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Orthotic Management of the Late Postpolio Patient[1]

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Since the introduction of a vaccine in 1954 by Dr. Jonas Salk, poliomyelitis has ceased to be the scourge that it once was in the western nations. This is not to say that polio is not still with us, for it is a very real presence in many parts of the world, and in the developed countries sizable populations affected in youth remain. It is this latter group that is the concern of this paper for it has been noted by a number of practitioners that an increasing number of older post-polio patients are seeking orthopedic solutions for their problems. The challenge presented by such a patient is a formidable one, and, while we can certainly not claim to have all the answers, we have garnered some experience and attempted to formulate guidelines which we herein offer for consideration.

Infantile Poliomyelitis is a viral infection that affects the anterior horn cells of the spinal cord resulting in flaccid paralysis but leaving the sensory system intact. It affects primarily the lower limbs. The two features, flaccidity and sensation, result in the common pathological picture regardless of the level of involvement. Good early management and the absence of spasticity has produced patients that are typically free of severely deforming flexion contractures and are able to adopt such compensatory movements as genu recurvatum and to otherwise make the best use of the remaining musculature.

Conversely, the lack of supporting muscles with their resilience and shock absorbing capacity implies that joints are prey to arthritic deterioration and the gradual stretching of ligaments, both of which may result in disabling pain. In a similar fashion sensation offers definite advantages and potential long term disadvantages. Unlike patients with injury to the spinal cord, the individual with polio is able to make optimum use of remaining muscles and thus a knowledge of joint positions to substitute for missing function. However, increasing deformity about the joints can result in pain and a decrease in function.

THE CLINICAL PICTURE

In general, postpolio patients are referred for one of two basic problems, although both as well as others are often present in the same patient. The first and possibly the easiest to cope with is pain. Pain can result not just from wear and tear, but also from angular deformity that unduly stresses supporting elements of the involved joint. It must be borne in

mind that these angular deformities are often of a functional nature. The goal in treatment is not to restore correct alignment, but to block the extreme of motion and reduce the pain to a tolerable level. Genu recurvatum is the best example of this principle.

The other broad category encountered is debility and an ensuing inability to cope as well as before. Frequently the increase in debility has been gradual and undramatic, and the patient complains of an increase in fatigue, unsteadiness, and experiences more falls than was the case formerly. In other instances the patient is seen under more dramatic circumstances in the aftermath of some recent illness or surgery (itself often times a result of increasing age) or after healing of a fracture (possibly a side effect of the unsteadiness cited above). In these instances, the loss in strength can be pronounced and is a considerable source of concern to the patient. In any event, this broad category of increasing debility is a difficult one to cope with and the goals must often be of a limited nature. It may well be that the only recourse is to stop motion at a joint so as to further compensate for a failing compensatory motion in order to increase safety and enable the patient to use available resources to a better effect elsewhere. In either category the problem for which help is sought is not necessarily in the most severely involved extremity, but in the so-called "sound side." The limb may be failing as a result of the high loads put on it over the years and the best treatment may well be to restore the more severely involved leg to a more functional state, thus relieving the "sound side" of its unequal share of the load.

As a result of their intact sensory system and capability for compensatory motions, when first seen patients may well relate a history of having discarded whatever orthosis had been provided previously or of retaining only a portion of it. This abandonment is generally described with pride as an example of recovery (as well as a benefit of tendon transfers and bone blocks) and of the patient's ability to find a satisfactory solution to his own problems despite the somewhat ineffectual, but well intentioned help of a clinical team years ago. When this attitude is coupled with the normal aversion to wearing an orthosis that is not strictly necessary, it is not hard to understand the anxiety and even outright hostility with which any suggestion that an orthosis may be needed is greeted. It is difficult to convince them that with age their stamina and strength have decreased, adversely affecting their ability to compensate. It is equally hard to convince them that whatever measure of deformity and pain they are experiencing is quite likely to progress with debilitating results unless some measure of prophylatic treatment is instituted and maintained. Winning their confidence and cooperation is a formidible obstacle that must be accomplished by the clinic team.

This discussion of the clinical picture is of a general nature and is compiled not just from our own somewhat limited clinical experience, but also from discussions with other professionals seeing similar numbers of patients. It is put forth, not as a totally accurate and all inclusive description, but as an orientation to a problem that is uniquely difficult and infrequently encountered by most clinical teams.

PRESCRIPTION PRINCIPLES

Orthotic prescription for the postpolio patient is a formidable problem, not only owing to the physical condition of the patient, but also because of the individual's past experience with orthotic devices.

The patient may have rejected all orthoses at some point in the past and may be unwilling to consider an orthosis now. In another instance, the patient may have worn one particular orthosis for years and be completely opposed to any change. This hesitancy is best overcome by citing the advances in materials and fabrication techniques that have been made and the potential benefits these changes offer. Orthoses fabricated from polypropylene, polyethelene, and aluminum joints around an individual mold taken from the patient's limb offer not just greater comfort, cosmesis, and improved control, but also lighter weight, an important consideration for those individuals with full sensation and decreased strength. In addition, that the shoe need not be an integral part of the orthosis is a telling point for it means that the patient will have a wider range of footwear available and will be able to change shoes with almost total freedom.

During the formulation of the prescription and the actual fitting process, the need for compromise and "tailoring" of the orthosis must be kept in mind. It is often difficult to determine the real needs of the patient and the practitioner may find himself imposing his misconception of the problem on the patient, to their mutual frustration. At all times the clinic team must be willing to sacrifice secondary goals in order to retain primary ones. Wearing of an orthosis implies not only acceptance of its advantages, but also its disadvantages and to win acceptance it is necessary to "maximize" the one and "minimize" the other. Some portion of the orthosis may not only be uncomfortable or cumbersome, but actually interfere with compensatory motions with disastrous implications. The need is to decide whether or not the offending portion can be sacrificed without adverse effects. This is nothing more than a reiteration of the principle that an orthosis should perform only the intended function and nothing more, but it cannot be emphasized enough when dealing with the postpolio patient.

The fitting process is likely to be a long and arduous one demanding much patience and tact from all concerned. A decision to fit the postpolio patient should not be taken lightly and the prescribing physician will spare both the orthotist and the patient needless frustration, expense, and inconvenience if he will first determine not just a real pressing need for an orthosis, but also a sincere willingness on the patient's part to accept such a solution. Moreover, everyone should know beforehand that success is not assured and when it is abundantly clear that a successful solution is impossible, they should be willing to face the facts squarely and call it "quits" on good terms.

CASE HISTORIES

The following case histories have been chosen to illustrate one or more points made in the previous discussion.

CASE NO. 1 (Fig. 1)

C.H. is a 24-year-old speech therapist with an onset of polio at age four. Despite general weakness, hip flexion contractures, and a lower-limb length discrepancy, she has walked with crutches and led an independent life. In the summer of 1977 she was seen by the prescribing physician, complaining of difficulty with gait, increased fatigue, discomfort in stance, and occasional buckling of the right knee. Examination revealed that her more involved side, the right, demonstrated shortening, subtalar inversion, and genu valgum and recurvatum. In

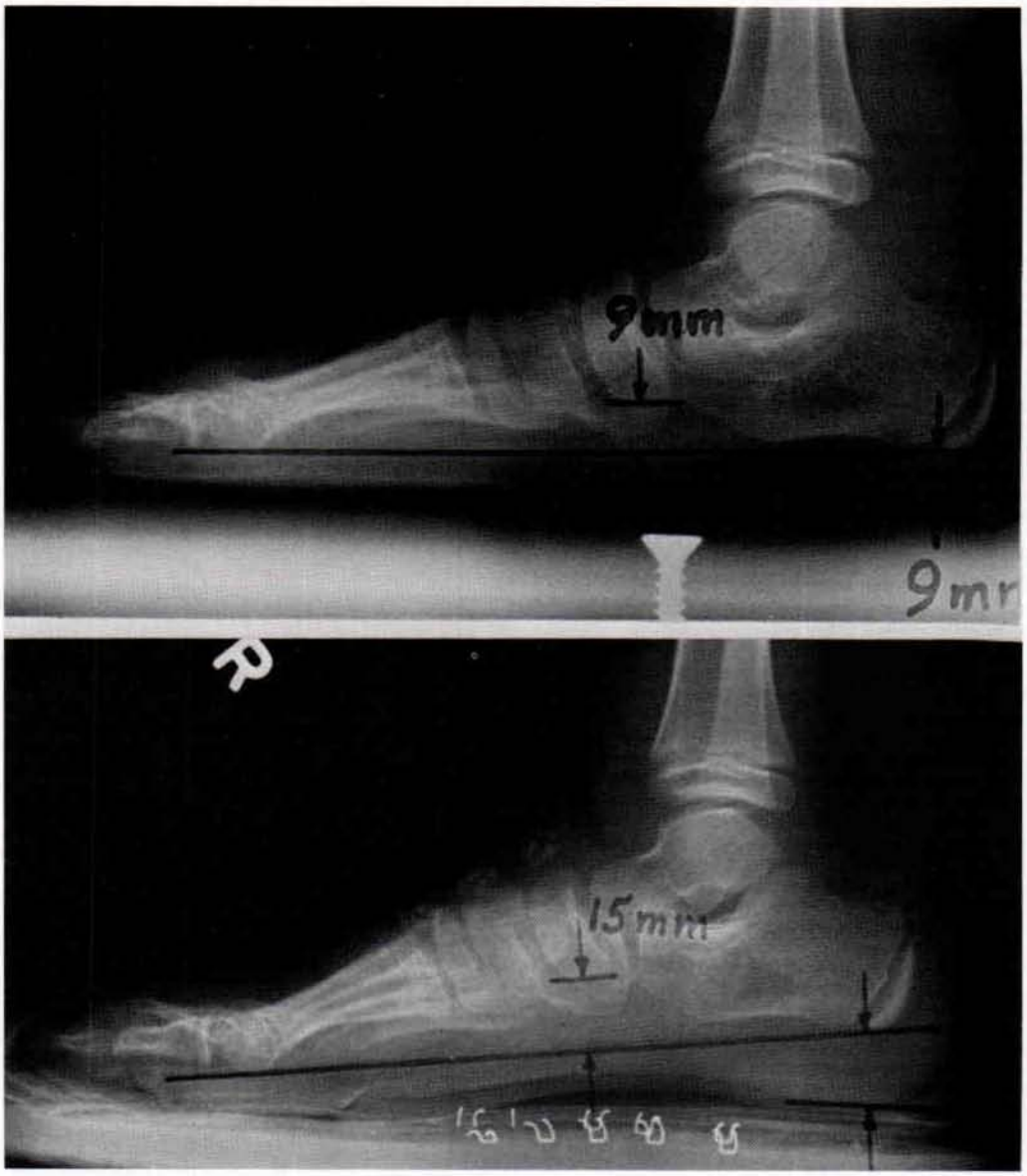

Fig. 1. C.H. with and without KAFO. Weightline visualization techniques demonstrate the improvement in alignment with a decrease of Genu Recurvatum. For an explanation of weightline visualization consult reference 7.

addition, it was determined that the left knee demonstrated recurvatum. Following examination in the Gait Clinic it was decided to fit the more severely involved, right, leg with a KAFO with offset knee joints and optional drop lock to support the ankle and limit the painful genu valgum and recurvatum. Following ini-

tial delivery of the orthosis the patient was seen a number of time for minor adjustments. At the last consultation, she was walking with a free knee and reported a cessation of pain in both knees. As a result, plans to apply an orthosis to the "sound" left knee were abandoned.

CASE NO. 2 (Fig. 2)

L.S., a 64-year-old male, was seen on referral to be fitted with a new orthosis lighter than the one he had been wearing for some 20 years. A printer by trade, L.S. had been fitted originally with an orthosis after a fall at work in an attempt to prevent reoccurrences and potential damage to the knee. Examination revealed that the residual effects of polio were essentially confined to the one limb and that the orthosis was forged of carbon-steel with partial ischial gluteal weightbearing, bail lock, and a sandal that fitted inside of the shoe. The patient's only real complaints with this orthosis were the bail lock which interfered with his pants and the need for shoe modifications to accommodate the sandal. A previous attempt had been made to fit him with a polypropylene orthosis without success. The patient stated that he felt insecure in this orthosis and objected to the drop locks. It turned out that his orthosis had been fabricated without ischial gluteal weightbearing and that the knee sagged into flexion on weightbearing. An impression was taken and a new polypropylene orthosis was fabricated, in which ischial

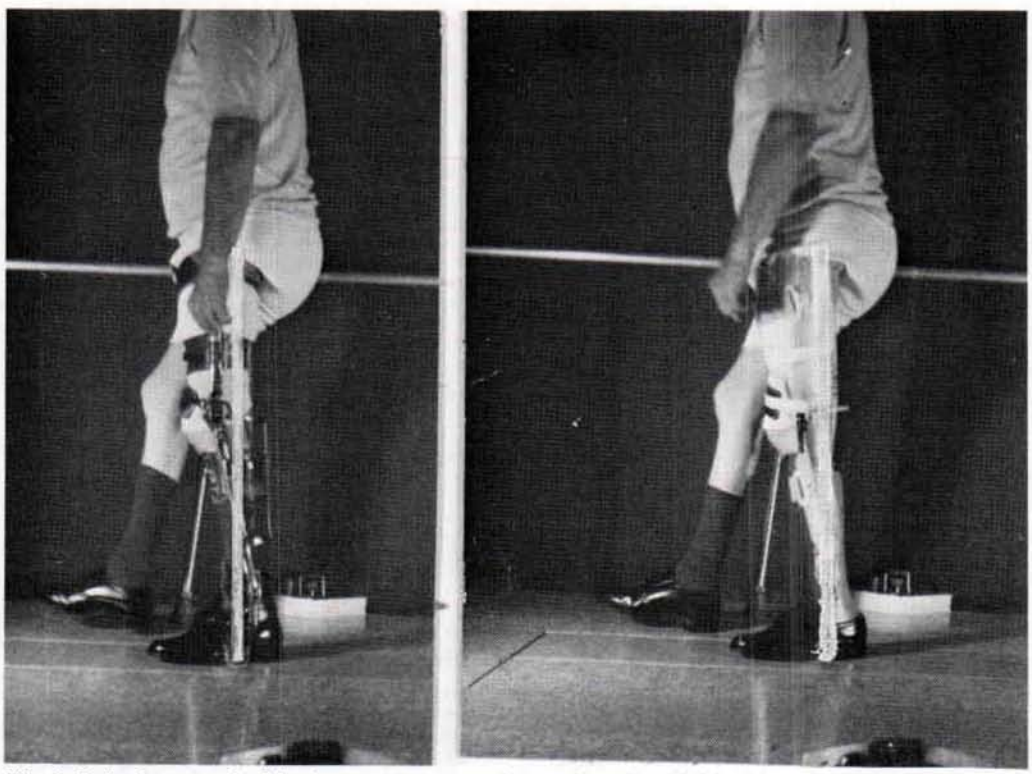

Fig. 2. L.S. photographed in the same instance of the gait cycle with his old steel orthosis and the new one fabricated of lightweight materials. Alignment is essentially unchanged as demonstrated by the position of the weight line relative to the limb.

gluteal weightbearing and a bail lock were incorporated. Considerable effort and several fitting sessions were necessary to adjust the KAFO to the patient's satisfaction. While he appreciated a decrease in weight, it was only after the new orthosis fitted as well as the old one that he preferred it to his original.

CASE NO. 3 (Fig. 3)

L.B., a 35-year-old female with a history of polio at age 12, was referred to us with a prescription for bilateral KAFO's to support her painful knees. She was ambulatory despite a pattern of such diffuse weakness that she was unable to rise from a normal height chair without assistance. Essentially, the only muscles better than trace or poor in the lower limbs were her toe flexors, and to walk she found it essential to wear shoes with high heels. The functional genu recurvatum that enabled her to walk had been causing an increase in pain just prior to her appearance at the clinic, and she was using a wheelchair more than before. Due to the unique nature of her gait pattern and the role played in it by the compensatory motions and her musculature, it was decided that it was vital to address only the specific complaint with as few side effects as possible. After gaining the physician's approval to a change in prescription, she was cast for bilateral supracondylar knee orthoses (S.K.O.'s) as described by Hans R. Lehneis. The intention was to block only the extreme of genu recurvatum and thus the pain without interfering with the vital function this compensatory motion played in her life. As a result of the high loads generated in the soft tissues and the shrinkage that resulted it was necessary to see the patient persistently over a period of six months for adjustments before a stable state that was both comfortable and functional was achieved. Follow up after a year and a half reveals that she is still wearing the orthosis.

Fig. 3. L.B. photographed with weightline visualization techniques and ambulating with bilateral supracondylar knee orthoses. Recurvatum and the torque generated by the force line in the right knee are readily appreciated.

CASE NO. 4 (Figs. 4 and 5)

M.R., a 59-year-old male who had polio at age three, was seen for treatment of progressive genu valgum and recurvatum in the right leg. He has worn a Swedish knee cage unsatisfactorily for this condition, and has walked for many years with crutches. The condition has worsened since he fractured his left hip two years before presenting. In addition there is marked involvement of both feet. After discussion with the patient and the clinic team a plastic impression was made and a KAFO with single axis free flexion knee joints was fitted. During the initial fitting it was necessary to extend the trimlines about the knee and add a broad leather band to win patient acceptance. Subsequently he was seen because the orthosis felt heavy (2½ pounds), cumbersome, and interfered with driving and stair climbing. To meet these objections all function about the ankle was sacrificed, rendering the ankle portion flexible and purely a suspensory component. Material was removed where possible in other areas, and the broad leather strap posterior of the knee was replaced by a one-inch-wide Dacron strap that passed in an oblique fashion from one side over to and about the joint on the opposite side of the knee and back again (Fig. 5). This idea for knee control was borrowed from Robert Nitschke's design for a single upright KAFO, and the patient found it

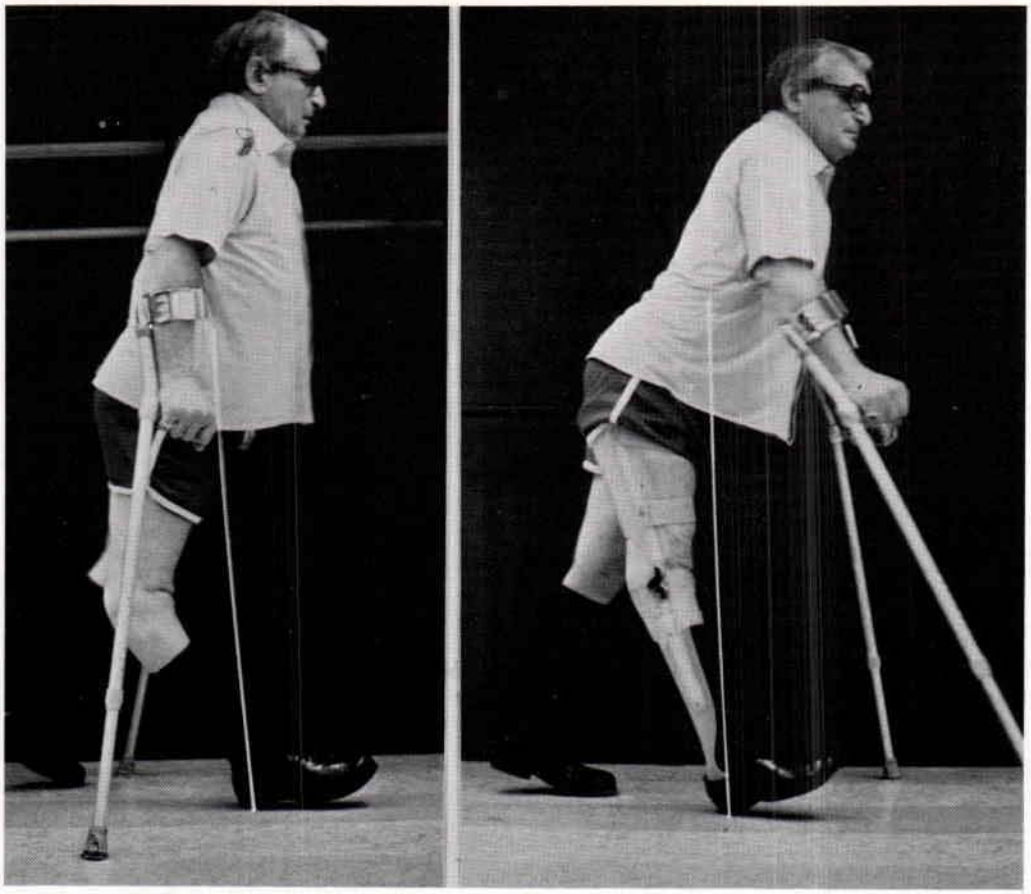

Fig. 4. M.R. ambulating in walkway without and with the orthosis.

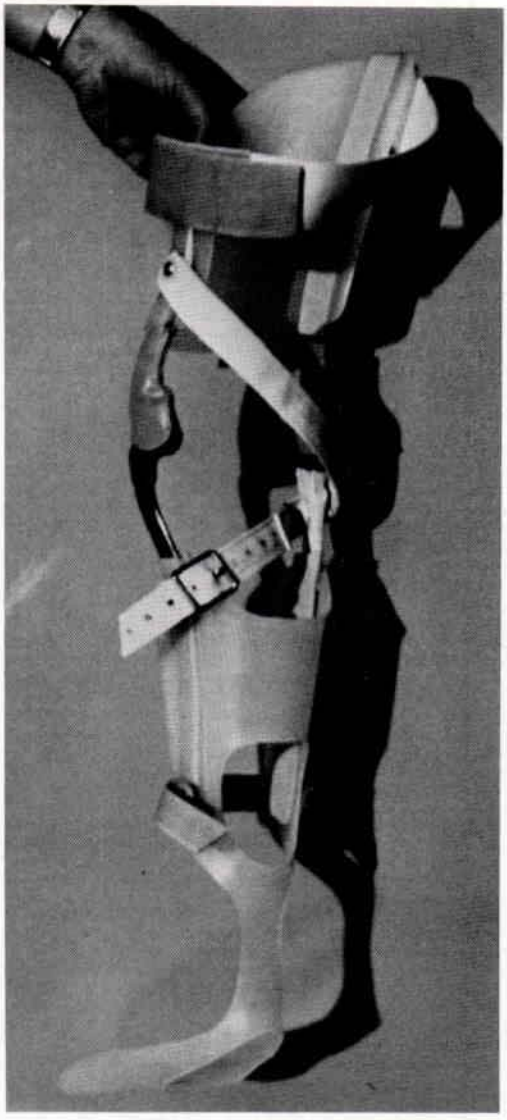

Fig. 5. Ultimate configuration of M.R.'s orthosis. Proximal thigh section covers the anterior portion of the limb and at the patient's request the heel portion of the foot plate has been eliminated, without deleterious effects. The ankle portion has been reduced to a very flexible leaf spring and serves only for suspension of the more proximal portions of the orthosis.

more comfortable than the previous arrangement. He has been seen since for adjustment to the ankle and addition of a strap over the distal tibia for proper control of the genu recurvatum which the patient found to be comfortable and tolerable. The net result after some effort is an orthosis that specifically controls the undesired motion at the knee and sacrifices any other function in order to win the patient's acceptance. Subsequent to the original fitting period the patient was seen for replacement of the distal lateral upright which had broken from the stress applied to it by the oblique strap. While he had formerly been reluctant to wear an orthosis the patient now stated that he was unable to do without one and found the present KAFO of considerable benefit.

DISCUSSION

That postpolio patients are currently presenting with increased muscle weakness, skeletal deformity, and joint pain which is interfering with a previously achieved level of independence is corroborated in several other documented case studies (1,2,3). A common explanation for this functional deterioration has been that paretic or flail musculature cannot provide adequate joint and long-bone protection and thus leads to ligamentous laxity, articular damage, deformity and pain. This rationale has been applied regardless of the etiology for these clinical symptoms, e.g., inadequate surgical or orthotic intervention in early management, lack of appropriate follow-up, and chronic stress on inadequate tissues. However, a review of the literature yields very few attempts to correlate these or any other etiological factors to the clinical manifestations. Moreover, the studies cited seriously question the validity of this common clinical assumption (4,5,6).

The additional muscle weakness with which these patients present has been attributed to chronic stress on inadequate tissue which leads to trauma and fatigue. In an attempt to relate this etiology to the latent weakness, Campbell, Williams, and Pearce presented five case studies and reviewed 83 similar cases presented in the literature (4). The only conclusion drawn from this study was that the latent weakness followed a benign course. Examination of the sites of the involved muscles did not justify the selection of stress as the sole causative factor. Additional explanations for this muscle weakness included reoccurrence of the original disorder, persistence of a latent virus or a secondary biochemical disorder.

An explanation used to explain the presenting symptoms of deformity and pain is that prior surgical intervention is no longer adequate leading to unwanted joint motion and degenerative joint changes. Robins examined the late results of triple arthrodesis, a standard operation used to stabilize the foot in patients with poliomyelitis (5). Sixty feet of poliomyelitis patients who had undergone surgery ten to twenty-four years previously (mean = 19 years) were examined. Robins reported only a low incidence of lateral ankle instability indicating the long-term success of this intervention and a striking absence of osteoarthritis of the ankle joint.

Glynn, et al (6) examined the presence of osteoarthritis in the lower limbs of patients with poliomyelitis. The hip and knee joints were examined in 100 patients who had been diagnosed as having poliomyelitis at least ten years previously. Patients selected had primary involvement in one lower limb, wore a "long-leg" orthosis, and ambulated regularly. Both lower limbs of each patient were examined and a similar number of age and sex-matched healthy subjects were used as controls. The results indicated that the osteoarthritis demonstrated radiographically in the joints of the more involved limb was considerably less than that found in the stronger limb. This could be explained by assuming that the stronger limb was absorbing most of the weight, thereby sparing the more involved limb. However, the incidence of osteoarthritis was similar when comparing the radiographic findings of this limb to the lower-limb joints of the control sample. The explanation that the polio patients generally ambulate less than healthy subjects and therefore require longer to develop degenerative problems was also examined. There was no indication that the patients who were more active had any increased incidence of osteoarthritis when compared to those patients who walked less frequently; furthermore, these patients were presenting with the symptoms generally ascribed to degenerative joint disease, e.g., pain and deformity. These data refute the common assumption that chronic stress on a muscularly inadequate limb leads to osteoarthritis. In fact, the incidence of osteoarthritis was significantly lower than that found in the age and sex-matched healthy control sample. These findings led the authors to suggest that the residual paralysis following poliomyelitis in some way hinders rather than promotes the development of osteoarthritis.

This cursory review of the literature raises questions of a fundamental as well as a clinical nature. It appears that the underlying mechanisms responsible for the clinical symptoms merit further investigation and should include the following: 1) the etiology of the latent muscle weakness; 2) the physiological mechanisms responsible for the apparent prevention of osteoarthritis in this population; 3) the source of the persistent complaint of joint pain in the absence of any degenerative disease; 4) the implications of these findings to other disease cate-

gories which produce chronic disability, e.g., cerebral vascular accident, cerebral palsy, spina bifida. Furthermore, although an increasing number of postpolio patients are returning for clinical treatment, there is a surprising dearth of literature to which the clinician can refer. No literature was found which presented a comprehensive clinical picture of these patients nor were there articles to suggest a management regime. Perhaps an investigation into the long term effects of orthotic or surgical intervention for this patient population would provide insight into the early management of other disease categories which produce chronic disability.

Footnotes

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