CENTERS

The overall successful rate in completing the training is about 75%. Most failure is spinal cord injury level dependent. The higher the spinal cord lesion, the greater the failure rate will be. Medical problems not related to the use of the RGO and lack of motivation are other common causes of failure.



Paraplegic patient demonstrating how he walks with RGO and FES

Frontal radiograph shows columnar radiolucent streaks within the proximal and distal diaphyseal regions of the tibia with associated mild bony expansion. No internal calcification, cortical destruction nor periosteal new bone formation associated with these lesions. The epiphyses and epiphyseal plates are not involved. No soft tissue calcification seen. The fibula is normal. Findings are typical of multiple enchondromatosis (Ollier's disease).

Ollier's disease is a non-hereditary disorder of failure of cartilage ossification. As a result, multiple foci of cartilage are present within bones and these are sometimes even deposited subperiosteally. These lesions usually involve the bones on one side of the body predominantly or exclusively. Affected bones are shortened and deformed. There is risk of pathological fracture in children and risk of malignant transformation in adults with this disorder. Radiographically, tumours appear as linear or columnar radiolucent regions in the metaphyses or flat bones and these represent sites of persistent cartilaginous tissues (cartilaginous rests). With age, these cartilaginous areas may show punctate calcifications. If there is soft tissue haemangiomas associated, this is known as Maffucci's syndrome.

In terms of walking distance, 20% of patients can walk within 180 meters. 50% of patients can walk between 180 – 450 meters and 30% of patients can walk more than 450 meters.

The average speed for RGO walking coupled with FES is 0.22 m/s (0.79 km/hr). This speed is obviously slow compared to normal walking. However, the device provides patients stable, safe and balanced standing and walking. On some occasions, patients prefer to use the wheelchair, as the speed of transport offers definite advantage. The overall outcome shows that the combined use of the wheelchair and the RGO coupled with FES is the preferred mode for most patients.

Radiographic Quiz

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Four-year-old girl presented with left upper and lower limbs shortening.

What does the frontal radiograph of her left leg show? What is the diagnosis?

A Spine Workshop, sponsored by Johnson and Johnson, was held between 13-18 April 2002 at the Duchess of Kent Children's Hospital. It is the first Spine Workshop of its kind specially designed and held for training the spine surgeons from mainland China and Macau. Surgeons came from Beijing, Shanghai, Guangzhou, Fushan and Macau to participate in the six days workshop which included live surgery demonstration, saw bone workshop, lectures and interactive case discussion. It is anticipated that this training course will be held on a yearly basis.



Participants of the Spine Workshop with members of Division of Spine Surgery

A delegate of 12 Chinese spine surgeons from The Chinese Spine Society consisting of members from Beijing, Shandong, Nanjing, Ningxia, Hua-xi and Shanxi, led by Professor Dang Gengting from the Beijing Medical University and Professor Hu Yougu from The Affiliated Medical College of Qingdao University, visited the Department on 26th April 2002. They were particularly interested in how the Department under the leadership of Professor John Leong has earned its international reputation, and how Professor Leong has earned himself the most outstanding award in China, the "Academician of the Chinese Academy of Sciences".



Delegates from The Chinese Spine Society with Professor SP Chow and members of the Department