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Original Articles

NUC MED AND MRI
By Gregory Priest, DC,FACO

I've heard a lot of questions in the past about various imaging studies. Based upon what I've heard, some folks aren't quite sure about the utility of two of my favorite studies, nuclear medicine (or, bone) scans and MRI, and I've also heard some common misconceptions mentioned. Therefore, I thought it might be of interest to offer some information that the health care provider (HCP) might find useful when caring for patients. Enhancing the understanding of when to utilize nuclear medicine and/or MRI can greatly benefit the HCP in determining the appropriate clinical indications for advanced imaging studies.

First, there are a lot of good radiology websites that one can review as a refresher for nuclear medicine and/or MRI. You can type in the terms 'nuclear medicine' or 'MRI' into your favorite search engine and you'll soon discover a world of information.

Nuclear Medicine

Nuclear medicine scans come in 3 varieties: whole body (planar), SPECT (single photon emission computerized tomography) and triphasic scans. Because triphasic scans are less commonly ordered, this discussion will be restricted to the planar and SPECT scans. Whole body (WB) and SPECT scans are perhaps the most commonly ordered of the bone scans. Frequently, nuclear medicine doctors will order a SPECT after reviewing the WB scan if there's a need. However, if you're not sure, you can order the WB and SPECT scans simultaneously. Dialogue with the nuclear radiologist can establish the specific protocol that is followed and consistent orders for that particular facility can be then practiced. The SPECT scan is especially useful when attempting to age a spondylolisthesis or, to determine if it's a new or an old injury. The SPECT scan can better differentiate between an arthritic "hot spot" verses a pathological area or fracture as the SPECT scan, like radiographic tomography, cut the image into slices and offers a better view than a planar scan. It may however, be necessary to order an MRI further evaluate the area in question.

Skeletal nuclear medicine studies essentially involve injecting a tiny amount of radioactive isotope, usually Tc99m into the forearm and the patient leaves for 3 hours and returns for the actual scan. They then lay on a table and a scanner picks up the emission data from the body and a computer converts the data into a picture that looks like the faint outline of a skeleton. Since the radiopharmaceutical has a predilection for areas of bone with increased metabolic activity, i.e., bone turnover, such areas will show up as black spots or, “hot spot” on the film. For example, if a fracture or bone tumor is present, the tracer will collect in the area of pathology and be visible as a hot spot. It is extremely important to understand that nuclear medicine scans are extremely sensitive but are similarly non-specific. In other words, a hot spot can represent a fracture or simply arthritic activity. The more active the lesion, the more “hot” or dark the area appears on the image. An x-ray of a rib fracture may be completely negative for an acute fracture, but a bone scan will often show the hot spot(s) in as little as 2 days post trauma. Similarly, if a patient has breast cancer with persistent low back pain (LBP) and x-rays are normal; a bone scan can identify the metastatic bone lesion usually quite dramatically. In fact, I would STRONGLY suggest ordering a bone scan for the patient with a history of breast cancer and persistent LBP to rule out metastatic carcinoma (METS) due to the high morbidity and potential mortality associated with METS. Remember, the four “red flags” of LBP include cancer, infection, fracture and cauda equina syndrome and bone scanning can facilitate the diagnosis in three of these four disorders.

Nuclear medicine or bone scans include something called a 'Rule of 2's: visible in 2 days, peaks in 2 months (some say 2 weeks) and visible for up to 2 years. This is why bone scans are not as good as some think for 'dating' compression fractures.

The tracer has a very short half-life, and will be excreted through the kidneys within 24 hours or so to the extent that the amount of residual radioactive tracer is nearly immeasurable. Also, it is extremely rare for anyone to have a bad reaction to the tracer, as no iodinated compounds are involved.

MRI

There are many benefits of MRI, such as no ionizing radiation, no known side effects, excellent visualization of soft tissues (such as herniated nucleus pulposis or HNP), and few absolute contraindications. In everyday practice, the most common problem is claustrophobia due to the tight, tunnel-like confines of the scanner. However, this is becoming less of an issue with the advent of open or short-bore scanners as well as the greatly decreased scan times due to better scanners and software.

More difficult findings to identify on MRI that can be easily missed even by radiologists unless specifically evaluated include high-intensity zones (HIZs) in the posterior annulus. The presence of the HIZs suggests annular fiber tears which may be identified in the absence of frank HNP. An HIZ might be considered a 'pre-herniation' in that there is a rent or tear in the posterior annulus, which can evolve into a potential pathway for nuclear extrusion. Another great application of MRI is when a suspected or even obvious compression fracture is present, the MRI can facilitate in the differentiation between a recent versus an old compression fracture. More specifically, an acute compression fracture will demonstrate marrow edema (the fluid/edema is readily visible, particularly on T2-weighted sequences), whereas an old fracture will not because the edema has resolved. Lastly, the “gold standard” for evaluating epi-/subdural hematomas (closed head injuries) used to be CT, but that is changing. MRI is becoming so good, that before long, MRI will supplant CT in the diagnosis of these injuries. There are two other reasons that CT scans have been preferred for diagnosing subdural hematomas. These include the fact that CTs were more readily available in almost every hospital, and the scan times were very short. But this too is changing, as MRI scans are quickly catching up in both the availability and decreasing scan times’.

Give these studies a closer look and familiarize yourself with appropriate usage and algorithmic protocols. Become comfortable in ordering these tests as they can greatly enhance your ability to assess the patient so that proper management protocols on a timely basis can be followed.

Reprints & Abstracts

By Michael Smithers

Reduced Risk of Alzheimer Disease in Users of Antioxidant Vitamin Supplements: The Cache County Study

Zandi P. P., Anthony J.C., Khachaturian A.S., et al

Archives of Neurology 61: 82-88, 2004

Background: Antioxidants may protect the aging brain against oxidative damage associated with pathological changes of Alzheimer disease (AD).

Objectives: To examine the relationship between antioxidant supplement use and risk of AD

Design: Cross-sectional and prospective study of dementia. Elderly (65 years or older) count residents were assessed in 1995 to 1997 for prevalent dementia and AD, and again in 1998 to 2000 for incident illness. Supplement use was ascertained at the first contact.

Setting: Cache County, Utah

Participants: Among 4740 respondents (93%) with data sufficient to determine cognitive status at the initial assessment, we identified 200 prevalent cases of AD. Among 3227 survivors at risk, we identified 104 incident AD cases at follow-up.

Main Outcome Measures: Diagnosis of AD by means of multistage assessment procedures.

Results: Analyses of prevalent and incident AD yielded similar results. Use of vitamin E and C (ascorbic acid) supplements in combination was associated with reduced AD prevalence (adjusted odds ratio, 0.22; 95% confidence interval, 0.05-0.60)and incidence (adjusted hazard ratio, 0.36; 95% confidence interval, 0.09-0.99). A trend toward lower AD risk was also evident in users of vitamin E and multivitamins containing vitamin C, but we saw no evidence of a protective effect with use of vitamin E or vitamin C supplements alone, with multivitamins alone, or with vitamin B-complex supplements.

Conclusions: Use of vitamin E and vitamin C supplements in combination is associated with reduced prevalence and incidence of AD. Antioxidant supplements merit further study as agents for the primary prevention of AD.

Commentary

Free radical brain degeneration is often discussed, but infrequently understood. Think of the neuronal tissue that free radicals affect as shiny new silvery threads of steel wool, teased out in a thousand directions. Free radicals are like misting these gossamer shimmering metal tendrils with water (hydrogen-oxygen-hydrogen–a

type of “free radical”), and letting them air dry (two oxygen atoms slightly chemically bonded– another “free radical”). Quickly the shiny delicate threads oxidize and crumble away,
leaving only a central wad of compact rusted steel that used to be a blaze of shimmering silver. If, instead, one were to have sprayed a protective oily/teflon coat over the new metal (antioxidant), the outcome would have been significantly different, and the free radical oxygen forms would not have degenerated the steel so quickly, if at all.

As steel wool, neurons are especially vulnerable to free-radical mediated damage because of their delicate spidery structure, and need defense. Antioxidants protect neurons by scavenging free radicals and other reactive oxygen forms from damaging their cellular membranes, organelles, and macromolecules. However, if accumulation of reactive oxygen agents is allowed, this may overwhelm the protective reserves of a neuron’s antioxidants, which is termed oxidative stress. In the brain, this may result in the delicate highly functioning tendrils of neurons “rusting away”. This accumulation of free radicals and consequent neuronal degeneration, may lead to aging and the pathogenesis of Alzheimer’s Disease (AD), and like steel wool, may leave only a very dysfunctional wad of brain tissue that used to be a neurological wonder.

There are a few well recognized prior studies that have attempted to ascertain whether or not vitamins C and E may have a beneficial effect on anti-oxidation of the brain. One was the East Boston Study, which only found risk reduction using vitamin C (ascorbic acid) . The problem with this study was that although ascorbic acid was reported to be of value, more than half the participants taking vitamin C also took vitamin E (selegiline hydrochloride). Another observational project, the Honolulu-Asia Aging Study, found benefit from combined vitamin E and C use, but this was not oriented to AD, but to vascular dementia (senile dementia).

A European project for Alzheimer Disease reported on the benefit of dietary intake of flavonoids, mostly from red wines. Flavonoids are antioxidants. From this came the claim, which was reported in this country, of one to two glasses of deep red wines, which are rich in flavonoids, are good for the heart because of the antioxidant activity. There was little to no mention of the study’s investigational purpose, which was flavonoid/antioxidant intake through dark red wines and decreased incidence of AD .

The Chicago Health and Aging Project (CHAP) found that there was a decrease in risk of AD when dietary intake of vitamin E was consumed, but not vitamin C. The Rotterdam Study discovered that there was an inverse relationship to the dietary intake of vitamin E to Alzheimer Disease, and also, but to a lesser extent, vitamin C. The Washington Heights-Inwood Columbia Aging Project found that neither vitamin E nor C had any reduction in the incidence of AD.

The beauty of the Cache County, Utah study is that is was so large (4740 respondents). The main criticism was that it was short (3 yrs.). The authors categorized participants according to their vitamin supplement dosage. They were vitamin E users if the subjects reported taking an individual supplement of vitamin E or multivitamin that contained more than 400 IU of selegiline HCl. Likewise, vitamin C users were those who stated
they took either supplement or multivitamin dosage of at least 500 mg ascorbic acid. Multivitamin users were classified as those whose dosages of vitamin E and C were lower than above. Those who were classified as vitamin B participants took only supplements that contained only the B complex vitamins, and were used as controls for the above two groups.

Those who took vitamin E and C supplements, compared to nonusers, were younger, better educated, and in better general health. Those who took only multivitamins were reported as in poorer health as compared to the subjects who took vitamin E and C supplements.

The authors summarize their research project by stating “our findings using both prevalence and incidence data from the large, population-based Cache County study suggest that antioxidant vitamins, specifically the

combination of vitamin E and C supplements, may prevent AD." This is a remarkable statement. They also comment that there was a trend toward reduced AD incidence with vitamin E and multivitamins in combination, and that the use of multivitamins alone was not notably related to AD risk."

Function and Back Symptoms in Older Adults

Susan L. Edmond and David T. Felson

Journal of the American Geriatric Society, 51:1702-1709, 2003

Objectives: To determine the relationship between back symptoms and limitations in nine specific functional activities

Design: A cross-sectional study

Setting: This study was conducted as part of the Framingham Heart Study, a population-based study performed on a representative sample of community-living residents of Framingham, Massachusetts.

Participants: Subjects consisted of 1,007 surviving members of the original cohort who participated in the 22nd Biennial Examination in 1992-93. Ages ranged from 70 to 100.

Measurements: subjects were asked whether they experienced pain, aching, or stiffness in the back on most days and whether they had difficulty performing nine specific functional skills. Odds Ratios (Ors) and confidence intervals are reported for the entire sample and within categories of sex. The proportion of functional limitations attributable to back symptoms and the proportion of limitations ascribed by subjects to back symptoms among subjects with these limitations are also reported.

Results: The results provide evidence of a relationship between back symptoms and functional limitations. Ors were highest for difficulty standing in one place for about 15 minutes, pushing or pulling a large object, and walking half a mile. Of those with back symptoms, 43% to 63% of limitations in activities were due to back symptoms. Among all subjects, back symptoms were so prevalent that 18% to 34% of all functional limitations were attributable to back symptoms. The association between back symptoms and functional limitations was especially strong in women.

Conclusion: Back symptoms account for a large percentage of functional limitations in older adults, especially in women.

Commentary

This article is a fascinating study of just how important back health is to the geriatric, with back health a product of genetic variances, lifetime physical abuse, male vs. female differences, and trauma. This study clearly shows that back problems severely affect the elderly's ability to perform activities of daily living, with these activities being not only
painful, but functionally compromising, for all the rest of their tomorrows.

The activities this study tested were standing in place for 15 minutes (as in standing in the kitchen preparing food), walking half a mile (a simple shopping trip), stooping, crouching or kneeling (cleaning), lifting a 10 pound object off the floor (a small sack of potatoes), getting in and out of a car, pushing or pulling a large object such as a living room chair,

putting on socks or stockings, reaching or extending the arms above shoulder level (as in retrieving objects from a clothes closet), and writing, handling, or fingering small objects. A functional limitation in any one of these activities was recorded if the elderly person stated that they had a lot of difficulty or were unable to perform the activity.

These are basic activities that everyone does numerous times throughout every day. Sadly, up to 2/3 of people who have back symptoms have one or more of the above functional disabilities, and up to 1/3 of those who have no back symptoms also have functional losses of these activities of daily living.

This study is a good reason why we as chiropractors should be very vocal in advocating back health throughout one's life, for the damage done when one is younger definitely haunts the elderly every single day for the duration of that person's life.

Traction Radiography Often Helpful in Evaluating Scoliosis

News Author: Laurie Barclay, MD
CME Author: Désirée Lie, MD, MSEd

Nov. 15, 2004 - Traction radiography performed under general anesthesia (TUA) is better at evaluating curve flexibility for scoliosis repair than the current standard, supine bending, according to the results of a prospective study published in the Nov. 1 issue of *Spine*.

"Assessment of curve flexibility is important in decision making before surgical correction of scoliosis," write Ben J. Davis, MRCS, from the Hartshill Orthopaedic Unit, City General Hospital in Stoke-on-Trent, U.K., and colleagues. "Supine bending radiographs are presently the gold standard technique by which flexibility is assessed, but their reliability has been questioned. No literature has shown a conclusively superior role for traction radiography in assessing idiopathic scoliosis curves."

Twenty-four patients with late-onset idiopathic scoliosis each had erect anteroposterior radiographs and supine-bending radiographs, as well as TUA on the day of surgery. The investigators compared the correction obtained in the Cobb angle between the bending and TUA radiographs and determined the influence of TUA on the decision for anterior-release surgery and its correlation with the postoperative result.

Compared with supine-bending radiographs, TUA demonstrated significantly greater curve flexibility ($P <$ .001). After review of the TUA, 11 of 13 patients who were scheduled for anterior-release surgery and posterior instrumentation were able to avoid anterior release. There was no significant difference between the TUA and postoperative correction ($P <$ .13).

"Traction radiography is superior to supine bending radiography in assessing curve mobility before surgery," the authors write. "This method benefits patients by allowing them to avoid anterior release surgery and helps predict postoperative correction."

DePuy Acromed, maker of orthopedic devices and supplies, supported this work. The authors did not receive any funds in support of this work, and no benefits have been or will be received from a commercial party related directly or indirectly to the subject of this article.

Spine. 2004;29:2466-2470

Clinical Context

Accurate preoperative assessment of scoliosis is important for surgical decision making about the fusion level, surgical approach, and the need for anterior release with posterior instrumentation to achieve the best correction. Surgical approaches include anterior, posterior, and combined. The ultimate goal of surgery is to achieve a stable balanced spine that centers over the pelvis. The gold standard for assessing scoliosis flexibility is presently the supine-bending radiograph. However, concerns have been expressed about its reliability as it varies with patient effort with voluntary bending, and compliance in children with neuromuscular problems is difficult to obtain. Other methods include fulcrum-bending and push-prone radiographs and TUA. TUA has the advantage of not depending on patient compliance.

According to the authors, no study has assessed the accuracy of preoperative TUA over supine-bending radiographs. This is a case series examining the accuracy of the two diagnostic methods when performed preoperatively on 24 patients with idiopathic scoliosis at one center. The outcomes used were difference between preoperative and postoperative correction and need for anterior release. The criterion used for anterior release at the unit was a curve that did not correct to less than 40º on preoperative radiographs.

Study Highlights

- Inclusion criterion was patients with idiopathic scoliosis admitted for corrective surgery who received standing and bending anterior-posterior and lateral radiographs. Those whose spine did not correct to less than 40º on bending supine lateral radiographs were also scheduled for anterior release.
- After induction of surgery, TUA was performed and degree of correction with traction was measured. Traction was applied by one assistant via the lower leg at the ankles while another applied countertraction via the axillas. The surgeon then applied translatory pressure to the curve apex. The radiograph was taken at this point.
- Primary outcomes were the difference between the mean angle measured in the supine bending film and postoperative correction and the mean angle measured in the TUA film and postoperative correction.
- Secondary outcome was the difference between need for anterior release as determined by supine-bending radiograph and actual performance of anterior release after TUA assessment.
- Mean age was 14.7 years, 23 were female, mean curve on erect anterior-posterior film was 63º (range, 36º to 92º), on supine bending film was 46º (range, 24º to 76º), and on TUA was 28º (range, 11º to 65º).
- Based on the preoperative bending radiograph, 13 of 24 patients were scheduled for anterior release.
- Overall, the TUA showed significantly greater correction than the supine-bending radiograph ($P < .001$).
- TUA was superior to supine-bending radiographs in correcting spines with curvatures both above ($P < .001$) and below ($P = .005$) 60º when testing for curve magnitude.
- Lenke 1, 2, and 3 curves all showed significantly greater flexibility with the TUA compared with the supine-bending radiograph.
- Difference between mean angles preoperatively and postoperatively for the bending radiograph was 15º ($P < .001$) while difference between preoperative and postoperative mean angle for TUA was only 1.5º ($P = .13$). Thus, the TUA was more predictive of the final postoperative correction.
- Anterior release was avoided in 11 of the 13 patients scheduled for anterior release based on the supine-bending radiograph.

Pearls for Practice

- Methods of assessing the flexibility of scoliosis spines include supine-bending, fulcrum-bending, and push-prone radiographs and TUA.

- TUA is superior to supine-bending radiographs in correcting spine curvature preoperatively, predicting the accuracy of postoperative correction, and avoiding the need for anterior release.

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"I have always strenuously supported the right of every man to his own opinion, however different that opinion might be to mine. He who denies another this right makes a slave of himself to his present opinion, because he precludes himself the right of changing it." -- Thomas Paine, 1783

Case History

Clinical Pearl

Review of the Literature

GUIDELINE TITLE

American Academy of Orthopaedic Surgeons (AAOS) clinical guideline on wrist pain - phase I.

BIBLIOGRAPHIC SOURCE(S)

- American Academy of Orthopaedic Surgeons (AAOS). AAOS clinical guideline on wrist pain - phase I. Rosemont (IL): American Academy of Orthopaedic Surgeons (AAOS); 2002. 15 p. [79 references]

MAJOR RECOMMENDATIONS

Definitions for the ratings of the strength of recommendation (A-D) and the levels of evidence (Type I-Type V) are provided at the end of the "Major Recommendations" field.

Differential Diagnosis

Tendonitis

Definition of the Problem

Tendonitis is a condition resulting from irritation of a tendon, usually in a region where the tendon passes through a tunnel. Pain and swelling develop over the localized area of tendon. Pain is worse with motion, especially motion that puts the involved tendon on stretch. A squeaking or rubbing and sometimes a triggering or catching sensation will be described by patients who have significant tenosynovitis. Tenosynovitis around the finger flexor tendons in the carpal tunnel region can have the associated symptoms of fingertip numbness from median nerve compression. Splinting, rest, anti-inflammatory agents, and local corticosteroid injection* will all lead to improvement. Tenosynovitis may result from inflammatory arthropathies such as rheumatoid arthritis or from gout. Tenosynovitis from amyloidosis is also common in renal dialysis patients. Adults who overuse their wrists with repeated motion may develop tendonitis.

Examination reveals localized pain, swelling, and tenderness. The pain will be worsened with certain motions, such as stretching the involved tendon, or with active work of the involved tendon, especially work against a resisting force. Crepitus and sometimes triggering can be palpated if a significant tenosynovitis has developed.

X-rays may be useful to rule out other potential causes of pain in the area in question, but they will not show a tendonitis. A magnetic resonance imaging (MRI) scan will show any significant tenosynovitis and tendon nodules that sometimes develop. However, the diagnosis can almost always be made clinically without the need for an MRI **("B" recommendation)** (Alberton et al., 1999; Armstrong et al., 1987; Giovagnorio, Andreoli, & De Cicco, 1997; Glajchen & Schweitzer, 1996; Higgs & Young, 1996; Klug, 1995; Marini et al., 1994; Sueyoshi et al., 1996; Zenone et al., 1999).

Recommendations

Initial treatment consists of splinting to immobilize the involved tendon(s), nonsteroidal anti-inflammatory drugs (NSAIDs)**, and activity modifications to avoid painful motions and actions **("B" recommendation)** (Alberton et al., 1999; Armstrong et al., 1987; Grundberg & Reagan, 1985; Higgs & Young, 1996; Klug, 1995; Moore, 1997; Teefey, Middleton, & Boyer, 2000; Thorson & Szabo, 1992; Wood & Linscheid, 1973). If pain and swelling are severe, or if the symptoms do not abate within four to six weeks, then a corticosteroid injection* can be used to relieve symptoms **("B" recommendation)** (Alberton et al., 1999; Giovagnorio, Andreoli, & De Cicco, 1997; Grundberg & Reagan, 1985; Harvey, Harvey, & Horsley, 1990; Higgs & Young, 1996; Klug, 1995; McKenzie, 1972; Moore, 1997; Rankin & Rankin, 1998; Tan, Low, & Tan, 1994; Teefey, Middleton, & Boyer, 2000; Thorson & Szabo, 1992; Wood & Linscheid, 1973)

Patients who do not improve or those who have recurrence of symptoms should be referred to a specialist. Surgery is indicated for refractory cases.

Expected Clinical Results

Tendonitis resulting from overuse will usually respond to splinting, activity modification, NSAIDs**, and corticosteroid injection*. However, the symptoms frequently reoccur when activities are resumed and when the injection wears off in one to two months **("B" recommendation)** (Alberton et al., 1999; Grundberg & Reagan, 1985; Harvey, Harvey, & Horsley, 1990; Higgs & Young, 1996; Moore, 1997; Rankin & Rankin, 1998; Tan, Low, & Tan, 1994; Thorson & Szabo, 1992; van Vugt, van Dalen, & Bijlsma, 1998). Tenosynovitis resulting from other causes will often respond only minimally to medical management and usually requires surgical tenosynovectomy to recover. Long-standing tenosynovitis increases the risk for tendon rupture. Surgical decompression of tendons and tenosynovectomy are generally very successful for relieving symptoms and for preventing future problems **("B" recommendation)** (Alberton et al., 1999; Arons, 1987; Grundberg & Reagan, 1985; Harvey, Harvey, & Horsley, 1990; Higgs & Young, 1996; Klug, 1995; Rankin & Rankin, 1998; Tan, Low, & Tan, 1994; Thorson & Szabo, 1992; Zenone et al., 1999).

Alternative Approaches

Debilitated patients that cannot undergo surgery may be treated with serial corticosteroid injections*, long-term splinting, and permanent activity restriction. However, these patients will have a significant risk for tendon rupture and further functional impairment.

Carpal Tunnel Syndrome

Definition of the Problem

Carpal tunnel syndrome is a condition resulting from compression of the median nerve within the carpal tunnel. Symptoms may include numbness in the thumb, index, middle, and/or ring fingers. The numbness is usually intermittent and normally occurs more frequently during sleep or rest. There may be associated pain in the palmar hand, wrist, and forearm. If the carpal tunnel syndrome becomes severe, the patient may develop thenar atrophy, weakness, and persistent numbness with loss of texture discrimination. Carpal tunnel syndrome is much more common in women than in men. The incidence increases with patient age. The cause may be multifactorial or may be unknown.

Neurologic findings such as Phalen's and Tinel's signs may be present **("C" recommendation)** (Borg & Lindblom, 1986; Harrington et al., 1998; Katz et al., 1990; Novak et al., 1992; Phalen, 1966). In severe cases, thenar atrophy with weakness of thumb opposition and loss of two-point and texture discrimination will become apparent. Nerve conduction studies will show delayed conduction of the median nerve across the wrist.

Recommendations

Initial treatment usually consists of wrist splinting, NSAIDs**, and activity modifications **("B" recommendation)** (Higgs & Young, 1996; Gelberman, Aronson, & Weisman, 1980; Harrington et al., 1998; Harter et al., 1993; Kruger et al., 1991). Therapy instruction for wrist exercises is sometimes beneficial. If the patient's work environment is in question, an ergonomic evaluation and modifications to reduce wrist motion in the work place can also decrease symptoms.

If, after four to six weeks, symptoms remain significantly bothersome, then referral to a specialist is indicated. Nerve conduction studies should be obtained to confirm the diagnosis. A corticosteroid injection into the carpal tunnel* can be helpful to alleviate symptoms, at least temporarily **("B" recommendation)** (Higgs & Young, 1996; Gelberman, Aronson, & Weisman, 1980; Harter et al., 1993; Phalen, 1966)]. Persistent (rather than intermittent) numbness and thenar atrophy are signs of severe median nerve compression that may lead to permanent nerve damage. In these cases, referral to a specialist for surgical decompression should occur in a timely fashion.

Expected Clinical Results

Most patients with carpal tunnel syndrome will initially respond favorably to splinting, NSAIDs**, activity modification, and corticosteroid injection* **("B" recommendation)** (Higgs & Young, 1996; Gelberman, Aronson, & Weisman, 1980; Harrington et al., 1998; Harter et al., 1993; Phalen, 1966). However, symptoms almost always return, wax and wane, and eventually worsen and require surgical release. Severe cases with persistent numbness and/or thenar atrophy rarely respond to nonoperative management and have the potential for developing permanent nerve damage. The majority of patients will improve significantly with surgery **("B" recommendation)** (Higgs & Young, 1996; Harter et al., 1993; Phalen, 1966).

Alternative Approaches

For patients too debilitated to undergo surgery, and for carpal tunnel syndrome (CTS) of pregnancy, prolonged splinting and serial corticosteroid injections are helpful*.

Ligamentous Injury

Definition of the Problem

Ligament injuries represent conditions in which damage to ligaments leads to their incompetence. Patients may present with acute pain following an injury, or chronic symptoms from an injury in the past. Besides pain with

activity, symptoms of ligamentous incompetence may include joint swelling, stiffness, weakness, and mechanical symptoms such as giving way, catching sensations, and popping. Long-standing joint instability may lead to the development of arthrosis. Ligament injuries occur in adults and can result from trauma such as a fall on an outstretched hand or a twisting force. In the skeletally immature, ligament injuries are rare.

Physical examination may demonstrate swelling, weakened grip, visible or palpable shifting of carpal bones, clunks or pops under stress, and limited range of motion.

X-rays may show an abnormally widened space between two carpal bones, most commonly the scaphoid and lunate. The scaphoid and/or lunate may show abnormal angulation. In some patients, routine x-rays will be normal and either x-rays under stress, arthrograms, or fluoroscopy are needed to demonstrate the instability **("A" recommendation)** (Brahme & Resnick, 1991; Braunstein et al., 1986; Brown & Lichtman, 1984; Cantor et al., 1994; Chidgey, 1992; Dalinka et al., 1983; Hodgson, Royle, & Stanley, 1995; Johnstone et al., 1997; Ko & Viegas, 1997; Kuschner & Lane, 1997; Linn, Mann, & Gilula, 1990; Manaster, Mann, & Rubenstein, 1989; Mrose & Rosenthal, 1991; Nakamura et al., 1997; Oneson et al., 1996; Palmer, Levinsohn, & Kuzma, 1983; Raskin & Beldner, 1998; Richmond et al., 1998; Roth & Haddad, 1986; Schweitzer et al., 1992; Weiss, Akelman, & Lambiase, 1996; Yin et al., "Surgeons' decision making," 1996; Young & Higgs, 1996; Potter et al., 1997; Yin et al., "Evaluation," 1996; Zlatkin et al., 1989). Some ligament tears can be demonstrated by an MRI scan, but the scanner does not always define the pathology. Post-traumatic arthrosis develops in chronic cases, and x-rays will show subchondral sclerosis, osteophytes, and joint space narrowing.

Recommendations

X-rays should be taken to aid in diagnosis, rule out fracture, and in chronic cases to determine the extent of post-traumatic arthrosis. Splinting, NSAIDs**, activity modification, and intra-articular corticosteroid injection* can all help to reduce the symptoms in chronic cases. Therapy is indicated to increase strength and employ a mechanical advantage with activities requiring force **("B" recommendation)** (Chidgey, 1992; Kuschner & Lane, 1997; Nakamura et al., 1997; Apergis, 1996).

For suspected acute ligament tears, and for chronic tears not responsive to medical management, referral to a specialist should be made. Surgical treatment is usually necessary for acute ligament tears and for chronic tears with persistent, significant symptoms **("B" recommendation)** (Koman et al., 1990; Weiss, Akelman, & Lambiase, 1996; Apergis, 1996; Ashmead et al., 1994; Augsburger et al., 1992; Hastings & Silver, 1984; Pisano & Peimer, 1991; Tomaino, Delsignore, & Burton, 1994; Viegas, 1994; Watson, Goodman, & Johnson, 1981).

Expected Clinical Results

Chronic ligament tears will often show partial response to splinting, activity modification, and therapy for strengthening. However, post-traumatic arthrosis eventually develops and worsens with time. In these patients, surgical treatment consisting of arthrodesis or arthroplasty would be expected to relieve pain **("B" recommendation)** (Ashmead et al., 1994; Augsburger et al., 1992; Hastings & Silver, 1984; Pisano & Peimer, 1991; Tomaino, Delsignore, & Burton, 1994; Viegas, 1994; Watson, Goodman, & Johnson, 1981). Acute ligament tears will improve some over several months with decreased pain and swelling but without surgical repair will have continued problems with activity-related pain, swelling, weakness, and mechanical symptoms such as giving way or joint popping. Surgical repair will usually decrease pain, swelling, and mechanical symptoms. Whether surgical treatment is rendered, or not, most patients will have some permanent loss of wrist motion **("B" recommendation)**(Ashmead et al., 1994; Augsburger et al., 1992; Hastings & Silver, 1984; Pisano & Peimer, 1991; Tomaino, Delsignore, & Burton, 1994; Viegas, 1994; Watson, Goodman, & Johnson, 1981).

Alternative Approaches

Patients who are unwilling or unable to have surgery because of a severe medical condition can be treated with long-term splinting and analgesics.

Arthrosis

Definition of the Problem

Arthroses represent pathological conditions of the joint itself with destruction of the articular cartilage. The wrist is a common site for the development of arthrosis. Pain and loss of motion worsen over time. Pain is worsened by activity and movement. Symptoms are usually lessened with splinting and NSAIDs**. Osteoarthritis is more common after age 50, but arthroses resulting from other causes may occur at much younger ages. The multiple possible causes of wrist arthroses include trauma, osteoarthritis, inflammatory arthritis, gout, and sepsis.

Examination reveals diminished range of motion, pain and crepitus with motion, weakness, and diffuse swelling and tenderness around the joint.

X-rays may show joint space narrowing, periarticular cysts and erosions, osteophytes, and subchondral sclerosis.

Recommendations

X-rays should be taken to confirm the diagnosis and determine the severity of the arthrosis. Initial treatment consists of activity modification to reduce aggravating factors, NSAIDs**, and splinting of the wrist **("B" recommendation)** (Docken, 1987; Patterson, 1975; Sarkin, 1975; Stolzer et al., 1962). Intra-articular injection of corticosteroids* will usually alleviate pain for several weeks **("B" strong recommendation)** (Docken, 1987; Sarkin, 1975; Stolzer et al., 1962).

If symptoms persist and are significantly bothersome, then referral should be made to a specialist. Surgical treatment may be indicated when pain warrants.

Expected Clinical Results

Splinting, NSAIDs**, and intra-articular corticosteroid injections* are all expected to aid in reduction of pain and swelling. For patients with severe arthroses, medical management may not be helpful. In these severe cases, surgical treatment including joint arthroplasty or arthrodesis will generally alleviate the pain **("A" recommendation)** (Docken, 1987; Sarkin, 1975).

Alternative Approaches

Prolonged immobilization may lead to permanent joint stiffness and is thus usually avoided. However, patients refusing surgery, or those who are too debilitated to undergo surgery, can have significant pain reduction with long-term splinting. Serial intra-articular corticosteroid injections* and analgesic medications will also help relieve pain in these patients.

*Corticosteroid injection may temporarily elevate blood glucose and blood pressure in some patients.

**NSAIDs are relatively contraindicated in patients with renal insufficiency or pregnancy. Administer cautiously in patients with hypertension or gastrointestinal intolerance. Side effects and toxicity should be monitored during administration.

Definitions:

Type of Evidence

Type I. Meta-analysis of multiple, well-designed controlled studies; or high-power randomized, controlled clinical trial

Type II. Well-designed experimental study; or low-power randomized, controlled clinical trial

Type III. Well-designed, nonexperimental studies such as nonrandomized, controlled single-group, pre-post, cohort, time, or matched case-control series

Type IV. Well-designed, nonexperimental studies, such as comparative and correlational descriptive and case studies

Type V. Case reports and clinical examples

Strength of Recommendations

A. Type I evidence or consistent findings from multiple studies of types II, III, or IV
B. Types II, III, or IV evidence and findings are generally consistent
C. Types II, III, or IV evidence, but findings are inconsistent
D. Little or no systematic empirical evidence

CLINICAL ALGORITHM(S)

An algorithm is provided in the original guideline for Universe of Adult Patients with Wrist Pain--Phase I.

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EVIDENCE SUPPORTING THE RECOMMENDATIONS

REFERENCES SUPPORTING THE RECOMMENDATIONS

References open in a new window

TYPE OF EVIDENCE SUPPORTING THE RECOMMENDATIONS

The type of supporting evidence is specifically stated and identified for each recommendation (see the "Major Recommendations" field).

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IDENTIFYING INFORMATION AND AVAILABILITY

BIBLIOGRAPHIC SOURCE(S)

- American Academy of Orthopaedic Surgeons (AAOS). AAOS clinical guideline on wrist pain - phase I. Rosemont (IL): American Academy of Orthopaedic Surgeons (AAOS); 2002. 15 p. [79 references]

ADAPTATION

Not applicable: The guideline was not adapted from another source.

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1996 (revised 2002)

GUIDELINE DEVELOPER(S)

American Academy of Orthopaedic Surgeons - Medical Specialty Society
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GUIDELINE COMMITTEE

American Academy of Orthopaedic Surgeons Task Force on Clinical Algorithms

COMPOSITION OF GROUP THAT AUTHORED THE GUIDELINE

Revision panel: Victoria Masear, MD, Chair; Morton Kasdan, MD; William LaSalle, MD; Carolyn Kerrigan, MD; B. Kent Maupin, MD

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FINANCIAL DISCLOSURES/CONFLICTS OF INTEREST

Not stated

GUIDELINE STATUS

This is the original release of this guideline.

This guideline updates a previous version: American Academy of Orthopaedic Surgeons. Clinical guideline on wrist pain. Rosemont (IL): American Academy of Orthopaedic Surgeons; 1999. 6 p.

GUIDELINE AVAILABILITY

Electronic copies: Available from the American Academy of Orthopaedic Surgeons Web site.

Print copies: Available from the American Academy of Orthopaedic Surgeons, 6300 North River Road, Rosemont, IL 60018-4262. Telephone: (800) 626-6726 (800 346-AAOS); Fax: (847) 823-8125; Web site: www.aaos.org.

AVAILABILITY OF COMPANION DOCUMENTS

The following is available:

- Universe of adult patients with wrist pain -- Phase I. Rosemont (IL): American Academy of Orthopaedic Surgeons; 2002. 3 p.

Electronic copies: Available in Portable Document Format (PDF) from the American Academy of Orthopaedic Surgeons Web site.

Print copies: Available from the American Academy of Orthopaedic Surgeons, 6300 North River Road, Rosemont, IL 60018-4262. Telephone: (847) 823-7186; (800) 346-AAOS. Fax: (847) 823-8125. Web site: www.aaos.org.

PATIENT RESOURCES

None available

NGC STATUS

This summary was completed by ECRI on March 15, 2000. The information was verified by the guideline developer on July 11, 2000. This NGC summary was updated by ECRI on August 10, 2004. The information was verified by the guideline developer on September 1, 2004.

Current Events

The Academy in conjunction with the Inter-organizational Coalition are pleased to announce that three Diplomate examinations are scheduled for 2005 and preliminary work is being done for 2006.

Please visit the website and review the "Guidelines for Authors". The examination committee would like your participation in the development of questions for the Diplomate examination. You have great cases that you see, follow the guidelines for authors and send your completed work to the web address for the "Academy prez". This is your opportunity to support the examination process. It has been one of the goals of the Coalition to have as much participation for the field doctors in the development of the examination. It strengthens our specialty. Thanks!

Attribution

Ed Payne, FCER