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## THE INVOLVEMENT OF JOINTS OF THE EXTREMITIES FOLLOWING TRAUMA IN OTHER AREAS\*

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The involvement of joints of the extremities in relation to trauma can be divided into two sections: (1) the joints have been injured directly by the trauma, and the post-traumatic changes are, therefore, the result of that direct injury; (2) the joints have not been involved directly in the injury, and the changes in the joints are secondary to the injury elsewhere in the extremities or trunk. It is this second group in which the joint involvement is secondary to injury elsewhere in the extremities that we shall consider at this time.

The group of joint involvements secondary to injury in other parts of the extremities is impressive. It includes reflex sympathetic dystrophy, arthofibrosis and adhesive pericapsulitis ("frozen joints"), muscle atrophy with secondary loss of motion of the joints, traumatic arthritis, limitation of motion of the joints, changes concurrent with "Volkmann's ischemia," myositis ossificans, and chondromalacia patellae.

Reflex sympathetic dystrophy, which is recognized in its most extreme form as "Sudek's atrophy," is that condition manifested by pain in the extremity, loss of motion of the joints of the extremity, atrophy and fibrosis of the muscles with atrophy of the small bones of the involved extremity, and subsequent fibrosis of the capsular structures about the joints. This is seen most frequently in the hands and feet; and may occur following even minor trauma, such as contusions, of the forearm, hand, ankle, or foot. It is a condition extremely distressing to both the patient and his doctor; and when it has reached its peak of development is often irreversible. To prevent this complication it is necessary to recognize the onset at the earliest time; and to do this one must be immediately alert to any irregularity in the symptoms of pain in the injured extremity. It is most frequent after such injuries as a "Colles's" fracture of the wrist, sprain of the ankle, or fractures about the ankle joint. It manifests itself by intractable, otherwise unexplained pain in the hand or foot of the injured extremity, frequently in that type of patient who tends to be classified as a "chronic complainer," and the symptom of pain is out of proportion to that which should be expected. This pain, with swelling of the involved extremity—particularly of the fingers or toes—and some change in the temperature of the digits are early signs. Treatment is not always successful, but requires immediate and energetic use of sympathetic blocks—either cervical or lumbar for the corresponding upper or lower extremity—in association with the use of vasodilator drugs such as Priscoline, systemic Cortisone, and intensive active motion of the involved digits.

Arthofibrosis and "adhesive pericapsulitis"—commonly called "frozen joints"—are more frequent but equally distressing joint complications of contiguous

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trauma. These are seen in injuries about the cervical spine in which there is protective immobilization of the shoulder joints in relation to referred pain; in shoulder joints in which motion has been limited because of immobilization of the upper extremity by plaster casts in the treatment of fractures of the elbow, forearm, or wrist; and in knees when the lower extremity has been immobilized in treating fractures of the hip, femur, or tibia in hip spica or long leg casts. Involvement of the other joints of the extremities with this condition is less frequent. It should be prevented by as early active—and, if necessary, passive—motion of the respective joints as can be carried out without endangering the treatment of the fracture. Active abduction and circumduction exercises to the shoulder concurrent with the immobilization of the arm for the treatment of the fracture is essential; and these exercises should be continued until there is no longer any possibility of involvement of the joint. Similarly, elbow joints should be removed from immobilization as soon as treatment of the fracture permits—and this is particularly true of fractures about the wrist when short arm casts permitting active motion of the elbow should be instituted as soon as feasible. Also, finger joints should be kept actively and passively mobile throughout the period of fixation of the rest of the extremity. Following removal of the immobilizing plaster cast, intensive physical therapy to all the joints of the extremity should be carried out. In like manner, treatment of the knee to prevent stiffness of this joint from enforced immobilization should, like the shoulder, elbow or wrist, be carried out by active mobilization and physical therapy. Associated with this type of involvement of the knee joint there occurs occasionally chondromalacia patellae. This may respond to conservative measures, but if sufficiently symptomatic, may require correction by surgical procedures.

Loss of functional motion of the joints of the extremities, particularly extension of the knee, is often associated with atrophy of the musculature from disuse during immobilization of the extremity. Most frequently so involved is the quadriceps muscle mechanism in the lower extremity. This can, to a great extent, be prevented by the institution early of active quadriceps muscle strengthening exercises even while the extremity is immobilized.

In lower extremities in which a fracture of a long bone has resulted in malalignment or shortening of the bone there may result a poor weight-bearing mechanism of the adjacent joints, particularly the knee or hip joint, or the spine with a resultant traumatic arthritis developing in these joints. This is a difficult condition to prevent; but should be approached by attempting to equalize the leg lengths or to correct for the malalignment by the use of conservative measures ("lifts" to the shoe on a short leg) or the surgical correction of the deformity. In older patients with preexisting degenerative joint changes—and in individuals in any age group with preexisting rheumatoid arthritis—there may be a marked exacerbation of pain and limitation of motion from enforced immobilization of such joints associated with treatment of injuries elsewhere in the extremity. This difficult problem can be combatted only by the early, functional motion of these joints.

Limitation of motion in elbow joints resulting from mechanical malposition of

fracture fragments of the radius and ulna, with or without radio-ulnar synostosis, preventing full pronation and supination as well as flexion and extension must be recognized at the time of initial treatment of the fracture, and prevented by correct anatomic alignment of the fracture fragments.

Involvement of elbow, wrist, and interphalangeal joints secondary to "Volkmann's ischemia" with changes in all the soft tissues about these joints is a most distressing complication of injuries of the upper extremity, and can be prevented only by recognizing the condition when it is impending and taking energetic measures to prevent progression of the condition. Such measures may require immediate surgical intervention by a skilled vascular surgeon, particularly if occlusion or rupture of the brachial artery is suspected.

Limitation of motion of the joints of the extremities, especially the elbow and occasionally the knee, by myositis ossificans traumatica developing in the soft tissues about these joints is a condition about which we know little as to the cause, and even less as to its prevention. However, this condition should not be treated by surgical measures at an early stage.

This brief outline of the involvement of joints of the extremities secondary to trauma not directly involving such joints does not cover all the possibilities; but it does indicate the frequency and scope of such complications. In the last analysis, treatment of these conditions is best carried out by bearing in mind the possibilities and preventing them whenever possible; and by recognizing them early when they do occur, and whenever possible, referring them to the specialist most experienced in these conditions in the field of orthopedic surgery and traumatology.