

AN ORIGINAL CONTRIBUTION

SACROILIAC ARTHROGRAMS AND POST-ARTHROGRAPHY COMPUTERIZED TOMOGRAPHY

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Sacroiliac joint (SIJ) injection and arthrography have been described, yet no study has specifically categorized the morphological characteristics of SIJ arthrograms versus post arthrogram computerized tomography (CT). Forty-three patients with a mean age of 33 years (range 20-48 years) and an equal male to female distribution were studied radiographically for SIJ pathology. A total of 74 SIJ injections were performed using Image-intensifier-control and a posterior-inferior approach. Symptom reproduction indicating a provocation positive outcome, was reported in 63.5% with a mean injected volume of contrast me-

dia of 1.08 cc (S.D. 0.29). SIJ findings were then classified and scored in each aspect of the SIJ capsule by plain film arthrography followed by post arthrogram CT (anterior, posterior, superior and inferior aspects of the capsule). There was a significant direct correlation between the plain film and CT arthrography findings in each category (Kendall correlation coefficients 0.63 – 0.99, p<0.01). In addition, there was a significant direct correlation between provocation positive outcomes and volume of contrast injected (Kendall correlation 0.25, p<0.01; ANOVA, p<0.03). Post arthrogram CT revealed significantly more positive anterior

capsule findings compared to plain film arthrography (McNemar's test, p<0.04). Conversely, plain film arthrography noted more diverticula compared to post arthrogram CT (McNemar's test, p<0.01). These findings demonstrate that a detailed radiographic analysis of the SIJ capsule is reasonable by either plain film arthrography or post arthrogram CT, with excellent agreement between the two techniques. Further, each test has specific regional benefits that may be appreciated in certain cases.

Key words: Sacroiliac Joint, Computerized Tomography (CT), CT Arthrography, Provocation

Low back pain has been an enigma to patients and clinicians alike. Billions of health care dollars are spent annually on the diagnosis and treatment of low back pain(1). In this age of managed care, many algorithms for the evaluation and treatment of low back pain have been constructed by government, insurance, physician and allied health groups. Even though there has been a growing emphasis on the management of low back pain, the exact etiology in many circumstances remains unknown (2-4). The sacroiliac joint syndrome, one such etiological factor, is a source of controversy in the literature (2,3,5-7). The medical community at large has been reticent to accept the sacroiliac joint as a putative cause of low back pain. Skepticism remains despite studies that demonstrate that the sacroiliac joint moves, is richly innervated and can

be provoked in a reproducible manner (5, 8-11). Some of this controversy lies in its difficulty to examine due to its anatomical position. Other factors include alternative sources of pain generation in surrounding areas (such as the lumbosacral spine and hip joints) and the lack of knowledge regarding specific diagnostic tests to clearly delineate true sacroiliac pathology (2,3,6).

While radiographic evaluation of the SIJ has been attempted, there is little agreement on its merit and much confusion over interpretation. Adding more to the dilemma is the presence of degenerative changes on plain radiographs in up to 25% of patients over the age of fifty regardless of symptoms (12,13). Radionuclide scanning is beneficial for diagnosing sacroiliac joint inflammation, stress fractures, infection or neoplasm. However, in the face of structural abnormalities or degenerative lumbar spondylosis, there may be a large element of false positive findings (14,15). Computerized tomography can clearly demonstrate the anatomical features of the SIJ which is particularly helpful in infection, inflammation or trauma (13,16,17). However, it is also non-specific and can show degenerative changes after 30 years of age despite the

lack of symptomatology (13,16). It is possible to detect subtle SIJ changes such as asymmetric joint width or sacral torsion (13,16). Magnetic resonance imaging offers promise for delineating soft tissue pathology surrounding the joint, as well as marrow space changes, however, it is not yet part of routine clinical testing. There is limited information regarding sacroiliac joint arthrography; however, Fortin et al (11,18) described a technique for contrast roentgenography which allowed easy cannulation of the SIJ, reproduction of pain referral and isolation of SIJ pathology.

Although diagnostic testing for SIJ pathology continues to be performed, there are no reports in the literature designed exclusively to correlate the morphological characteristics of SIJ arthrograms with those of post arthrography CT. The purpose of the current study is to clearly delineate arthrographic changes with SIJ pathology in symptomatic patients and to correlate this with findings on post-arthrography CT. It is felt that analysis of the SIJ from these two diagnostic perspectives may lead to further clarification of true joint pathology as well as provide some information regarding the usefulness of each test as a diagnostic modality.

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METHODS

Forty-three subjects with a mean age of 33 years (range 20-48) were enrolled in the study. These subjects were referred to a regional spinal diagnostic center for complaints of low back pain which had been present for greater than two weeks. Although these subjects did not carry the diagnosis of SIJ dysfunction all were included in the study to avoid preselection bias. Subjects were excluded from the study on the basis of: prior knowledge of the study, allergy to contrast and/or iodine, females who were B-HCG positive or refusal to participate in the study. Of those forty-three subjects enrolled in the study, a total of seventy-four sacroiliac joints were studied (thirty-one subjects with bilateral complaints). There were an equal number of male and female subjects studied.

A thorough history and physical examination was performed on each patient entered into the study. This included a pain questionnaire and pain diagram completed by each patient. In addition, clinical testing was performed by the same clinician (JF) including standing and seated flexion tests as well as the Gillet test (7,19). Sacroiliac joint provocative injection/arthrography with the aid of direct fluoroscopic visualization was performed on the sacroiliac joints as described in a prior study by Fortin et al (11). If symptoms were unilateral, the corresponding SIJ was initially studied and if symptomatic the contralateral joint was subsequently examined as an internal control to substantiate the provocation reaction. In the limited number of the patients with bilateral provocation positive injections, a lumbosacral disc or posterior joint injection served as a control to validate the SIJ pain response. The volume of contrast media injected into each joint was recorded as well as the outcome of the injection (provocation positive or negative).

Posterior-anterior, oblique and lateral x-rays of the SIJ were obtained following the arthrography. Post-arthrography CT was performed on the same joints with a GE 9800 "Quick" scanner. Five millimeter transaxial and direct coronal scans were acquired (employing a minus 20 degree gantry angle for transaxial sections and a positive 20 degree angle on coronal slices). The images were photographed on both soft tissue and osseous window/level

settings. The anterior, posterior, superior and inferior aspects of the joints were studied by reviewing the post arthrogram x-rays and CT scans.

Statistical analysis was performed on the SAS computer system in conjunction with a statistician. Kendall correlation coefficients were calculated between the radiological findings of SIJ arthrography compared to post-arthrography CT. McNemar's chi square analysis was conducted to examine the significance of particular radiographic findings in each category of arthrography as opposed to the same category of post-arthrography CT (i.e. anterior capsular findings compared to posterior capsule findings, etc.). Finally, multivariate discriminate analysis (ANOVA) was performed to analyze more than one variable at a time (i.e. provocation outcome and volume of contrast material injected).

RESULTS

Forty-three patients were enrolled into the study with a mean age of 33 years (S.D.=7 years, range of 20 – 48 years). There was a 50:50 male to female relationship. A total of 74 sacroiliac joints were studied. Of those studied, 47/74 (63.5%) subjects yielded a positive provocation result. Thus upon injection of the joint with radiopaque dye, there was pain referral to the area of the SIJ pain referral pattern. The mean volume of dye injected was 1.08 cc (S.D.=0.29, range 0.5 – 1.8 cc). Right and left sides were equally positive. There was a significant direct correlation between provocation positive outcome and the volume of the dye injected into the SIJ ($p<0.01$, Kendall correlation coefficient 0.25). One way analysis of variance (ANOVA) was performed and showed that with provocation positive, there was a significant increase in volume injected into the SIJ ($p=0.03$). However, there was no significant correlation between provocation positive and x-ray or CT arthrogram findings in the SIJ analysis. There was no significant correlation between age and volume of material injected.

Findings were examined by plain x-ray and CT/arthrography for all aspects of the joint (anterior, posterior, inferior and superior aspects). Although there were different possibilities of findings for each aspect of the joint, they were compared in a binomial fashion for either positive or negative abnormal findings. Each aspect of the joint on plain x-ray vs. CT

arthrography was contrasted using the McNemar's test. The results indicate that there was a significant difference between the subjects with positive anterior capsule findings on x-ray compared to CT (25.7% compared to 33.8% respectively; $p=0.032$). Therefore, there was a tendency to see more positive findings by CT arthrography than on plain x-ray when examining the anterior capsule. Most commonly seen on x-ray were capsular attenuation and frank ventral tears while on CT capsular schism was seen most frequently. When SIJ diverticula were assessed, there was a tendency to see more diverticula by x-ray than by CT (47.3% compared to 31.1%, $p=0.002$ by McNemar's test). One to two diverticula were seen most commonly by each approach. There were no significant differences seen between x-ray and CT arthrogram findings when examining the posterior, inferior or superior aspects of the SIJ capsule (McNemar's test >0.05).

Kendall correlation was performed comparing plain x-ray and CT arthrography for each aspect of the joint capsule. There was a statistically significant direct correlation of x-ray and CT findings for each variable studied (Kendall Correlation Coefficient range 0.63 – 0.99 with two-tailed $p=0.001$ in each case).

Further analyses were used between age and x-ray or CT arthrogram findings. Although there was no strong correlation, there was a relationship seen between increasing age and decreased number of diverticula (Kendall Correlation Coefficient = -.029, $p=0.025$). Finally, there was no significant difference seen between male and female sex and x-ray or CT findings (Man Whitney test $p=0.17$).

DISCUSSION

Although plain film arthrography and CT scan have been performed in the past for the SIJ, they are by no means routinely used in the diagnosis of SIJ pathology. Further, clinicians are not familiar with the subtle radiological findings of the SIJ that could be responsible for the patients' complaints of pain. Currently, there are two potential modalities that can be used to accurately and completely assess all of the anatomical dimensions of the SIJ – plain film arthrography and CT arthrography. This study was a first approximation to compare the findings of SIJ arthrography to post-arthrography CT. However, false positive radiographic

findings are common and may not relate to symptoms.

There is a distinct advantage to using arthrography in the diagnosis of SIJ capsular pathology. Joint injection allows the determination of a provocation positive or negative test and site specific anesthetization may help confirm the diagnosis. As in other joints more commonly studied, introduction of a fluid medium into a joint capsule can serve to distend the joint capsule and reproduce a particular pain pattern in a symptomatic joint (18,20,21). Further information is obtained regarding the amount of the fluid injected into the joint capsule. For example, a joint capsule with a tear, capsular attenuation or diverticula should theoretically accept more fluid into the joint. This study showed that there was a direct relationship between volume injected and provocation positive joints. Therefore, the arthrogram can provide some immediate useful information in the diagnosis of SIJ pathology regardless of whether the injection is followed by plain x-ray or CT.

The next element of useful information obtained from this study was the close relationship between conventional plain film x-ray arthrography and CT arthrography. This study was valuable in that it allowed the detection of close similarities in assessment between x-ray and CT for the posterior, inferior and superior capsular elements of the SIJ. For example, there was an equal relationship between x-ray and CT arthrogram for diagnosing such capsular pathology as capsular attenuation, schism, ventral tears, extent of dye extravasation and joint redundancy. This realization has several important implications. First, these findings have never been routinely addressed for the SIJ. Although some of these findings are small radiographically, they are still elements of joint pathology that putatively may be pain generators. Second, there is clear reproducible radiographical evidence that the SIJ capsule can be graded for pathology leading to further understanding of this complex joint.

There were two areas of difference between x-ray and CT/ arthrography. One difference was that more diverticula were visualized on conventional plain film arthrography than on CT/ arthrography. This finding is useful in that x-ray is a more practical test to obtain the most information in initial SIJ imaging. The other difference was that the CT arthro-

gram was more useful in detecting anterior or capsular pathology (8.1% more pathology than with x-ray) compared to the x-ray arthrogram. CT arthrography can be considered as a diagnostic test in individual cases where there is a high clinical suspicion for SIJ pathology despite normal plain film arthrograms.

One intriguing finding was the absence of a significant correlation between symptomatic joints on provocative injection and either x-ray or CT arthrogram positive findings. This may be explained on the basis that some patients had subradiographic SIJ pathology (e.g isolated capsular inflammation). It may also point to the provocative test as an extremely sensitive modality, or conversely, that there was a certain number of false positive provocation tests.

Another curious finding was that there were not more positive radiographic findings with increased age. This might be explained by the age range in this study. The mean age was 33 years with a range of 20-48 years. If joint pathology is expected to be a function partially of increasing age, this study may not have examined an old enough range. Namely, perhaps a group over the age of 50 may show significant radiographic abnormalities correlating with degenerative joint diseases (12,13). The subjects in this study were select young individuals with distinct injuries to the low back which may have been irrespective of degenerative findings. The purpose of this study was not to discern age related changes to the SIJ, but rather the similarities between x-ray and CT arthrography in patients with SIJ mediated pain (individuals who were previously healthy).

CONCLUSION

The sacroiliac joint is a complex joint that is responsible for many cases of low back pain. Accurate diagnosis of sacroiliac joint syndrome in the evaluation of low back pain has been sought by various methods. Although imaging modalities have been used in the past for the diagnosis of SIJ pathology, few studies have examined grading methods to investigate each aspect of the joint capsule. Further, no studies have compared the utility of SIJ arthrograms to post-arthrography CT. This study has found that the SIJ can be successfully graded by either radiologic method. Further, there was significant

direct correlation between the SIJ arthrogram and post-arthrography CT. This has important implications in that an initial screening approach to SIJ capsular pathology can consist of SIJ arthrography. In those cases that are more difficult to diagnose in this manner, then post-arthrography CT can be used to add further information on SIJ pathology.

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