

proach. Bone marrow and hydroxyapatite are being investigated as substitutes for bone grafts.

The high-energy open tibial fracture remains a difficult problem. The prompt recognition of vascular problems and early arterial repair with fasciotomies, stabilization with an external fixator, and early wound coverage using free or local flaps can lead to a more acceptable salvage rate. The anterior half-pin external fixator allows easy access to soft tissues and better nursing care. Severe crush injuries or severely damaged tibias with no posterior tibial nerve function and major muscle loss should be considered for early amputation.

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REFERENCES

- Bosse MJ, Burgess AR, Brumback RJ: Evaluation and treatment of the high energy open tibia fracture. *Adv Orthopaedic Surg* 1984; pp 3-15
- Chapman MW, Mahoney M: The role of early internal fixation in the management of open fractures. *Clin Orthop* 1979; 138:120-131
- Velazco A, Whitesides TE Jr, Flemming LL: Open fractures of the tibia treated with a Lottes nail. *J Bone Joint Surg (Am)* 1983; 65:879-885

Diagnosing and Treating Chronic Distal Radioulnar Joint Pain

ULNAR WRIST PAIN HAS THE REPUTATION of being an extremely challenging clinical disorder. A careful clinical evaluation and standard x-ray films will sometimes fail to reveal the cause of the problem. In such situations, diagnosis and treatment can be aided by the newer techniques of the past several years—that is, scintigraphy, arthrography (sometimes in combination with fluoroscopy), computed tomography, arthroscopy, and magnetic resonance imaging.

Pain in the distal ulnar region can result from carpal lesions such as local arthritis or from pathologic disease of the triangular fibrocartilage complex (TFCC) or the radioulnar joint itself. A tear or peripheral detachment of the TFCC can be detected by wrist arthrography if dye is injected into the radiocarpal or distal radioulnar joint. An abnormality of the TFCC would be evidenced by an extrusion of dye across the complex. In elderly patients, this finding is not necessarily abnormal, so further investigation would be needed. The diagnosis can be confirmed by arthroscopy, which may also be used to debride a tear. Often tears in the TFCC can be observed noninvasively by magnetic resonance imaging, a technique that will undoubtedly be put to greater use in diagnosing wrist problems.

If the disease resides in the distal radioulnar joint itself, several treatment options are available. Ulnar shortening procedures are effective if the joint is intact but the ulna is simply longer than the radius. This increased ulnar variance often occurs as a result of a Colles' fracture. If the joint is also abnormal, other means of resolving the pain and improving forearm rotation must be sought. The Darrach procedure, long considered the mainstay of treatment of this type of problem, consists of resecting the distal ulna. Such resection, however, may fail to reduce the pain and, with excessive ulnar resection, may result in distal instability.

The importance of preserving the integrity of the ulnocarpal ligament complex has been emphasized. The reason for doing so is to maintain the TFCC and thus maintain stability of the ulnar side of the wrist. In response to this requirement, modifications of the Darrach procedure have been described. The hemiresection-interposition arthroplasty is one variation. Another is the matched ulna resection, wherein the distal ulna is partially resected so that the

remaining segment parallels the contour of the distal radius and the stabilizing ligaments of the distal ulna are retained. Last, the Lauenstein procedure—sometimes called the Suave-Kapanji procedure—involves arthrodesis of the distal radioulnar joint along with resection of a 1- to 2-cm section of the distal ulna just proximal to the site of arthrodesis. This technique is effective in reducing pain and restoring forearm rotation while maintaining full support for the ulnar side of the carpus.

Thus far, no single procedure has been uniformly successful. The principles of treatment are yet to be fully elucidated and hinge on a broader understanding of structure and function. Until that point of understanding has been reached, this particular area of orthopedics will remain a focus of active clinical investigation.

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REFERENCES

- Bowers WH: Distal radioulnar joint arthroplasty: The hemiresection-interposition technique. *J Hand Surg (Am)* 1985; 10:169-178
- Minami A, Ogino T, Minami M: Treatment of distal radioulnar disorders. *J Hand Surg (Am)* 1987; 12:189-196
- Whipple TL, Marotta J, Powell J: Techniques of wrist arthroscopy. *Arthroscopy* 1986; 2:244-252
- Zinberg EM, Palmer AK, Coren AB, et al: The triple-injection wrist arthrogram. *J Hand Surg (Am)* 1988; 13:803-809

Diagnosing Internal Derangement of the Knee With Magnetic Resonance Imaging

INTERNAL DERANGEMENT OF THE KNEE represents a common medical problem with significant patient morbidity. Although arthroscopy has been used increasingly in the diagnosis—and treatment—of such derangements, less invasive diagnostic techniques can be used effectively before or in place of arthroscopy if they are accurate. In recent years, magnetic resonance (MR) imaging has proved to be a reliable method and, in many instances, has replaced arthrography in the evaluation of internal derangements of the knee. The advantages of MR imaging include excellent spatial and contrast resolution, direct multiplanar imaging capability, and the absence of a known biologic hazard.

Magnetic resonance imaging is particularly valuable in analyzing intra-articular soft tissue structures, including the menisci, cruciate and collateral ligaments, and the hyaline cartilage of the patella, the distal portion of the femur, and the proximal portion of the tibia. When done by experienced physicians, the accuracy of the MR examination in evaluating the menisci has been reported to be 90% to 95% (sensitivity 95%; specificity 91%). Similar accuracy has been evident in the diagnosis of cruciate ligament disruption. In these assessments, arthroscopy usually has been used as the gold standard, although it has been argued that owing to the ability of MR imaging to delineate intrameniscal alterations, some of the falsely abnormal MR results may, in reality, represent falsely normal arthroscopic examinations. As with any diagnostic examination, however, pitfalls in interpretation exist when the magnetic resonance study is done by persons who lack considerable experience and expertise.

Preliminary data also indicate that MR imaging holds great promise in the detection of focal or diffuse abnormalities of the articular cartilage in patients with osteoarthritis, osteochondritis dissecans, and chondromalacia patellae. The presence of a joint effusion is beneficial in the delineation of such chondral alterations, and, in the absence of joint fluid, some investigators have advocated introducing saline (or

gadolinium) before the MR examination (MR arthrography).

Kinematic MR examinations, in which a series of transaxial images are taken at various degrees of knee flexion, have been used to assess tracking abnormalities of the patellofemoral joint, providing new insight into patellar subluxation and dislocation.

The major disadvantages of MR imaging include its high cost and lack of availability. Recent technical advances using pulse sequences that tilt the net magnetic moment vector at an angle of less than 90 degrees allow the examination to be done in a shorter period of time with decreased cost; furthermore, with an increasing number of magnetic resonance installations in the United States and abroad, availability is becoming less of an issue.

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REFERENCES

- Glyys-Morin VM, Hajek PC, Sartoris DJ, et al: Articular cartilage defects: Detectability in cadaver knees with MR. *AJR* 1987; 148:1153-1157
- Herman LJ, Beltran J: Pitfalls in MR imaging of the knee. *Radiology* 1988; 167:775-781
- Mink JH, Levy T, Crues JV III: Tears of the anterior cruciate ligament and meniscus of the knee: MR imaging evaluation. *Radiology* 1988; 167:769-774
- Shellock FG, Mink JH, Fox JM: Patellofemoral joint: Kinematic MR imaging to assess tracking abnormalities. *Radiology* 1988; 168:551-553

Treating Scoliosis

TO DETERMINE the appropriate treatment of scoliosis, the natural history of the disease process must be understood. It is now known that in only a small percentage of skeletally immature patients curves less than 20 degrees will prove progressive. Factors that help to predict the risk of progression include the age of onset (the younger age has a higher risk); curve pattern (thoracic curves have the highest risk of progression); menstrual history (the risk of significant curve progression is three times higher for a premenarchal girl than a woman who is postmenarchal); the Risser sign of iliac apophyseal growth (risk is three times greater for Risser stage 2 or less than for a Risser stage greater than 2); and curve severity (risk of progression is about 20% for a 20-degree curve, 60% for a 30-degree curve, and 90% for a 50-degree curve).

The indications for nonoperative treatment have changed substantially in recent years based on this improved knowledge of the natural history. As it is now appreciated that most curves of less than 20 degrees do not progress, treatment is usually not recommended unless the curves are greater than 25 degrees or there is a progression of 10 degrees or more before treatment. As it is well documented that the risk of curve progression decreases dramatically after menarche, brace treatment would be started for few patients who have reached this stage.

The Milwaukee brace has been largely supplanted by thermoplastic thoracolumbar spinal orthoses that are form-fitting and easily concealed by clothing. Treatment protocols have traditionally required 23 hours per day until skeletal maturity is reached, followed by a gradual weaning program. Recent information indicates that part-time brace wear—16 hours per day—may be sufficient to arrest curve progression in many cases. As cosmetic appearance is not expected to improve with brace treatment, an unacceptable appearance contraindicates brace treatment.

Electrical stimulation of the convex side of the curvature has been tried both as an implanted system and by surface

stimulation. Although some investigators disagree, the results of this method of treatment in several series have not shown any improvement over that expected by natural history alone.

The Harrington rod remains the gold standard of operative treatment. Instrumentation alone, however, is inadequate to preserve the correction, and a solid arthrodesis must always be obtained. Segmental fixation of the spinous processes to the Harrington rod may be accomplished using the Wisconsin wiring technique. Segmental fixation may also be accomplished using sublaminar wires attached to a rod placed on either side of the midline as described by Luque. Some series have reported an increase in neurologic morbidity from this procedure. Cotrel-Dubousset instrumentation is the most recent implant to become available. Its advantages include the ability to create both distractive and compressive forces on the same rod, to recreate thoracic kyphosis and lumbar lordosis, and to create fixation sufficiently stable that postoperative external immobilization is unnecessary.

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REFERENCES

- Bunnell WP: An objective criterion for scoliosis screening. *J Bone Joint Surg (Am)* 1984; 66:1381-1387
- Dunn HK: Spinal instrumentation—Part I: Principles of posterior and anterior instrumentation. *Instr Course Lect* 1983; 32:192-202
- Renshaw TS: Orthotic treatment of idiopathic scoliosis and kyphosis. *Instr Course Lect* 1985; 34:110-118

Magnetic Resonance Imaging in the Evaluation of Children's Spine Disorders

BACK PAIN IS UNCOMMON IN CHILDREN and adolescents and deserves a thorough evaluation. A technetium bone scan remains the most useful test in localizing the source of nonspecific signs and symptoms or with a suggestion of infection. Magnetic resonance imaging (MRI), however, is the most definitive and cost-effective imaging technique for diagnosing and evaluating children's spine disorders not diagnosed by standard radiographs. Recent reports have documented MRI findings in cases of pediatric infection, neoplasia, and congenital vertebral anomalies. If a history, physical examination, and standard radiograph localize the problem, the MRI has proved helpful in further elucidating both pathologic anatomy and physiology.

The uncommon problem of pediatric spine infection has been an issue of primary disc space infection versus osteomyelitis with extension into the disc space. In osteomyelitis and neoplasia, T1-weighted images have shown decreased signal intensity within affected vertebral bodies. T2-weighted images often reveal sparing of the disc space with neoplasia and involvement of the disc with infection. A report of MRI scanning in a child with classic physical and plain radiographic findings of diskitis revealed (on T1-weighted images) osseous involvement above and below the narrow disc consistent with osteomyelitis. Likewise, a child's hamstring tightness, paravertebral spasm, and altered gait could be explained by the posterior herniation of a narrowed lumbar disc into the spinal canal, as noted on T2-weighted images. The noninvasive, nonionizing nature of MRI has offered new information on a historically self-limited condition in which invasive studies are usually not justified.

Congenital vertebral anomalies can involve both osseous