RECONSTRUCTIVE SURGERY IN POLIOMYELITIS

by Mr. R. P. Lancaster, F.R.C.S.

An address given at S.A.S.P. Council Meeting, East London, September, 1957.

I feel honoured, Madam Chairman, to be invited to read a Paper before such an august body as the South African Society of Physiotherapists. Having, however, been an Honorary Vice-President of the Border Branch of your Society, I feel that I am one of you. More over, Physiotherapists and Orthopaedic Surgeons work together as a team and I am glad to say that in East London we are happily married.

It is only fit and proper that there should be a maximum amount of co-operation between us and nowhere is this team spirit shown to better advantage, than in the management and treatment of cases of Poliomyelitis. Last year, we experienced a severe epidemic of Poliomyelitis which strained our resources to the maximum. I wish to place on record the excellent work carried out in East London and Kingwilliamstown by all our Physiotherapists. I am grateful for the co-operation I received. The recovery of patients with the minimum number of deformities is due to their skill.

Poliomyelitis is not a new disease. It has existed since early civilisation, as borne out by Hieroglyphics carved in stone on the monuments and temples of ancient Egypt. Enormous advances have been made in the proper understanding of the disease in recent years and most fortunately, a mode of control by vaccination has been evolved. Various observers in Britain, South Africa and America feel that about 80% immunity is conferred on the population by vaccination. This is most gratifying. Perhaps, one day, even more effective control will be obtained and then Poliomyelitis may join the ranks of other plagues that once have been, at least in the Western civilised countries.

Poliomyelitis may be said to have four stages:—

1. The prodromal stage, when the individual is incubating the disease.
2. The stage of acute onset, when paralysis ensues.
3. The stage of convalescence, when the acute illness has subsided.
4. The stage of residual paralysis.

We, as Physiotherapists and Orthopaedists, are concerned with the last three stages. Our job is manifold. We must always remember that Poliomyelitis is an exhausting ailment, physically and psychologically and we must in our endeavours to improve body function, be mindful of the mental state of patients and throughout treatment, be kind, courteous, considerate, patient and encouraging. The morale of the patient must not be allowed to flag.

Those who have escaped contact with the crippled, do not appreciate the mental anguish they suffer. Shakespeare has captured this anguish in the monologue of Gloucester, when in Richard III he exclaims—

"Cheated of feature by dissembling nature,
Deformed, unfinished, sent before my time,
Into this breathing world, scarce half made up,
And that so lamely and unfashionable,
That dogs bark at me as I halt by them."

Although the Orthopaedic Surgeon is responsible for the direction of stages 2, 3 and 4, the Physiotherapist is the one most intimately concerned with the actual management and treatment of the case.

In stage 4, however, when the residual stage of the disease has been well established and improvement in muscle power can no longer be expected from conservative treatment, surgical measures should be contemplated. This stage is seldom reached before two years have elapsed following the onset of paralysis. Prior to that, deformities may arise if treatment is neglected. In this case, surgery may occasionally be necessary to relieve the overstretching of the paralysed or weakened muscles.

Fig. I
Azarial Khokhotho—Polio (Before treatment).

In the time at my disposal, it is quite impossible to run through the gamut of Orthopaedic procedures which may be required for rehabilitation of patients suffering form Poliomyelitis. It must suffice for me to outline the broad principals of reconstructive surgery and thereby show what can be done for these patients.

Deformities.

Deformity may result from the effects of gravity, faulty posture, unrelieved muscle spasm or muscle imbalance. With skilled nursing and correct Physiotherapy, deformities should rarely occur, at any rate in the limbs. Splints should be utilised where necessary and joints must be put through their full range of movement when spasm has subsided, aided, if necessary, by warmth, hot baths or even by the use of anti-spasmodic drugs.

I wish to draw your attention to the deforming force of the Ilio-tibial band. As you, no doubt, remember, this band arises from the crest of the Ilium. On the lateral aspect of the thigh, it is continuous with the lateral inter-muscular septum and hence is attached to the femur. at it's lower end,

Fig. II
Azarial Khokhotho—Polio (after treatment).

it is inserted into the outerside of the tibia. If there is spasm of the biceps, Glutei and Tensor Fascia Femoris and a complete range of passive movement of the hip and knee is not maintained, flexion, abduction and external rotation contracture of the hip may arise, genu valgum and flexion contracture of the knee, external tortion of the tibia and femur and lastly, pelvic obliquity with scoliosis.

In a flail leg, gravity tends to externally rotate the leg.

To prevent this, I make a light plaster splint extending from the thigh to the toes with a transverse bar at the heel which prevents the limb from rolling out.

If deformities are recent, conservative measures, such as, splinting, traction or manipulation may relieve them. If soft tissues are contracted, tenotomies, tendon lengthening procedures, fasciotomy and capsulotomy may be needed. When deformities are longstanding, the bones may be altered in contour and osteotomies will be required.

Operative Measures.

Operative measures for the residual stage of Poliomyelitis are designed:

1. To correct deformities including discrepencies in leg lengths.
2. To re-establish muscle power.
3. To stabilise relaxed or flail joints.

Before operation is undertaken, the Surgeon must anticipate the possible effect of a contemplated procedure and a mental picture of the post-operative condition of the patient must be created. It is not enough for one to say that because the patient has a specific deformity that a standard operative procedure should be undertaken to rectify it. For instance, lengthening the Tendo Achilles is good policy for an equinus foot, but a patient with paralysis of the Quadriceps who has an equinus deformity of the foot may be able to get around reasonably well, if he has a powerful Gastrocnemius which is able to stabilise the knee through the origins of the muscle from the femoral condyles. If the Tendo Achilles is lengthened in such a patient, he may no longer be able to walk unaided and a caliper may have to be prescribed.

Tendon Transplantation.

Tendon transplantation or transposition is the most useful to restore a lost functional capacity. Careful judgement must be exercised, in the selection of the tendon used for transference.

Certain postulates must be made.

1. The tendon must have adequate power.
2. It must be inserted in a comparatively direct line, from its origin to its insertion.
3. It must lie in a sheath or in fat to permit correct gliding.
4. There must be no deformity of the joint over which the new transplant passes.
5. The tendon must be under correct tension.

I wish to illustrate the use of this type of operation by a few examples.

Clawed Toes.

Firstly, it is a useful procedure in the treatment of clawed toes. Clawed toes are due to overaction of the Long Extensors or weakness or paralysis of the Flexors or Intrinsic muscles of the toes. The operation which I carry out consists of making incisions over the dorsal aspect of the toes, across the metatarso-phalangeal joints, dividing the insertion of the Long Extensor tendons from the phalanges and freeing the tendons back to the region of the metatarsal necks. A hole is then drilled through the neck of each metatarsal, the tendon is passed through the hole and sutured to itself, the foot being kept at a right angle and the tendon being pulled through the hole under tension. The interphalangeal joints are arthrodesed by excision of the cartilage and fixing the phalanges with short lengths of Kirschner wire. The foot is placed in a padded Plaster of Paris cast which is maintained for about a month, when the wires are removed from the toes.

Physiotherapy is then instituted. The Long Extensor tendons act as a sling which pull up the metatarsals, re-creating a transverse arch.

Dropped Foot.

In a drop foot deformity due to paralysis of the Tibialis Anterior, if the Tibialis Posterior is powerful, I transpose the the insertion of this muscle.

I do so by first making an incision over its insertion into the navicular and free it with special tendon strippers as far as the medial malleolus.

I then make a second incision over the anterior surface of the lower third of the lower leg and work my way between the tibia and fibula till I reach the interosseous membrane which I incise. The tendon of the Tibialis Posterior, which as you remember lies in the posterior compartment of the leg, is found and then brought through the opening in the interosseous membrane to the anterior compartment of the leg.

A third incision is then made on the dorsum of the foot towards it's medial aspect and the sheath of the tendon of the Tibialis Anterior is opened. Using tendon transplantation forceps, I insert this into the sheath of the Tibialis Anterior till it emerges at the second incision. The end of the tendon of the Tibialis Posterior is now grasped and drawn down through the sheath, emerging at the dorsum of the foot.

A hole is made through one of the bones in the area and the tendon is now passed through this and sutured back on itself with the foot in dorsi-flexion and slight inversion. A

plaster cast is applied to the foot and lower leg and maintained for about a month.

At the end of this period, the patient is referred back to the Physiotherapist for re-education of the transplant. In addition to exercise, Faradic stimulation is often necessary. If the transplant is of normal strength or near normal, the patient is fully able to dorsiflex the foot and also to invert it.

Paralysed Quadriceps.

An operation which often proves most useful is transplantation of one of the Hamstrings into the Quadriceps, when that muscle is paralysed, in order to give increased stability to the knee. If the Hamstrings are well developed, utilising only the Biceps Femoris is enough. If both the Semi-tendonosus and the Biceps are utilised and the Gastrocnemii are not well developed, genu recurvatum will arise.

Paralysed Biceps.

Lastly, an example in the arm. When the Biceps is paralysed and the patient has well developed wrist and finger flexors, Steindler's operation is most useful. This consists in transferring the origin of the Flexors of the wrist and fingers together with a small flake of bone to the upper portion of the supra-condylar ridge and fixing the fragment of bone to the humerus. The Flexors now arise above the elbow joint and pass in front of it. Hence they must flex the joint.

Tenotomies and Fasciotomy.

Tenotomies and fasciotomy are frequently carried out in conjunction with other operations.

Example 1: In pes cavus, Steindler's operation of stripping the plantar structures off the os calcis is often done in combination with a wedge tarsectomy.

Example 2: I have already referred to contracture of the Ilio-tibial band and the Glutei which will give rise to flexion and abduction deformity of the hip. An excellent method of correcting this deformity is by carrying out *Soutter's Fasciotomy*. This consists of making an incision along the anterior portion of the crest of the Ilium, dividing the Sartorius at it's insertion and stripping off all the Abductors from the crest of the Ilium, working one's way down to the Rectus Femoris and if necessary, even opening into the capsule of the hip joint itself. To complete the procedure and to prevent the prominance of the Iliac bone, the crest of the Ilium itself is frequently exercised. I then make use of the Dame *Agnes Hunt method* of correcting flexion deformity, by applying a Plaster of Paris spica to the opposite leg, the hip on this side being flexed with a view to flattening the lumbar spine. The operated hip is then placed in a Thomas splint which is gradually lowered, until all the tissues in the front of the hip are thoroughly stretched when the plaster spica is removed from the opposite leg.

We carry out large numbers of these operations every year on the Bantu and convert many of these patients into useful and erect citizens where before they were either bed-ridden or crawled about their kias on hands and knees. (See photographs).

Stabilisation of Joints.

The purpose of foot stabilisation in Poliomyelitis is to cause a reduction in the number of joints which weak or paralysed must control. The operation of foot stabilisation should not be undertaken before the age of 10 as the tarsal bones consist chiefly of cartilage and there is relatively little cancellous bone to ensure fusion. Furthermore, growth disturbance may occur if the operation is undertaken at too early an age.

There are different types of foot stabilising operations depending upon the muscle balance of the ankle and the foot.

Ryerson's Triple Arthrodesis.

For instance, if the dorsiflexors and plantarflexors are equally developed and there is lateral instability due to paralysis of the invertors and evertors, *Ryerson's Triple Arthrodesis* is done. This consists in erasing the articular cartilage between the talus and os calcis, between the talus and navicular and between the os calcis and cuboid.

Dunn's Arthrodesis.

If, however, the calf is weak, it is better to carry out *Dunn's Arthrodesis* which consists in removal of the scaphoid bone itself permitting the talus and hence the ankle joint to be brought nearer to the centre of the foot. This procedure allows a relative lengthening of the posterior lever arm of the foot and hence the weakened calf muscle put to a greater mechanical advantage.

A satisfactorily stabilised foot should look natural in shoes, should not invert or evert on walking and a brace to control the foot should not be necessary.

Arthrodesis of Knee.

If a knee is flail and no muscles are available for tendor transference, either a caliper or an arthrodesis of the knee joint is indicated. In children it is always best to use a caliper, at any rate, until they have reached a fairly mature age. In the adult Bantu, especially those who live in the "Bundu," arthrodesis is often a wise procedure, for, if the patient is given a caliper, he frequently does not wear it, or, it is always breaking down.

The operation which I now use esclusively consists in excising the articular cartilage and exposing the cancellous bone. If there is a deformity of the knee, enough bone is removed to correct this and on occasions, a lengthening of the Hamstring tendon is also done. The knee is put up in about 15 degrees of flexion and a Charnley-Key splint is utilised. This consists of the introduction of Steinman Pins through the femur and the tibia, the ends of the Pins

Fig. III
Wilson Bingiwe—Polio
Walks on all fours. Gross deformities of both hips—Before Treatment.

being attached by telescopic tubes which on tightening the raw opposing surfaces of the bones causes compression and, therefore, more rapid union. Although we remove the splint in a month and keep the patient in plaster up to three months, it has been shown that many of these knees are clinically solid at the end of a month.

Stabilisation of Hip.

In the case of the flail hip which is not splinted and in which faulty postures are allowed to develop, the leg may come into marked adduction and with the stretching of the joint capsule and surrounding muscles, a pathological posterior dislocation of the hip occurs. An excellent way of giving stability to the hip is to carry out a sub-trochanteric osteotomy of the femur, the dislocation first being reduced by abduction of the leg. The shaft of the femur is then brought down to the neutral position and the two fragments, the upper still being held in an abducted position, are then fixed by a metal plate. A Plaster of Paris spica is applied until union is complete.

Scoliosis.

I have already referred to the tilt of the pelvis occasioned by contracture of the Ilio-tibial band and how frequently *Soutter's* fasciotomy will correct this. If the scoliosis persists inspite of this measure, it will be frequently found to disappear when the leg is abducted. The method that we adopt to correct the scoliosis is to first screen the trunk and hips in the X-ray Department to ascertain the degree of abduction of the hip that is necessary to correct the scoliosis. Having ascertained the angle of abduction of the hip necessary to correst the scoliosis, a sub-trochanteric osteotomy is carried out, a wedge of bone being removed from the medial aspect of the femur equal to the degree of abduction of the hip. The fragments are then plated in this position. Excellent results have been obtained by this measure.

Arthrodesis of Shoulder.

In a flail shoulder, arthrodesis is undertaken provided the Trapezius is not paralysed. One of the functions of the Trapezius is to cause rotation of the scapula and hence, if there is bony fusion between the humerus and the scapula, active contraction of the Trapezius will allow abduction of the arm to occur. If, in addition to the flail shoulder, the Biceps is not strong enough to flex the forearm against gravity, when arthrodesis is carried out, the arm should be put up in a few degrees of internal rotation, so that when it is abducted, gravity will assist the Biceps in flexing the elbow and permit the hand to be placed opposite the mouth. If the Biceps is completely paralysed and the Flexors of the wrist and fingers are powerfully developed, they can be shifted proximally as in Steindler's Operation to pass in front of the elbow and thus flex it. An alternative procedure is to utilise the sternal fibres of the Pectoralis Major which are transplanted into the Biceps itself.

If one is unable to make use of the Pectoralis Major and the Flexors of the foearm are not considered to be sufficiently strong enough to flex the elbow, consideration can be given to the ingenious operation devised by *Bunnell* whereby the sterno-mastoid is transferred into the Biceps. The muscle is detached from the sternum and the clavicle and elongated, by suturing a strip of fascia lata to it, so that it can be made to pass via a subcutaneous tunnel to the tendon of the Biceps in the region of the elbow. By rotation of the head and neck the forearm can be flexed. I have also undertaken one such operation, but although the new tendon could be definately felt and seen to contract, I did not place enough tension on the sternomastoid itself to enable it to flex the elbow joint. The patient, a Coloured adult, refused to let me re-operate exclaiming:—

"Wat sal dit help, Doktor, as ek my kop draai om my elmboog te laat buig. Ek sal nie 'n staat wees om te sien wat ek doen nie."

Fig. IV
Wilson Bingiwe—After Treatment.

Arthrodesis of Elbow and Wrist.

Instability of the elbow and wrist are best dealt with by arthrodesis if no tendons are available for transplant. The elbow should be put up at about 120 degrees and the wrist in about 10 degrees of dorsiflexion. These are the positions for optimum function.

Leg Lengthening and Leg Shortening.

If there is more than 2 inches of shortening in adolescence or young adults, consideration may be given to leg lenghtening, but it should be pointed out that the operation may be a formidable procedure, especially if the femur is being lengthened and a whole series of complications have to be considered.

1. Deformities of the foot, such as, valgus and equinus may arise. These are due to failure of the soft parts to lengthen proportionately to the bones.
2. Deformities of the knee—genu valgum and flexion contracture.
3. Stiffness of the ankle due to the tremendous pressure on the articular surfaces causing traumatic arthritis.
4. Bowing of fragments with mal-union or non-union.

5. Nerve complications, such as, paralysis of muscles or loss of sensation due to over-stretching of the nerves.

6. Disturbances of circulation causing oedema or even, occasionally, gangrene of a part of a limb.

7. Bone Infection.

Many surgeons, therefore, prefer to shorten the leg by re-section of bone or by epiphyseal arrest.

In Cape Town, *Bell* has evolved an interesting operation for equalisation of leg lengths. He operates on both femora, osteotomising the shortened bone and removing a complete section of the opposite femur roughly equal to the amount of shortening in the other leg. This segment of bone is left in situ under the muscles, while the main fragments are held together by a Kuntscher Nail until they have united.

In the interim, traction is applied to the osteotomised and shortened limb, by skeletal traction. When the fragments are distracted to the required amount, the patient is re-subjected to surgery, the section of the bone in the opposite leg is removed and transferred to fill the gap between the distracted fragments of the effected femur. The three fragments are now held in position by the insertion of a Kuntscher Nail. I have not undertaken one of these operations myself, but have seen the end results of three of Bell's cases and have been most impressed by this ingenious method of equalising the leg lengths.

No attempt should be made to lengthen a limb if the discrepency in leg length is such that it is known in advance that even after the procedure is complete, there will still be so much disparity that an appliance will never-the-less be necessary.

Shortening a normal limb by resection or epyphyseal arrest, however, must not be lightly undertaken for, inspite of every care, there is still the ever present risk of infection of bone and if this should insue, the end results might well be disasterous. If epiphyseal stapling is undertaken in a child who is unable to make a decision for himself, the problem should be thoroughly discussed with the parents and the pros and cons of lengthening as opposed to shortening must be raised and the potential complications pointed out.

Osteotomies of Bone.

Osteotomies of bone for the correction of deformity are frequently undertaken. I have already mentioned one or two examples. Supra-condylar osteotomy of the femur for genu valgum and wedge tarsectomy for cavus, varus and valgus deformities of the foot are frequently undertaken. These operations are usually extremely successful.

Conclusion.

I have spoken for long enough and in my talk have only mentioned a few of the many technical procedures undertaken to correct deformities which have arisen and to improve the function of a limb. The subject is too vast and I have only skimmed through some of the problems as encountered in the extremities, having largely ignored the varied and highly complicated problems met with in the trunk—problems, such as, scoliosis. Nor have I dealt with the procedures for the hands. The purpose of the paper, however, is to show what can be done by surgical re-construction, for those patients who are severly disabled by Poliomyelitis. By restricting his work entirely to the handling of Poliomyelitis patients, an Orthopaedic Surgeon can gain sufficient experience in almost all the surgical procedures dealt with in the whole field of Orthopaedics.

Treatment is usually prolonged, time-consumimg and exacting, but what greater reward can a man have than when a child who has been under his care for months or years and who has been subjected to many operations, stretches out his hand to the surgeon and says, "Doctor, you have made me walk."

Photographs lent by kind permission of "The East London Camera Shop."