ORIGINAL RESEARCH PAPER

Radiodiagnosis

IMAGING OF SI JOINT: MODIFIED CT PROTOCOL OF SACROILIAC JOINT TO MINIMISE RADIATION DOSE IN DIAGNOSIS OF SACROILIITIS

KEY WORDS: Sacroiliitis, Spondyloarthritis(spa), Magnetic Resonance Imaging(Mri), Computed Tomography (ct) Scan.

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ABSTRACT

The early diagnosis of sacroiliitis is need for Radiologist in low back ache cases for diagnosis, prognostication and further planning of treatment. Even though MRI is the imaging modality of choice, the availability and cost of MRI are not allowing all patients to undergo MRI imaging. The CT scan with modified protocol has been done in limited length of 100-110 mm to include SI joint with low MA and KV technique without losing the diagnostic criteria and staging of disease.

INTRODUCTION:

The low back ache is due to either inflammatory arthritis or mechanical cause.(1) The Sacroiliitis is one of the inflammatory arthritis where the recognition of sacroiliitis is must to diagnose axial spondyloarthritis (SpA).About 20% of patients with low back pain have inflammatory-type pain (2) while about 20% of these patients with inflammatory-type pain will have axial SpA. The prevalence of axial SpA is about 1% (4,5), though this prevalence does vary according to ethnicity and HLA-B27 population prevalence. Early recognition and treatment of inflammatory arthritis can reduce symptoms; improve quality of life and morbidity.

SpA is diagnosed using a combination of clinical, serological and imaging criteria Clinical criteria include the presence of inflammatory-type low back pain with features of SpA like anterior uveitis. Serological criteria relate to HLA B27 positivity, and imaging criteria includes evidence of sacroiliitis and spondyloarthritis.

Only 50% of patients clinically diagnosed axial SpA have radiographic evidence of SpA, but the remainder have no radiographic features of SpA (3,4). These non-radiographic SpA patients may progress to radiographic SpA later or never progress at all. But the disease activity and morbidity are similar (5), the distinction may not change the prognosis or treatment, but those patients with radiographic evidence can be on follow up for disease progression and assessment of treatment response. Those non radiographic patients may also undergo follow up imaging for evidence of disease subjective progression.

MRI examination is still usually performed to detect sacro iliitis since it is sensitive imaging technique to detect sacroiliitis as it reveals bone marrow oedema . However low dose CT is performed to demonstrate erosions, joint space status and ankylosis clearly with less time and cost. The early diagnosis of inflammatory sacroiliitis and SpA in patients who have the disease, it is equally important to recognize the entities that may mimic sacroiliitis. The over-diagnosing inflammatory sacroiliitis and labelling the patient as having SpA can have a significant negative impact on lifestyle, job prospects, health insurance, etc. (6). Potential mimics of sacroiliitis include stress-related changes, infective sacroiliitis, osteoarthritis, stress fracture, insufficiency fracture and osteitis condensans ilii (7).

IMAGING:

Still the Radiograph is the primary modality for all patients with low back ache. Because of oblique alignment and irregular margin of sacroiliac joint, the radiograph fails to diagnose the sacroiliitis at early stage. The CT and MRI overcomes these difficulties, however the availability and financial implication on MRI makes difficult for all patients to get imaging done. The problem of CT scan is the radiation to pelvic structures which can be reduced by low Milliamphere and kilovolt (MA and KV) technique in limited field of vision(FOV) and CT sections. The scanogram is obtained in supine patient from anterior superior iliac spine to upper margin of pubic symphysis. The view angle of 180 degree, KV 80 and length of 100-110 mm are kept and obtaining single image which has CTDI of 0.02 mmGy in time of 0.753 second and DLP of 0.2 mGy*cm. NCCT axial helical scan is planned from superior margin of first sacral foramen to lower margin of second sacral foramen with thickness of 2mm, increment of 2mm for length of 110 mm and KV 80, MA 200. The dose right is Z-DOM with direct recon to get 50-55 images of 1mm thickness, CTDI of 4 mGy in 5.479 second duration. The total DLP of 59 mGy*cm is given to patient. These high resolution images are reconstructed in I dose (3) algorithm in Bone filter and window centre of 600 and width of 2000 in 512 matrix to obtain images which are adequate to diagnose erosion, sclerosis, joint space status etc.

CT TECHNIQUE: The patient is positioned supine in CT gantry with foot first position and no pelvic tilt in 256 Slice multi detector Philips iCT. The scanogram of 100-110 length is acquired. Helical scan planning is done from superior margin of first sacral foramen to inferior margin of second sacral foramen. The average number of slices is five with 2 mm thickness and 2 mm increment. The MA and KV are adjusted to as 200 MA and 80 KV and the effective MA on patient will be adjusted according to the thickness of the patient by automatic dose control technique. The 50-55 recon images are obtained in bone window and if required reconstructed in soft tissue algorithm.

INTERPRETATION OF IMAGES:

Age-related changes in the sacroiliac joint usually starts in puberty and continue throughout life (8). Degenarative changes are more common in females than in males of the same age and progress faster in multiparous than in nulliparous women (9). So differentiating sacroiliitis from degenerative changes can sometimes be difficult. The most common changes is loss of joint space (normal width = approximately 2.49 mm ± 0.66 in people under 40 years of age and 1.47 mm ± 0.21 in older people) (10). Vogler et al (11) used CT to study the sacroiliac joints of 45 asymptomatic subjects and found the joints to be symmetric in people under the age of 30 years and asymmetric in older people and found nonuniform iliac sclerosis, focal joint space narrowing in patients over 30 years of age with ill-defined areas of subchondral sclerosis, particularly on the iliac side, occur frequently in the asymptomatic population and so these are poor indicators of sacroiliitis (11). But sacral subchondral sclerosis (in young people), uniform joint space narrowing, erosions, and intraarticular ankylosis are rarely found in asymptomatic patients which may represent good indicators of sacroiliitis (11). Finally, osteophytes, pneumocysts, and the "articular vacuum sign" are characteristic of osteoarthritis,

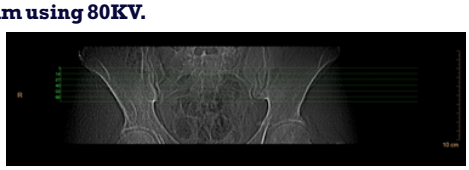
although the latter can also be detected in patients with sacroiliitis without active inflammation (9).

According to the modified New York criteria, five grades —from 0 (normal) to 4 (ankylosis)—can be differentiated (12). Grade 0 denotes normal sacroiliac joints with well-defined margins; Grade 1, suspicious changes with incipient sclerosis and decreased focal thickness of the articular space; Grade 2, minimal abnormality with loss of definition of the articular margins, subchondral osteoporosis, and areas of reactive sclerosis; Grade 3, unequivocal abnormality with subchondral sclerosis of both sacral and iliac articular margins (predominantly on the iliac side), erosions, reduced articular space, widening of the joint space, and incipient ankylosis; and Grade 4, complete ankylosis with residual sclerosis, which tends to decrease over time. On the basis of the modified New York criteria, bilateral changes corresponding to Grade 2 or higher, or unilateral changes corresponding to Grade 3 or higher, must be detected to diagnose sacroiliitis radiographically.

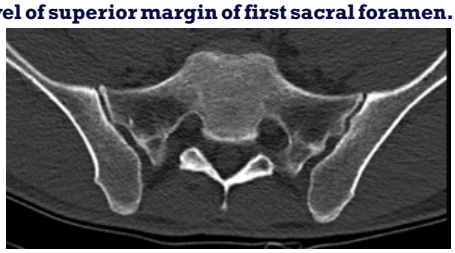
CT is more sensitive than conventional radiography for the detection of structural changes; therefore, it allows a more detailed assessment of the sacroiliac joints (13-15).There is minimal interobserver variability in the interpretation of CT findings (14), and CT allows good evaluation of bone proliferation in the ligamentous portion of the joint (16). The Problem of CT is radiation exposure and poor diagnosis at active inflammation.

The CT findings of sacroiliitis are similar radiographic findings which include erosions, sclerosis, and later stage ankylosis (17). A 2003 workshop on sacroiliitis proposed a grading system for CT findings in which grade IA denotes a sacroiliac joint articular space greater than 4 mm; IB, a sacroiliac joint space less than 2 mm; IIA, contour irregularities; IIB, erosions (appearing early in the iliac aspect and later on the sacral side); IIIA, significant subchondral sclerosis; IIIB, spur formation; IVA, transarticular bone bridges; and IVB, total ankylosis (18).

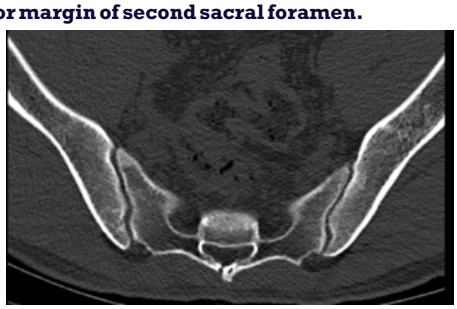
Scanogram (Fig 1): Image is obtained in 0.73 s to include 108 mm using 80KV.



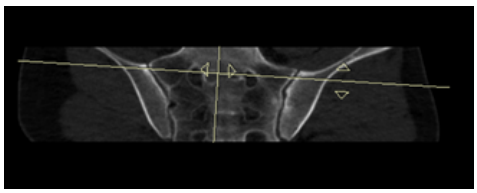
Helical CT SI Joint(Fig 2): Initial section of helical CT at the level of superior margin of first sacral foramen.



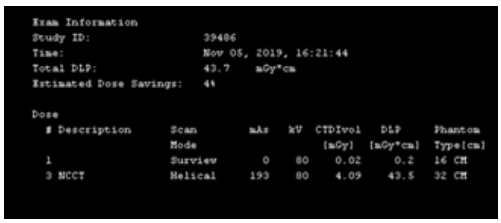
Helical CT SI Joint(Fig 3): The last image of helical CT at inferior margin of second sacral foramen.



Coronal oblique plane(Fig4): Reconstructed image is to show bilateral SI joints in coronal plane.



Radiation Dose Information(Fig5): The total radiation dose to the patient is reduced without losing the diagnostic information.



Exam Information
Study ID: 39486
Time: Nov 05, 2019, 16:21:44
Total DLP: 43.7 mGy*cm
Estimated Dose Savings: 4%

Dose

#	Description	Scan Mode	mAs	kV	CTDIvol [mGy]	DLP [mGy*cm]	Phantom Type[cm]
1		Survey	0	80	0.02	0.2	16 CM
3	NCCT	Helical	193	80	4.09	43.5	32 CM

SUMMARY:

is more sensitive than conventional radiography for the detection of structural changes on either side of SI joints. Even though MRI can diagnose bone marrow oedema which is an early change of inflammatory arthritis, the cost and less availability of MRI makes the imaging and follow up difficult. The CT is available in most of the places and it is cheap compared to MRI. However the radiation exposure is important one in CT scan. When we plan Scanogram and helical CT of limited length and 2mm slice thickness with 2mm increment without losing diagnostic information, the patient radiation dose will be highly reduced and almost equal to single pelvic radiograph. The marginal erosion, sclerosis of joint surface , joint space changes, symmetry and bony ankylosis are better appreciated in helical CT. Even though clinical and biochemical criteria may conclude the diagnosis to some extent, the imaging plays important role in diagnosis and to assess response to therapy as well as prognosticate the case. Other than MRI diagnosis of bone marrow edema, the CT provides information which helps to assess the morbidity of the patient , response to therapy and prognosis in future.

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