

Dimorphism in CMC Arthritis



Osteoarthritis of trapeziometacarpal joint is a functionally debilitating disorder which is reported at a prevalence in women that is twice that in men. As with other disorders that affect women more frequently than men, hormonal differences between the sexes have been proposed as an etiologic factor, though the exact nature of how hormonal differences affect the joint is not well understood. Increased joint laxity in women has also been proposed as an etiologic factor in carpometacarpal (CMC) arthritis, as well as other joint injuries that affect women at a greater prevalence than men, due to the altered biomechanics of joint loading that occur.

Relaxin, which is produced in women mainly during pregnancy, has been proposed to play a potential role in TMC arthritis. Relaxin has been shown to upregulate collagenase (MMP-1) and stromelysin (MMP-3) and downregulate tissue inhibitor of matrix metalloprotease-1 (TIMP-1). MMP-1 degrades type I and II collagen in cartilage and bone and MMP-3 breaks down the extracellular matrix, thereby leading to joint destruction in osteoarthritis.

Relaxin receptors have been identified in the anterior oblique ligament in the TMC joints of women undergoing surgery for TMC arthritis. Relaxin may increase joint laxity during the childbearing years, potentially causing abnormal joint loading, leading to arthritis over time. In addition, relaxin may have a direct effect on cartilage by upregulating MMP-1 and MMP-3, and downregulating TIMP-1 within the joint, leading to cartilage degradation and joint destruction.

More research is needed to fully elucidate all the factors that may be involved in order to develop preventive strategies. Careful evaluation of all patients who complain of hand pain for basilar thumb joint tenderness, deformity, loss of motion and generalized laxity and radiographs will aid in the diagnosis of CMC arthrosis.

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Dimorphism in Hip Pathology: Osteoarthritis



In a 2007 review article entitled “Sex differences in hip and knee osteoarthritis”, published in the *Journal of the American Academy of Orthopaedic Surgeons (JAAOS)*, O’Connor highlights that women have a higher prevalence of osteoarthritis (OA) than men.¹⁻³ Estrogen receptors in cartilage and the possibility that the heritable component of osteoarthritis is more influential in women are two theories to explain the difference in prevalence between the sexes. This increased effect of genetics in the manifestation of arthritis in females is underlined in a recent longitudinal study of 3,620 patients with hip arthritis in which 71% of

males with OA were determined to have some anatomic malformation, while only 37% of females were determined to have such.⁴ This study found that acetabular dysplasia was an independent risk factor for OA, and a recent study between sexes regarding anatomy of individuals undergoing hip resurfacing suggests that females have greater acetabular retroversion and lesser femoral offset than males.⁵⁻⁶ In the *JAAOS* article, O’Connor emphasizes that women are three times less likely to undergo arthroplasty for arthritis, but more likely to experience symptoms. The decreased rate of surgery in women with arthritis may be attributed to communication barriers between orthopaedic surgeons and women.⁷

Outcomes in treatment options for arthritis have also been different in women and men. In a recent retrospective analysis of over 4000 total hip arthroplasty procedures, female sex was determined to be protective for cup failure.⁸ Multiple studies of hip resurfacing have shown that the failure rates in females is higher than in males.⁹⁻¹¹ Birmingham group analyzed their data and surmised that higher revision rates in women may have more to do with femoral head size, as opposed to female sex.¹²



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Dimorphism in Hip Pathology: DDH and FAI

Developmental Dysplasia of the Hip

Approximately seventy-five percent of children diagnosed with developmental dysplasia of the hip (DDH) are female.¹⁻² Reasons for the significant difference in prevalence are not understood, but may include increased ligamentous laxity in females, greater estrogen circulation in female fetuses, and maternal pelvic shape- as being first born also increases the risk for DDH. Additionally, breech presentation at birth is a risk factor for DDH, and nearly twice as many female children present in the breech position in the birth canal.

Femoroacetabular Impingement

Although there may be trauma or congenital deformity related abnormalities of the hip that predispose to impingement, recent literature has described more subtle anatomic abnormalities that may also lead to arthritis. In the early part of 2000, Ganz et al published several articles on femoroacetabular (FAI) impingement in which, based primarily on his intra-operative findings during surgical hip dislocation, he characterized two primary types of hip impingement: cam and pincer.³⁻⁵ Ganz has described cam- type impingement as more likely to occur in young men and pincer-type impingement to be more common in middle-aged women, he also acknowledges that most femoroacetabular impingement is mixed in character.^{4, 6}

Additionally, in a CT analysis that compared male and female pelvic anatomy, Ganz's team did not find a difference in acetabular morphology, with the exception of total articular surface, which was found to be smaller in females than in males.⁷ In a retrospective study of patients who underwent hip arthroscopy for presumed intra-articular pathology, approximately half demonstrated osseous abnormalities. Although 56% of the 78 patients who underwent the procedure were women, there was no analysis of difference in either intra-articular or osseous findings by sex.⁸ In another study of 64 patients by Anderson, et al, delamination of cartilage, one of the findings common in individuals with femoroacetabular impingement, was analyzed. In this study, which included 22 women, there was some suggestion of female sex being associated with pincer- type impingement and male sex being associated with male sex.⁹

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Postural Sway and Core Strength Deficit: Risk Factors for FX and ACL Tear



Postural sway and core strength / proprioception deficits have been cited as possible contributory causes for increased incidence of falls in elderly women and in lower extremity sports injury in women, in particular ACL tear.^{1,2,3}

Current fall prevention strategies and sports injury prevention strategies focus on combining strength training along with balance training. Tai Chi has been shown to be effective in improving balance and preventing falls in the elderly as well.^{4,5,6,7}

An OVID Medline literature search using “Wii” as a keyword generated 1 case review of the use of the Wii gaming system for balance training in an elderly patient. There were several reports of its use for assessing balance and for use in patients with cerebral palsy, stroke or brain injury. It may have use in core/ balance training in other populations as well.

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Noncontact anterior cruciate ligament tear is known to be 4-8 times more common in females than males. Seventy percent of anterior cruciate ligament tears occur by a noncontact mechanism. The causes for this are thought to be multifactorial, but neuromuscular control has been central to interventional issues.¹

Core stability, which is an important component of neuromuscular control, is maintained by both static and dynamic structures of the lumbopelvic-hip complex. The dynamic core stabilizers (muscles) are felt to be critical to maintaining equilibrium and limiting displacement of the upper body in relation to the lower body. Measurement of core stability is difficult, and no one test or exam gives complete information.²

Brophy et al studied hip strength and range of motion, and one measurement of core strength in male and female collegiate soccer players. Males showed greater hip and abdominal strength than females. Hip range of motion was shifted toward internal rotation in female soccer players, and they showed significant side-to-side disparity in hip abductor strength which was not present in males.³ Zeller et al. showed increased femoral adduction in female versus male intercollegiate athletes using single leg squat testing and attributed this to differences in hip muscle strength between the sexes.⁴ Zazulak conducted prospective biomechanical-epidemiological studies looking at the effect of core proprioception on knee injury and found a 3.3 fold increase in odds ratio of ligament/meniscal injury for each degree increase in active proprioceptive repositioning error. They also looked at neuromuscular control deficit as a predictor of knee injury risk. They found lateral trunk displacement to be the strongest predictor of ligament injury.^{5,6}

Deficiencies in balance and core strength have been documented in individuals who have sustained ACL tear. Paterno et al studied biomechanical measures in acl reconstructed athletes using 3D motion analysis and postural stability assessment. They found that transverse plane hip kinetics, frontal plane knee kinematics during landing, sagittal plane knee moments at landing and deficits in postural stability predicted second anterior cruciate ligament tear.⁷

Hewitt et al in 2006, conducted a meta-analysis of neuromuscular intervention programs aimed at preventing anterior cruciate ligament tear. They concluded from their review that neuromuscular training may aid in the reduction of anterior cruciate ligament tear if they include plyometric, balance and strength training, performed more than 1 time per week for a minimum of 6 weeks.⁸ Two of the programs cited were the Sportsmetrics program and the PEP program.^{9,10}

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Dimorphism in Shoulder Instability



While shoulder dislocation events occur more commonly in men, shoulder instability remains a difficult problem in women. There is limited information in the reported literature specifically addressing shoulder instability in women. This is likely due to both sex and gender related issues. Sex associated differences arise from differences in the static stabilizers (differences in collagen elasticity), dynamic stabilizers (altered stabilizer muscle firing patterns), and proprioceptive differences. Women have long been

felt to have increased ligamentous laxity^{1,2}, though some authors have called this conclusion into question, at least in part, based on the ratios of men to women in studies reporting on surgical management of shoulder instability³ Women have been shown to have decreased joint proprioceptive ability in the shoulder joint⁴, as well as other joints. Little is known about scapular and rotator cuff muscle firing patterns in men compared to women, with respect to shoulder stability.

Rates of shoulder instability in athletic populations such as college athletes and the military are reported to range from 2.5%/0.9 per 1000 person-years/0.06 per 1000 AE for women vs 2.9%/1.82 per 1000 person-years/ 0.15 per 1000 AE for men^{5,6,7}.

Several authors have reported on results of surgical treatment of multidirectional shoulder laxity, but none address sex specific outcomes.^{8,9} A review of the Instructional Course Lectures for topics addressing management of shoulder instability for the past 6 years showed none to address sex or gender specific issues concerning shoulder instability. It was addressed by Templeton et al, in 2008, in their article on "Sports Injuries in Women..." noting the paucity of information regarding shoulder instability in women¹⁰. It is unknown at this time whether women respond better to nonsurgical management than men, or whether women may be offered surgical management less often, thus resulting in under-representation of women in studies reporting surgical results. More research is needed in these areas, as well as the interplay between static and dynamic stability and the role of proprioception in neuromuscular control of the shoulder with respect to underlying differences between men and women.

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Dimorphism in Adhesive Capsulitis

The myofibroblast is implicated in several superficial (fascial) fibrosing disorders that occur at different ages and are more likely to be found in specific areas of the body depending on the sex of the patient. These conditions have common histopathologic features and are characterized by inflammation, myofibroblast proliferation, and dense scar formation. Men are primarily affected with Dupuytren's, Ledderhose, and Peyronie's diseases. Men also have an increased incidence of posttraumatic elbow contracture. Women have a significantly higher incidence of adhesive capsulitis.

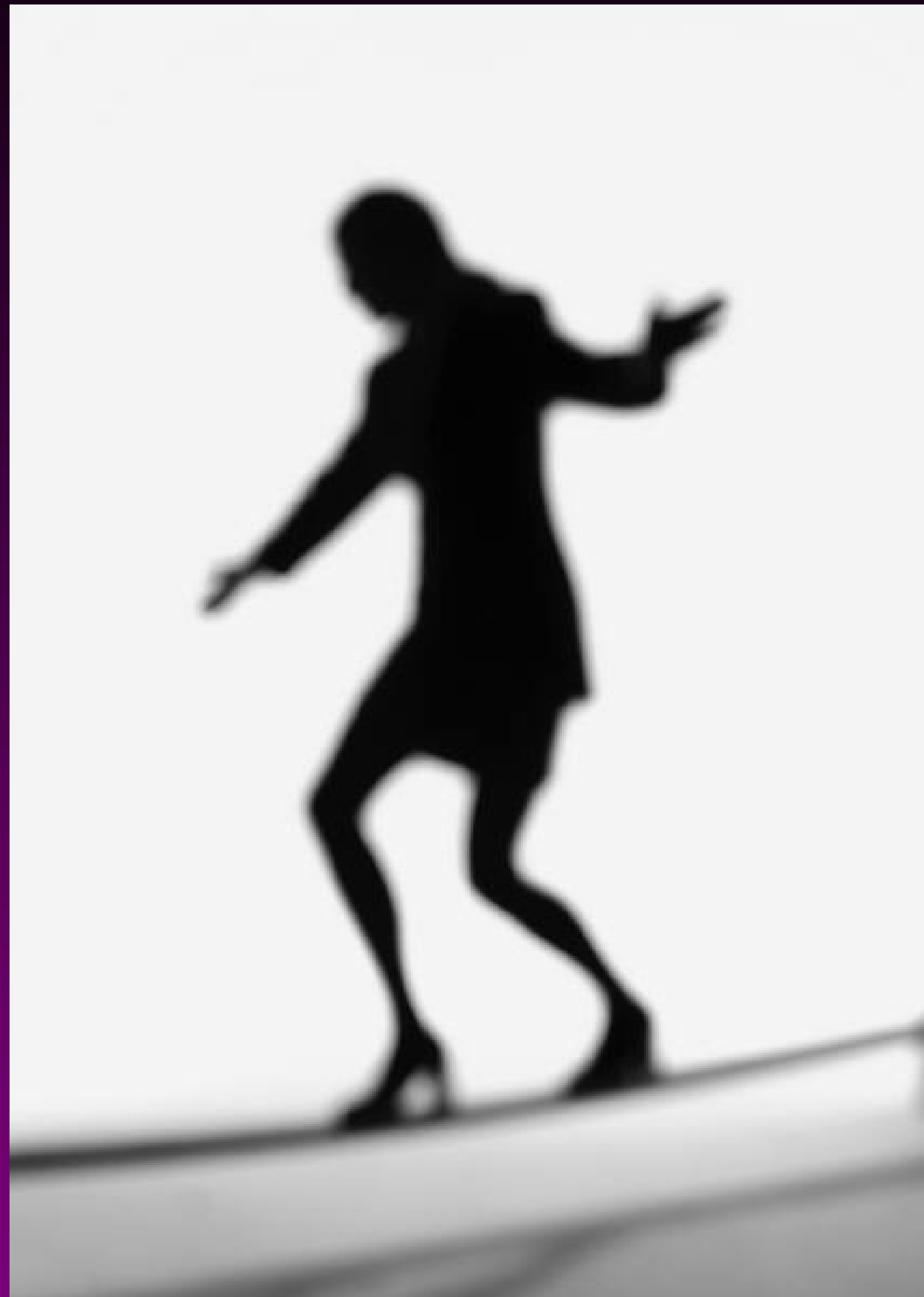
70% of all cases of adhesive capsulitis cases occur in women, most commonly 40 to 60 years old. 20 to 30% of patients will develop adhesive capsulitis in the contralateral shoulder. Adhesive capsulitis is characterized by a painful, gradual loss of both active and passive glenohumeral motion resulting from progressive fibrosis and ultimate contracture of the glenohumeral joint capsule. The development of adhesive capsulitis has been associated with diabetes mellitus, thyroid dysfunction, Dupuytren's contractures, autoimmune diseases, and the treatment of breast cancer. Primary or idiopathic adhesive capsulitis is often used to describe the process of capsular inflammation and fibrosis occurring in the absence of other pathology.

Adhesive capsulitis is characterized by four clinical stages, as well as a three-stage histopathologic progression:

- ◆ **Stage 1** is the 'pre-adhesive' stage, which is characterized by gradual onset of pain and loss of range of motion in all planes. Motion is fully restored with intra-articular injection of local anesthetic and corticosteroid, or anesthesia. Arthroscopy at this stage reveals a fibrinous synovial inflammatory reaction without significant adhesions. A biopsy will show hypervascular and hypertrophic synovitis with normal capsular tissue.
- ◆ **Stage 2** is the 'freezing' stage, with increasing pain and restriction of motion. Limitation of motion cannot be fully reversed with anesthesia or injection. Arthroscopy demonstrates early adhesion formation particularly in the area of the axillary fold of the capsule. A biopsy taken during this stage of the disease will show hypervascular and hypertrophic synovitis as well as perivascular and capsular scarring, with dense myofibroblast proliferation.
- ◆ **Stage 3** is the 'frozen' stage, with pain limited to the end range of motion, and a significant decrease in range of motion. No improvement in motion is seen with intra-articular anesthetic injection. Symptoms have typically been present for 9 to 15 months at this point. Obliteration of the axillary fold is seen on arthroscopic examination. Synovitis is diminished. A biopsy taken during this stage will show a thin synovial layer without hypertrophy or hypervascularity, dense scar tissue, and a proliferation of myofibroblasts within the capsular tissue. Intra-articular injections of corticosteroid are not effective as the inflammatory component of the condition has resolved.
- ◆ **Stage 4** is the 'thawing' stage, with minimal pain and gradual improvement in range of motion. Arthroscopy demonstrates fully mature adhesions. Histopathology has not been reported for this stage.

While this disease is felt to be self-limiting within 2 years of onset, different treatments have been employed to shorten the time period and/or decrease symptoms.

- ◆ **Physical Therapy:** Recommended to both prevent adhesion formation and to improve motion in the latter stages of disease. Despite the lack of high quality studies, it is felt to be beneficial. Gentle stretching and active motion within the pain-free range appear to sufficient and the treatment should begin when the patient no longer has pain at rest.
- ◆ **Intra-Articular Injection:** Intra-articular steroid injections have been shown consistently to help in the short term, but many studies have not shown a difference at long term follow-up as compared to controls. Studies looking at intra-articular injections by stage of disease have shown a greater efficacy in the early inflammatory stages. Recovery after injection was at a median time of 3 months, with stage 1 disease resolving by 6 weeks.
- ◆ **Capsular Disruption:** Manipulation under anesthesia, hydrodilatation, and capsular release all involve disruption/release of the capsular tissue to increase range of motion. These treatments are often reserved for the small group of patients that do not improve with non-operative management.



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