SPINAL INJURIES—
The Challenge of Current Rehabilitation

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There are many definitions of rehabilitation — a good one is — "To make fit, after disablement, for playing a part in the world". One of the major challenges today in all parts of the world, is not only to fit the patient for his environment, but also to prepare the environment to receive the disabled citizen. This does not only mean the home, but the wider aspects of the community as a whole,

— travel by train or 'plane
— access to public buildings
— allowing disabled drivers into pedestrian precincts in cities and so on.

There are also those aspects involved in the **attitude** of the able-bodied community in providing employment or sharing leisure activities. The prevalent emphasis on the disabled being second class citizens is completely at variance with the modern approach to rehabilitation.

For the patient with spinal cord injury the initial demand is that the patient should become as independent as possible within the limits imposed by the level of the lesion. **That is** — the patient must gain control over himself and his environment.

There are **Several Major Factors** apart from the usual ones of age, sex, previous medical history, which influence the rehabilitation of these patients.

1. **The height of the lesion** — this obviously determines the residual motor power, and the essential factor of the presence or absence of **'bridge muscles'.** That is those muscles which have a high segmental innervation and a low distal attachment. They thus form a bridge between the paralysed and non-paralysed areas of the body.

e.g. Trapezius — C1-4 — with attachment on the lower spine. Latissimus dorsi — C6, 7, 8, seen so magnificently on the mine dancers and the Abdominals T6-T12 with attachments on the pelvis.

2. **Physical Proportions of the Patient.** Height and weight are obviously significant factors but the essential question for the spinal patient is 'Does he have the 'monkey syndrome'?' — i.e. does he have long arms and a short trunk? The basis for many activities of daily living is the ability of the patient to lift his buttocks by pushing down on his hands. The longer the arms in relation to the length of the trunk the easier it is to lift.

3. **Previous Activities of the Patient** affects his coordination and his ability to relate to his surroundings. If he is well orientated in space and has a good body image his rehabilitation will be both easier and speedier. An Officer from the Household Cavalry had a lesion at C6. His training had involved taking his jacket on and off whilst jumping fences controlling his horse with his legs. In spite of his C6 lesion he achieved sitting balance in a week. Conversely a theologian with an incomplete L1 lesion needing only a long and a short caliper took months to learn to walk. He hardly knew he had two legs, never mind which was the right or left.

4. **The Motivation** of the patient not only affects the speed of his return to independence, but also how much he will achieve. Most patients thrive in the competitive atmosphere of the spinal unit. Yet to some the success of those around makes him feel even more inadequate. As everything seems quite beyond his capabilities he sees no point in even trying.

5. **Spasticity.** The aim of modern treatment involving good positioning and adequate physiotherapy is to obtain a degree of balanced spasticity with which the patient can cope satisfactorily in every day life. Sometimes, however, for no known reason, it becomes a formidable foe, a major problem which prevents activities which should be compatible with the level of the lesion.

All these factors affect not only the speed of rehabilitation, but also what can finally be achieved.

Functional Independence

In order to look at the independence achieved by patients with lesions at different cord levels, we need first to look briefly at what is involved.

(1) The patient needs to learn to care for his body — to feed, wash, dress, attend to his own bladder and bowels, and care for his insensitive skin.
(2) He needs to be able to transfer in and out of the wheelchair — to bed, car, toilet, bath, easy chair, etc. — to sit up in bed, turn over, and lift and move his paralysed limbs.
(3) He needs to be able to manage his wheelchair — both to move himself within it, and to be able to manoeuvre it in the environment.
(4) And, if possible, he needs to learn to walk with calipers and crutches to increase his independence in the community.
(5) Finally he needs to be resettled at home — to be able to transport himself in the community, and to return to employment and family life.

Levels

For the purpose of functional independence for patients with complete lesions we can divide the cord from C4-L1 into six categories, according to the major muscle groups involved. Those patients with lesions above C4 occasionally, though rarely, reach hospital, unless the lesion is incomplete and those below L1 are too good for the purposes of this study.

We therefore have the following groups:
C4 — with head control only.
C5/6 — with partial elbow and wrist control.
C7 — good elbow and wrist control but little or no hand function.
C8-T5 — good hand function — no abdominal muscles.
T6-T9 — partial innervation of the abdominal muscles.
T10-L1 — with good abdominal muscles.

In relating these groups to the activities to be achieved, it is obvious that the independence gained in any activity by a higher group will be achieved more easily, speedily and competently by the lower groups.

C4 The patients with lesions at this level have head control only, they have no protective reflexes, no protection from the effects of prolonged pressure and any independence can only be achieved by mechanical means.

Several **environmental control systems** have been developed over the past decade or so. The most popular in Britain is probably the POSSUM Control. Possum being Latin for "I can" or "I am able" and the letters P.O.S.M. standing for Patient Operated Selector Mechanism. This electronic system is mouth operated by gentle suction or pressure down a tube. Respiration is not affected as only the air in the bucchal cavity is required. The system is designed to give the patient control of up to 11 electrical devices such as an alarm, light, radio, door lock, telephone, etc. As the patient applies suction to the tube a light travels down a selector panel and the patient stops sucking when the light reaches the required control.

P.O.S.M. also produces a control system for an electric typewriter. By means of a key of combined puffs and sucks for each letter of the alphabet such patients can learn to type up to 40 words a minute.

A mouth stick with a dental bite is used by many patients, for simple activities such as turning the pages of books, using the telephone, etc.

Since a female patient found the trick and taught the therapists, patients with C4 lesions have been taught to swim! They can propel themselves slowly through the water by moving the head from side to side. Although such a patient can never be independent in the water, great satisfaction is derived from this free movement.

One of the current challenges of rehabilitation is to provide further mechanised aids for these patients with the highest lesions.

Second group are those lesions at:

C5/6 In this group are the patients whose initial injury is at C5. The lesion then descending to C6 on one or both sides. Extensor carpi radialis is present on one side and maybe bi-laterally, but it is not normal in strength. The patient has no triceps.

In recent years the greatest improvement in independence has been achieved by this group. These patients can learn to feed, wash, shave, type and write using simple gadgets, and to dress the upper half of the body. Some may learn to dress the lower half but speed usually makes this impractical except for emergencies.

Mat Work

As alwavs lifting and moving depends upon balance and strength. To keep the centre of gravity forwards of the hip joints when lifting, the head and shoulders and therefore the trunk must be kept well flexed, e.g. **To lift to the left** — the patient places his left hand about a foot away from his side and a little in front of the hip joint.

Leaning well forwards he pushes down on his hyperextended elbows, compensating for the paralysed triceps, and degresses his shoulders. At the same time he rotates his head and shoulders to the opposite side, i.e. the right, lifting himself to the left.

To get from lying to sitting without using a monkey pole or other aid:-

Starting with his arms to one side the patient flings his head, arms and shoulders to the opposite side, for example, to the left, with **such impetus** that he throws himself on to both elbows.

Leaning well over the left elbow he moves his right arm over to the right and balances on both elbows.

Keeping his head flexed, and shoulders protracted, he balances on the left elbow and flings the right arm behind him.

Transferring the weight to the right arm he flings the left arm behind in a similar manner.

Then he 'walks' his hands towards his body until his weight is over his legs.

Transfers for all patients with spinal cord injury fall into 3 categories:

(a) Those in which the feet are lifted and the trunk moves horizontally, e.g. chair to bed. This is the most stable method and therefore the easiest, but it requires strength.

(b) Those in which the feet are kept down and the trunk is moved horizontally, e.g. chair to toilet. These need skilled sitting balance.

(c) Those in which the feet are down and the trunk moves vertically, e.g. chair to floor. These are the most difficult requiring a high degree of both balance and strength.

Patients with lesions at C5/6 can usually accomplish group (a), i.e. chair to bed and car, but not usually any in categories (b) or (c).

To Transfer to the Plinth

3 manoeuvres are involved:

To bring the buttocks forwards in the chair to avoid lifting over the wheel.

The patient places his left hand behind his hip and pushes it forward either with the forearm pronated and using extensor carpi radialis, or with the forearm supinated and using biceps.

He then either repeats the procedure on the right or uses both hands to push both hips forwards at the same time.

To lift the legs

Hooking the right elbow behind the right chair handle for balance he places his left wrist under the right knee and lifts the leg.

He holds the right leg flexed by resting his left hand on the right armrest, and then changes the hand which supports his knee, to free the left hand to push the foot on to the plinth.

The left leg is lifted in a similar manner, and crossed over the right.

Lastly:

To Transfer The Trunk

He gives a series of lifts as practised on the mat, until he transfers his trunk to the plinth.

Patients at this level can **transfer into a car.** Most find it easier with a sliding board. During the transfer the trunk needs to be so flexed that the nose is almost on the steering wheel at the moment of lifting. They can drive a car with automatic transmission and especially adapted hand controls.

These young patients are often very inventive — one such patient is keen on clay pigeon shooting. He has found a method of supporting the barrel of his gun by means of a pole and spring and adapted the release so that he can fire it with his mouth.

And he even wins!

Wheelchair Management is limited, to pushing over smooth surfaces, turning round and going up and down small inclines.

To turn now to the group with lesions at:

C7 These patients have control over the elbow and wrist joints, as triceps and the wrist flexors are both innervated. Aside from this they fall into two groups — those with **little or no** finger movement, and those with **good hand function.**

Building on the activities achieved by the patient with a lesion at C5/6, the C7 lesion can dress the lower half of his body. Those without finger movement **cannot** look after their own bladder and bowels, they cannot put on the condom urinal or insert suppositories satisfactorily. Those with good hand function will be independent in this respect.

Transfers

Group (a) transfers, chair to bed and car, can be accomplished easily and most can transfer with the feet down

to toilet, and easy chair, and to the bath, usually finding it easier over the bath end.

They can turn independently in bed, positioning the pillow between the knees.

Wheelchair Management

These patients can manage the wheelchair more efficiently, being able to remove the footplates and pick objects up from the ground. They can manage over uneven ground and even 'bounce' the chair over small elevations.

Gait

The patient with a lesion at C7, with or without hand function, can support himself standing between parallel bars, and may walk in bars.

The next group is those with injuries between.

C8-T5 spinal segments.

This group of patients have good hand function but trunk control is limited as the abdominal muscles are paralysed.

They are completely independent in caring for the body, including caring for the bladder and bowels.

Transfers

All transfers including those in group (c), i.e. chair to floor and chair to bath can be mastered.

Wheelchair Management

There is total control of the wheelchair including balance on the rear wheels.

Gait is not usually **functional** for these patients but most learn to walk well in bars or on a rollator to gain all the usual benefits, help to minimise osteoporous, prevent contractures, etc.

Groups T6-T9 and T10-L1

The main difference between the last two groups, i.e. those with lesions between T6-T9 and those with lesions between T10-L1, is in the power of the abdominal muscles, and the only real difference in the activities of daily living is in relation to gait, except, of course, that all activities are easier and speedier for the group with normal abdominal muscles.

Both groups should be able to walk independently on crutches, be able to exit from the chair on to crutches, and to go up and down stairs using one rail and one crutch.

Although some of the T6-T9 group certainly use their walking for functional purposes, it is true to say that **for the most part** only those in the T10-L1 group have a really functional gait.

If gait is to be functional it must be speedy. Therefore swing-through gait is essential even for the very young. In our experience patients who have no speed when walking will give it up.

For the patient with a functional gait it is useful to be able to get to and from the floor on to crutches.

To get up from the floor

The patient positions his crutches with the tips forwards and in front of his head.

He puts his hands through the forearm supports and pushes up on his hands, using his abdominal muscles at the same time to control the pelvis and prevent his legs from sliding backwards.

He walks his hands towards his feet trailing the crutches. When his weight is over his feet, and the patient really needs to push his bottom backwards, he lifts one crutch (right) and puts his weight on it. He balances on the right crutch and positions the left crutch.

With the weight on both crutches he walks the crutches towards his feet until he is standing upright.

One of our patients with a lesion at T11, recently said that the two most important things he had learnt was to balance on the rear wheels and to be independent on crutches.

This man is an oceanologist who has returned to his job, and in spite of his paralysis, drives his one-man submarine, and goes aqua-lung diving to a depth of 100 ft. He travels all over the world by himself, walks into 'planes, wheels his chair over sand and even into rivers when necessary.

Few people have his requirements in relation to mobility in the community, but surely the challenge of rehabilitation is to fit the patient to fulfil his particular role in the world.

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