JournalofCardiovascularDiseaseResearch

ISSN:0975-3583,0976-2833 VOL13, ISSUE05,2022

Original research article

The normal ischiofemoral distance and its variations in the South Indians

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Abstract
Aim of study to measure the IFD in the normal hip joint with healthy surrounding soft tissues and elaborate its variations by genderand age so that this could serve as a reference for future studies on this topic. This is a retrospective study in which we reviewed the MRI scans of 100 patients (200 hips) who had MRI of pelvis for aetiology other than hip joints pathology. The images were reviewed for the IFD measurement (the smallest distance between the lateral cortex of the ischial tuberosity and the posteromedial cortex of the lesser trochanter).
The MRI scans belonged to 71 females and 29 males (F: 71%, M: 21%), with an average age of 38.8 (range 13-72). The mean right side IFD was 19.8mmm left side IFD mm 18.5mm.
Keywords: Ishiofemoral distance, ischial tuberosity, lesser trochanter, MRI

Introduction

Impingement around the hip joint can predominantly occur in three areas. While femoroacetabular impingement is more common, well understood and believed to be responsible for majority of the cases of hip pain[1,2]. The Ischiofemoral impingement (IFI) and subspinous impingement are less common and still not well understood. In IFI, there is a reduction of the ischiofemoral distance (IFD), i.e. the smallest distance between the lateral cortex of the ischial tuberosity and the posteromedial cortex ofthe lesser trochanter. This reduction then leads to inflammation and damage of the anatomical structures within this space, which is the quadratus femoris muscle[3,4].
A reduced IFD can be due to positional, secondary to a congenital abnormality or acquired[5]. Positional factors that may affect the ischiofemoral space include lower extremity extension/flexion, abduction/adduction and internal/external rotation[4-6].
Acquired ischiofemoral narrowing may be seen as a result of valgus osteotomy of the hip, fractures involving the lesser trochanter, osteoarthritis associated with superomedial migration [3], enthesopathy of the proximal hamstring insertion[7,8] or an expansile bony lesion in this region[9].
IFI was first reported by Johnson[3] as an iatrogenic complication following total hip arthroplasty. However, more recently, IFI has also been reported in patients with no history of previous hip trauma or surgery[9,10].
Johnson had estimated the size of the ischiofemoral distance to be 2 cm in his study with the hip in extension, adduction and external rotation. However, there was no data or evidence to support the accuracy of this measurement. Furthermore, it is quite surprising that most subsequent studies and case reports discussing this subject used Johnson's measurement of 2 cm as a reference for IFD[4,5,11]. To the best of our knowledge, a quantitative measurement of the IFD with a large number of patients has not been accurately reported in the south Indians. Theaim of this study, therefore, was to measure the IFD in the normal hip with healthy surrounding soft tissues and describe its variations caused by gender, and age so that this could serve as a reference for future studies on this topic.

Objective

- To measure the ischiofemoral distance (IFD) in the normal hip joint.
- To evaluate signal variations of quadratus femoris muscle on PDFS, T2W and T1W sequences.
- To describe the IFD variations by the ageand gender.

Material and methods

For the period of six months, all the patients who underwent an MRI scan of pelvis at our institution for

ISSN:0975-3583,0976-2833 VOL13, ISSUE05,2022

any pathology unrelated to the hip, proximal femur or associated soft tissue (gastrointestinaland genitourinary pathology) were included in our study. The IFD measured in the axial section either on T1W/PDFS sequences (fig-01). Suitable patientswere divided by gender and age.Exclusion criteria included history of recent hip trauma (within a month), infection or inflammatory arthritis of the hip, osteoarthritis of the hip, previous hip surgery and history of current hip pain. The above information was retrospectively collected from the medical records of all the patients.

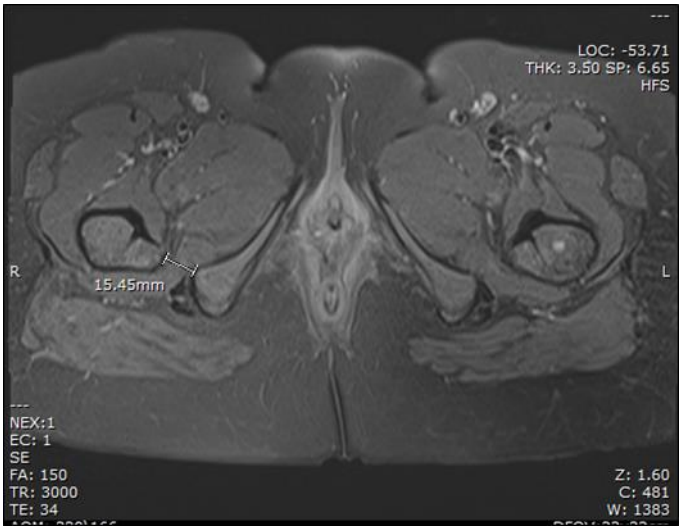

Fig 1: Axial PDFS image showing the measurement of IFD

After a detailed history and clinical examination, MR imaging was performed with SIEMENS MagnetomAvanto 1.5 Tesla MRI scanner. The following examination protocol was applied:

- T1-WI (TR/TE = 500-700/12-20; FOV, 200-300 mm) in axial, coronal ± sagittal.
- T2-WI (TR/TE = 4000-6000/76-90; FOV, 150-250 mm) in axial and coronal.
- PDFS in axial and coronal planes (TR/TE = >1000/<30, FOV, 200-300mm)

Discussion

There have been previous studies reporting IFD but none have provided measurements in south Indian population. The geographical groups may show substantial differences in IFD, this led to measure IFD of south Indian populations in our study.

The patients present with chronic hip pain, one of the causes can be ischiofemoral impingement syndrome, to diagnose this condition we need to know normal IFD.Abnormal MR signal intensity of the quadratus femoris muscleand narrowing of the ischiofemoral space makes diagnosis of ischiofemoral impingement syndrome easy.

Ischiofemoral impingement syndrome is a relatively new entity. It was first suggested in 1977 by Johnson in patients with prior hip surgery, who experienced pain relief after lesser trochanter excision[3]. More recently, it has been reported in patients with no history of previous hip trauma or surgery[6,8]. Its origin is found in compression of the quadratus femoris muscle between the lesser trochanter laterally, and the ischial tuberosity and the hamstrings medially[6].

It typically affects middle-aged women. The female predominance might be explained by the different configuration of the pelvis. Hip osteoarthritis, proximal femur fractures and intertrochanteric osteotomy may all narrow the ischiofemoral space. However, absence of these entities and bilateral hip involvement is reported in about one third of patients, also suggesting a congenital aetiology[6].

Patients may present with non-specific pain in the hip, groin or buttock. Incidentally a snapping sensation, crepitation or joint locking is mentioned. Irritation of the sciatic nerve with radiating pain to the lower extremity is less frequent[4,6]. Since no specific diagnostic test exists, imaging should be obtained for proper diagnosis.

Radiographs are usually of little contribution to the diagnosis. Important MRI findings are the narrowing of the ischiofemoral space with abnormal signal intensity of the quadratus femoris muscle[3]. Impingement leads to oedema of the quadratus femoris muscle, and eventually to fatty degeneration and atrophy at an advanced stage. The transverse imaging plane is preferred to measure the ischiofemoral and the quadratus femoris space. Both are significantly reduced in patients with ischiofemoral impingement when compared with control subjects[4]. The normal ischiofemoral space measures about 19 mm in healthy females and 23 mm in males[12]. A cutoff of ≤ 15 mm for the narrowed ischiofemoral space and ≤ 10 mm for the quadratus femoris space yielded the best sensitivity and specificity in a recent meta-analysis[13]. The extent of the imaging findings is not always in correlation with the clinical findings. Patients may be asymptomatic even with extensive signs of impingement on MRI[14]. Furthermore,

ISSN:0975-3583,0976-2833 VOL13, ISSUE05,2022

varying patient positioning during imaging might influence measurements adversely[4].
Treatment options include physical therapy, anti-inflammatory drugs, quadratus femoris steroid infiltrations or surgery in therapy-resistant cases.

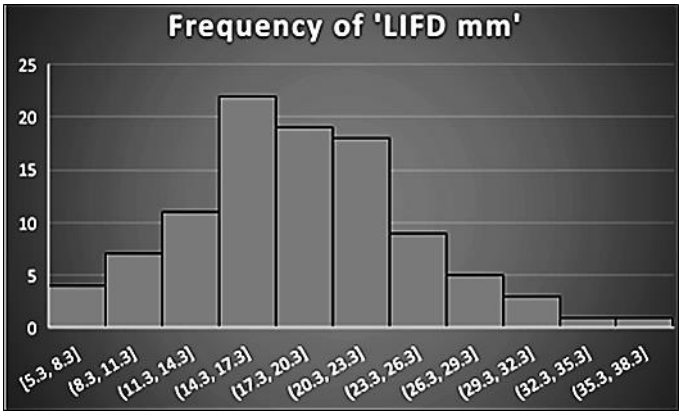

Fig 2: Bar chart showing the frequency distribution of LIFD

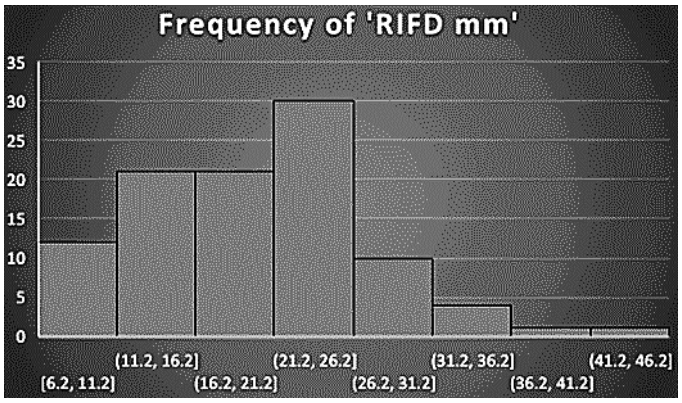

Fig 3: Bar chart showing the frequency distribution of RIFD

Johnson[3] first described IFI in 1977 as a potential cause of hip pain after total hip replacement and proximal femoral osteotomy. The article defined the distance between the lesser trochanter and the ischial tuberosity as 2 cm when the hip is in extension, adduction and external rotation. However, this study did not provide information as to the source of this figure and no measurementdata were provided.
In an attempt to measure the normal IFD, Torriani*et al*.[4]used a controlled group consisting of 11 hips from 10 female patients who underwent hip MRI following trauma to exclude a fracture. The hips were positioned in internal rotation with feet secured by adhesive taping.They reported that the IFD measured was 23.6 +/- 8 mm. However, most of the scans were being done for hip trauma, which introduces bias. In this study, trauma was an exclusion criterion as this can affect the resting position, flexibility of the hip and the surrounding soft tissue. The exclusively female population studied in Torriani*et al*.'s and the small numbers of patients involved also limited the study's applicability to other case.
In another case report, Ali *et al*.[5]described IFI following hip trauma causing a snapping hip. They performed a bilateral hip MRI and compared the IFD between the symptomatic and asymptomatic side. Another MRI was performed 7 months following the traumatic episode, which showed no difference between the IFDs and no abnormality of quadratus femoris. Another MRI at 19 months following the injury showed reduction of the IFD, and the 24-month MRI revealed further narrowing to 14.6 mm on the right and 22 mm on the left. They used the measurement published by Torriani as a reference and considered the distance measured in their study abnormally low. However, it is quite likely that the variation in rotation of the hip between Torriani's study and Ali's case study may have significantly affected the results.
Patti *et al*. [9] in a case report described IFI in a native hip joint with no history of trauma or surgery. Radiographs and MRI showed severe narrowing of the IFD however no measurement was provided.

Limitations

Given the population that this study was conducted on islimited, as our study was retrospective, we don't know the position of limbs while scanning that may alter the IFD measurement. It is therefore possible that different positions may show substantial differences in IFDand future studies in this area may be warranted.The difficulties in using an MRI for assessment of theIFD cause a problem.

ISSN:0975-3583,0976-2833 VOL13, ISSUE05,2022

Results

The mean normal RIFD and LIFD in a healthy female is 18.57mm and 17.46mm and in males is 23.06mm and 21.22mm respectively.

Table1: Mean RIFD and LIFD according to age groups

Age group (yr)	<20	20-40	40-60	>60
mean LIFD (mm)	17.25	18.53	18.67	19.4
Mean RIFD (mm)	18.8	19.7	20.3	20.5

Table 2: Mean RIFD and LIFD according to gender

Gender	Mean RIFD mm	Mean LIFD mm
Female	18.57	17.46
Male	23.06	21.22
Total	19.87	18.55

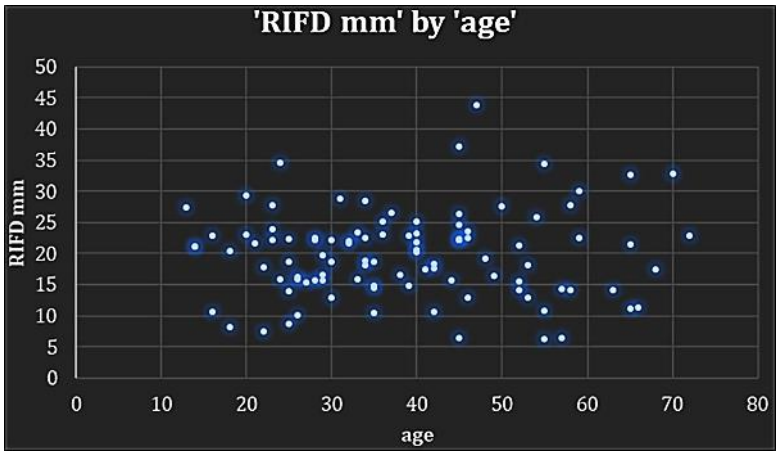

Fig 4: Scattered diagram showing the RIFD variation by the age

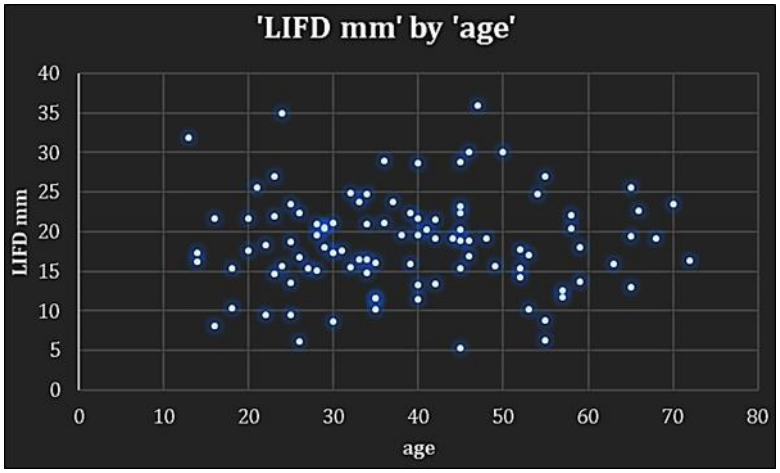

Fig 5: Scattered diagram showing the LIFD variation by the age

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