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Diagnosis of Achilles Tendon Pathology: Ultrasonography Versus Plain X-ray

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Author's contribution

This work was carried out in collaboration between all authors. Authors MRK and FN conceived the research idea, drafted research proposal and collected data. Alongside both of them, authors MABS and FH had significant go through on the manuscript and performed grammatical correction, statistical analysis, formatting figures/tables, etc. Authors MM, IJ, MAU, TM and NA also contributed profoundly providing literature resources during manuscript preparation. Besides significant editing work on the drafted manuscript, authors AKMS and SMR supervised the research work meticulously. Most importantly, all authors' approved the final version of the submitted write-up.

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ABSTRACT

Aims: The current study aimed to highlight diagnostic usefulness of ultrasonography (USG) in Achilles tendon pathology.

Methods: This cross-sectional study was conducted in the department of Physical Medicine and Rehabilitation in co-operation with Orthopedics and Traumatology facility of Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh. The study period was 2 years (July 2010 to June 2012); and 61 patients with posterior heel pain selected consecutively. Along with history taking, enrolled subjects examined meticulously. Non-invasive measures such as X-ray, USG (Siemens premium edition, Acuson antares, transducer: VF 10-5, 5.7-10 MHz) also used to acquire further information regarding heel pathology. A semi-structured questionnaire used to preserve primary data. Since, four subjects refused to do USG and X-rays were not available from another seven, we studied over rest fifty. Uni-variate analysis performed. Having been used kappa statistics, sensitivity, specificity, positive predictive value, and negative predictive value of ultrasound and X-ray in several Achilles tendon pathologies performed; $p < 0.05$ considered statistically significant.

Results: Among of all participants, 38.0% belonged to 36-45 age range and maximum (68.0%) were male. Although a substantial 37 (76.0%) had been suffering from localized back heel pain, 13 (26.0%) of them had systemic diseases like diabetes mellitus (76.9%), dyslipidaemia (1, 2.0%), systemic lupus erythematosus (1, 2.0%), and ankylosing spondylitis (1, 2.0%). Achilles tendinitis, Achilles tendon rupture, retrocalcaneal bursitis, tendon xanthoma diagnosed using ultrasonogram in 31 (62.0%), 7 (14%), 3(6%), and 1 (2.0%) patients respectively. Concerning Achilles tendon pathology, USG was 95.0% sensitive, 50.0%, specific, and 92.0% accurate, whereas diagnostic sensitivity, specificity, and accuracy for X-ray was 39.0%, 75.0%, and 42.0% respectively.

Conclusion: In diagnosing soft tissue pathologies in and around Achilles tendon ultrasound is far better option than conventional X-ray.

Keywords: Achilles tendon pathology; diagnosis; ultrasound; X-ray.

1. INTRODUCTION

Achilles tendinopathy is multi-factorial. Day by day, the prevalence of Achilles tendon pathology has been increasing, though presentation differs in different age groups, professions, even in the geographical locations [1]. Alongside physical examination, advanced technological (radio-imaging) appliances namely magnetic resonance imaging (MRI), ultrasonogram (USG), etc. have been proved to be useful not only in defining Achilles tendinopathy in exact but differentiating various Achilles tendon pathology also. Superficial tendons like tendo Achilles are very amenable to imaging with USG, providing clear information concerning tendon width, tendon sheath swelling, collagen integrity, vascularity, changes of water content within the tendon and or peritendon. Furthermore, role of USG in diagnosing small areas of calcification and bursal swelling in and around Achilles tendon is priceless [2,3]. High frequency diagnostic ultrasound resolves controversies between tendinitis, paratendinitis and retro-calcaneal bursitis as well. Foreign body lesions can also be recognized on USG [4]. As per experts, along with conventional approach, dynamic screening provides added value while assessing Achilles tendon tears on sonogram [5].

On the other hand, conventional X-rays provide very scarce information regarding soft tissue pathologies except soft tissue swelling around heel, compared to sonogram. In a study, contrasting ultrasonographic pre-operative evaluation to surgical findings of Achilles tendon disorders, USG found to be highly specific and sensitive in diagnosing Achilles tendon tears and priceless in illuminating many elusive cases of tendinosis and tendinitis. Because of diagnostic advantages, ultrasound can be used in the primary clinic set up both dynamically and real time. In addition, compared to magnetic resonance imaging (MRI), ultrasonography has the capability of demonstrating physiological movement as well. It is both simpler and cost effective [5,6]. To be more precise, in Achilles pathology, the diagnostic accuracy of USG and MRI is no more different [7].

Present study, stressing to compare the USG with conventional X-ray in diagnosing Achilles tendon pathology on a large scale. Since usefulness of ultrasonogram concerning this fact has not been examined in any Bangladeshi set up yet, we take the current initiative; and hope it will guide clinicians in understanding the role of ultrasound in various heel pathologies precisely.

2. METHODS AND MATERIALS

This cross-sectional (prospective) study commenced and completed between July, 2010 and June, 2012, enrolling 61 consecutive patients with rear heel pain attended at both Physical Medicine and Rehabilitation and Orthopedics and Traumatology department, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh. Patients' demographic and clinical information collected in a pre-fabricated data sheet. Furthermore, patients' examined using following physical signs/maneuvers: visible gap at Achilles tendon insertion, Achilles tendon swelling, local tenderness, Royal London test, Thomson test (to test Achilles tendon integrity), painful arc sign (to differentiate Achilles paratenonitis from tendinitis). Each patient had gone through heel USG and X-ray as well. Among the total, 11 had been excluded during the study (4 refused to do USG; X-rays were not available in 7 patients). Finally, we analyze data as to remainder 50 patients. Prior to commencement, institutional ethical review board approved the research proposal. Informed consent was also taken from each study subject.

2.1 Inclusion and Exclusion Criteria

Patients with both sex suffered from posterior heel pain and or swelling were included in the study. However, subjects suffered from concurrent heel ulcer, eczematous change, heel surgery, traumatic or a-traumatic calcaneal fracture exempted. We did also not include those patients, failing to tolerate minimum pressure of USG transducer during examination.

2.2 Equipment and Technique of Examination

In quest of different heel pathologies, Siemens premium edition (Acuson antares, transducer: VF 10-5, 5.7-10 MHz, Germany) had been used. A combination of longitudinal and transverse ultrasound scans provided a three dimensional approach to tendon examination. While examining tendon the patient lied on the examination bed with prone position, hanging legs by the bed edge so that radiologist can take the full advantage of real time ability by examining the tendon through flexion and extension maneuvers. We X-rayed patients' both ankle and foot (antero-posterior and lateral view) to have radiological information.

2.3 Data Collection and Analysis

Data collected in a pre-designed semi-structured questionnaire. They remained secure under lock and key. All the relevant collected data placed in Statistical Packages for Social Sciences (SPSS; 13.0). Taking clinical diagnosis as diagnosis of reference, we calculated the sensitivity (Sn), specificity (Sp), positive predictive value (PPV), and negative predictive value (NPV), accuracy of ultrasound and X-ray in detecting Achilles tendon pathology, based on imaging features according to formulae described by Knapp and Miler [8]. And in this study we tested following hypotheses: USG is a tool of choice in the diagnosis of Achilles tendon pathology.

Here, $Sn = a/a+c \times 100$, $Sp = d/b+d \times 100$, $PPV = a/a+b \times 100$, $NPV = d/c+d \times 100$, $accuracy = a+d/N \times 100$, here, a=true disease positive, b= false positive/disease negative, c=false negative, d= true negative, N= total population.

For the agreement of two diagnostic modalities (here, USG and X-ray in diagnosing posterior heel pathology), kappa statistics used and interpreted as follow: less than 0.20, poor agreement; 0.21–0.40, fair agreement; 0.41–0.60, moderate agreement; 0.61–0.80, good agreement; and 0.81–1.00, very good agreement. p – value, < 0.05 (at 95% CI) was considered statistically significant.

3. RESULTS

Participants' demographic profile present in Table 1. Among all respondents, maximum (19, 38.0%) were in 36-45 and least were in 55-plus age group. The distribution was 20%, 18% and 14% in 26-35, 16-25, and 46-55 age range respectively. Patients' mean age at presentation was 38.14±12.19 years; and male was dominating (34, 68.0%). Moreover, average disease duration was 0.77±0.96 years. Concerning clinical information (Table 2), all patients had posterior heel pain and in 74.0% cases there was superimposed back heel swelling (Fig. 1a), 56.0% had limping, and 76.0% had aggravated rear heel pain while walking. In addition, focal tenderness, crepitus, palpable nodule, and palpable gap elicited in 62.0%, 36.0%, 32.0%, and 16.0% cases respectively. Different clinical diagnosis was as follows: Achilles tendinitis (30, 60.0%), Achilles tendon rupture (8, 16.0%), retrocalcaneal bursitis (6, 12.0%), tendon xanthoma (2, 4.0%), and nonspecific heel (4, 8.0%) pathologies (Table 1).

Table 1. Demographic profile of participants (n=50)

Characteristics		Distributions
Age	<25	9(18.0)
	26-35	10(20.0)
	36-45	19(38.0)
	46-55	7(14.0)
	>56	5 (10.0)
	Mean (±SD)	38.14±12.19
Sex	Male	34 (68.0)
	Female	16 (32.0)
Occupation	Service	16 (32.0)
	Student	12 (24.0)
	Housewife	11 (22.0)
	Day Laborer	4 (8.0)
	Business	7 (14.0)
Clinical association	DM	10 (20.0)
	Dislipidemia	1 (2.0)
	SLE	1 (2.0)
	AS	1 (2.0)

Values are expressed in frequency, percentage
SD, standard deviation
DM, diabetes mellitus; SLE, systemic lupus erythematosus; AS, ankylosing spondylitis

Table 2. Clinical presentation of Achilles tendinopathy (n=50)

Characteristics		Distributions
Clinical Features	Pain at back of the heel and leg	50(100.0)
	Swelling at back of the heel and leg	37 (74.0)
	Limp	28(56.0)
	Pain while movement	38(76.0)
	Tenderness	31(62.0)
	Crepitus	18(36.0)
	Palpable nodule	16 (32.0)
	Palpable gap	8 (16.0)
Clinical Diagnosis	Achilles tendinitis	30 (60.0)
	Rupture	8 (16.0)
	Retrocalcaneal bursitis	6 (12.0)
	Tendon xanthoma	2 (4.0)

Values are expressed in frequency and percentage

Among all respondents, 19 (38.0%) had plain X-ray findings (Table 3) that included fat plane distortion (11, 57.9%), soft tissue swelling (10, 52.6%) (Fig. 1b), calcaneal erosion (Fig. 1b) at Achilles tendon insertion (4, 21.1%), calcification (4, 21.1%) (Fig. 1c) and spur (3, 15.8%) (Fig. 1d).

Along with X-ray, these conditions evaluated with clinical examination and all they were true positive. One case, having fat plane distortion was supportive as Achilles tendon pathology on X-ray, but not suggestive as the same on clinical examination, making the interpretation false positive. However, there were no significant changes on X-ray in remainder 31 (62.0%) cases, on physical evaluation different Achilles tendon pathology diagnosed in 28 subjects and in another 3 heel problem was non-specific. They were false negative and true negative respectively. Kappa value 0.035 revealed that statistically insignificant poor agreement between these two tests in the diagnosis of Achilles tendon pathology (Table 4). Sensitivity of X-ray to diagnose Achilles tendon pathology was 39.0%, specificity 75.0%, positive predictive value 94.7%, negative predictive value 9.7% and accuracy 42.0% (Table 5).

On the other hand, out of 50, Achilles tendon pathology on USG was found in 46 (92.0%) and absent in 4 (8%) subjects (Fig. 2a) (Tables 3 and 4): 93.5% patients matched for increased tendon thickness, 91.3% had irregular tendon margin, hypoechoic focus within tendon seen in 56.5%, 37.0% had calcification, 21.7% had tendon disruption, 19.6% had soft tissue swelling, and 8.7% had fluid collection in the retrocalcaneal area. Sensitivity of USG to diagnose Achilles tendon pathology was 95.7.0%, specificity 50.0%, positive predictive value 95.7%, negative predictive value 50.0% and accuracy 92.0% (Table 5). Likewise, sonographic features adjusted for Achilles tendinitis (Fig. 2b), tendon rupture (Fig. 2c), retrocalcaneal bursitis (Fig. 2d), tendon xanthoma in 31 (62.0%), 7(14.0%), 3(6.0%), 1(2.0%) cases respectively, though in 16.0% cases there was a diagnostic elusion. In 26 participants, USG guided Achilles tendinitis re-evaluated by clinical evaluation. They were true positive. However, in another five cases USG guided Achilles tendinitis did not match with physical examination findings and were false positive. Fifteen out of 19 USG negative for Achilles tendinitis, were also classified as non Achilles tendinitis on clinical examination whereas Achilles tendinitis diagnosed in 4(13.3%) cases, they were false negative and true negative respectively (Table 4). Sensitivity of

USG to diagnose Achilles tendinitis was 86.7%, specificity 75.0%, positive predictive value 83.9%, negative predictive value 78.9% and accuracy 82.0% (Table 5).

Table 3. Achilles pathology on X-ray and ultrasound

Characteristics		Distributions
Plain X-ray Findings of Heel (n=19)	Fat plane distortion	11(57.9%)
	Soft tissue swelling	10 (52.6%)
	Erosion of Calcaneus at the site of Achilles tendon insertion	4(21.1%)
	Calcification	4(21.1%)
	Spur	3 (15.8%)
USG findings of both Achilles tendon (n=46)	Increase tendon thickness	43 (93.5%)
	Irregularities of tendon margin	42 (91.3%)
	Hypoechoic focus within tendon	26 (56.5%)
	Fluid collection in the retrocalcaneal area	4 (8.7%)
	Soft tissue swelling	9(19.6%)
	Calcification	17 (37.0%)
	Tendon disruption	10 (21.7%)

Values are expressed in frequency and percentage

In all cases of Achilles tendon rupture, diagnosis confirmed by both USG and physical examination, making the association true positive. Only one, out of 43 cases of USG guided non-ruptured Achilles, classified as Achilles tendon rupture clinically. They were false negative and true negative respectively. Kappa value 0.922 revealed statistically significant (p value < 0.001) agreement between these two tests in the diagnosis of Achilles tendon rupture (Table 4). Sensitivity of USG to diagnose Achilles tendon rupture was 87.5%, specificity 100%, positive predictive value 100%, negative predictive value 97.7%, and accuracy 98% (Table 5).

Retrocalcaneal bursitis diagnosed with both USG and clinical evaluation in three cases. They were true positive and there was no false positive case. However, among rest 47 cases of USG confirmed heel pathologies, clinically retrocalcaneal bursitis defined merely in 3 subjects, while 44 were other heel entities. They were false negative and true negative respectively. Kappa value (0.638) revealed statistically significant agreement between these two tests in the diagnosis of retrocalcaneal bursitis (Table 2). Sensitivity of USG to diagnose retrocalcaneal bursitis was 50.0%, specificity 100.0%, positive predictive value 100.0%, negative predictive value 93.6% and accuracy 94.0% (Table 5).

Diagnostic accuracy was determined as receiver operating characteristic (ROC) curve (Fig. 3), suggesting that the area under the curve (AUC) of USG and X-ray was 0.728 and 0.571, respectively.

4. DISCUSSION

In Achilles tendinopathy posterior heel pain is unique. Though, posterior heel pain is multi-factorial, mechanical event is most obvious and is more common among athletes due to repetitive use of tendon [9]. In repetitive injury, initially, Achilles tendon looks diffusely swollen and edematous, and gets tender on palpation, maximum at 2–6 cm proximal to the tendon insertion. In addition, fibrinogen-rich fluid, fibrin can generate palpable crepitation around the tendon. However, in chronic cases, exercise-induced pain is the main symptom and, a tender, nodular swelling is a common sign [10]. Other common causes of heel pain are calcaneal stress fracture, nerve entrapment namely tarsal tunnel syndrome, sinus tarsi syndrome, heel pad syndrome, neuromas, and plantar warts, Haglund syndrome, Sever's disease, etc [11]. Likewise, posterior heel pain may be associated with some metabolic and inflammatory joint disorders such as dyslipidemia, obesity, hyperurecaemia, hypo-and-hyperthyoidism, spondyloarthropathy (SpA), etc [12,13]. Drugs such as Isotretinoin and Fluoroquinolone-induced non-insertional Achilles tendinopathy had also been reported in the literature [14].

Patients with posterior heel problem may present at various age, but in Blankstein et al. [4] and Kainberger et al. [13] series the mean age at presentation had been reported as 40, sounding similar with our study result. In our study, heel pain and swelling was documented with Achilles tendinitis, ruptured tendon, retrocalcaneal bursitis, and tendon xanthoma as well. Though, a substantial 37 patients presented with heel pain without any significant association, thirteen patients had systemic diseases namely DM, dyslipidaemia, systemic lupus erythematosus, and ankylosing spondylitis. Regarding occupation, we did not find any athlete presenting with heel pain, but a significant number of students, getting involved in sports activities presented with rear heel ache because of possible repetitive heel strain. Moreover, housewives went for vigorous works in paddy field, yards, posing back heel on great stress that might result in achillodynia.

Table 4. Association of USG, X-ray and clinical findings in the diagnosis of Achilles tendinitis, Achilles tendon rupture, retrocalcaneal bursitis and Achilles tendon pathology (n=50)

		Clinical diagnosis		**Total**	**Kappa value**	**'p' value (95% CI)**
		Present	**Absent**			
USG evaluation						
Achilles tendinitis	Present	26 (86.7%)	5 (25.0%)	31 (62.0%)	0.622	<0.001
	Absent	4(13.3%)	15 (75.0%)	19 (38.0%)		
Achilles tendon rupture	Present	7 (87.5%)	0 (0.0%)	7 (14.0%)	0.922	<0.001
	Absent	1 (12.5%)	42 (100.0%)	43 (86.0%)		
Retrocalcaneal bursitis	Present	3 (50.0%)	0 (0.0%)	3 (6.0%)	0.638	<0.001
	Absent	3 (50.0%)	44 (100.0%)	47 (94.0%)		
Achilles tendon Pathology	Present	44 (95.7%)	2 (50.0%)	46 (92.0%)	0.457	<0.001
	Absent	2 (4.3%)	2 (50.0%)	4 (8.0%)		
X-ray evaluation						
Achilles tendon Pathology	Present	18 (39.1%)	1 (25.0%)	19 (38.0%)	0.035	0.577
	Absent	28 (60.9%)	3 (75.0%)	31 (62.0%)		

Fig. 1a

Fig. 1b

Fig. 1c

Fig. 1d

Fig. 1. Clinical and radiological manifestations of different Achilles pathologies. Asterisk (*) indicates (a) woman with left posterior heel swelling in retrocalcaneal bursitis (b) calcaneal erosion at Achilles tendon insertion with rear heel soft tissue swelling (arrow) (c) Achilles opacification (calcification) in retrocalcaneal bursitis (d) posterior heel swelling with calcaneal spur

Table 5. Sensitivity, specificity, accuracy, positive and negative predictive values of the USG and X-ray in the diagnosis of Achilles tendon pathology

Diagnosis		Validity test (%)				
		Sensitivity	Specificity	PPV*	NPV**	Accuracy
USG diagnosis	Achilles tendinitis	86.7	75.0	83.9	78.9	82.0
	Achilles tendon rupture	87.5	100.0	100.0	97.7	98.0
	Retrocalcaneal bursitis	50.0	100.0	100.0	93.6	94.0
	Achilles tendon pathology	95.7	50.0	95.7	50.0	92.0
X-ray diagnosis	Achilles tendon pathology	39.0	75.0	94.7	09.7	42.0

PPV, Positive Predictive Value; NPV**, Negative Predictive Value*

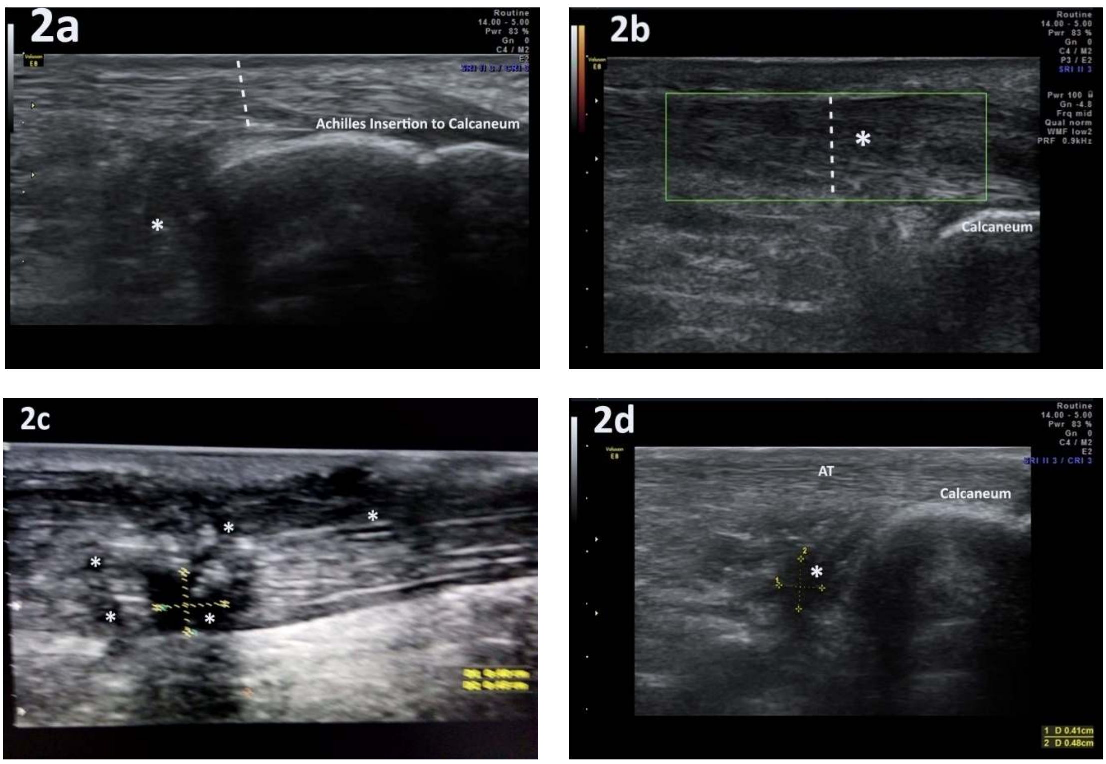

Fig. 2. Ultrasonogram findings of various Achilles tendon pathologies. Asterisk (*) indicates (a) normal ultrasound features of contralateral Achilles tendon in a female patient (b) hypoechoic Achilles tendon with increased thickness in Achilles tendinitis (c) Full-thickness Achilles tendon tear with multiple hypoechoic area signifying fiber discontinuity (d) retrocalcaneal bursitis with hypoechoic fluid filled cavity between Achilles tendon and calcaneum. AT, Achilles tendon

Evaluation of the Achilles tendon has long been based solely on physical examination. Recent total rupture is easily diagnosed from a history of injury, palpation of a clear-cut depression in the tendon, the Thompson test (in which pressure on the calf does not result in plantar flexion of the foot), and the inability of the patient to stand on tip of the toe, etc [14]. However, diagnostic difficulty in chronic cases demands further evaluation maneuvers [15,16]. Moreover, the sensitivity and specificity were 58% and 74% for direct palpation, 52% and 83% for the arc sign (the tendinous swollen area moves during dorsiflexion and plantar flexion of the ankle), and 54% and 91% for the Royal London test (local tenderness is elicited by palpating the tendon with the ankle either in neutral position or with slightly plantar flexion). When all the three tests combined, sensitivity and specificity was reportedly high as 58% and 83% respectively [14].

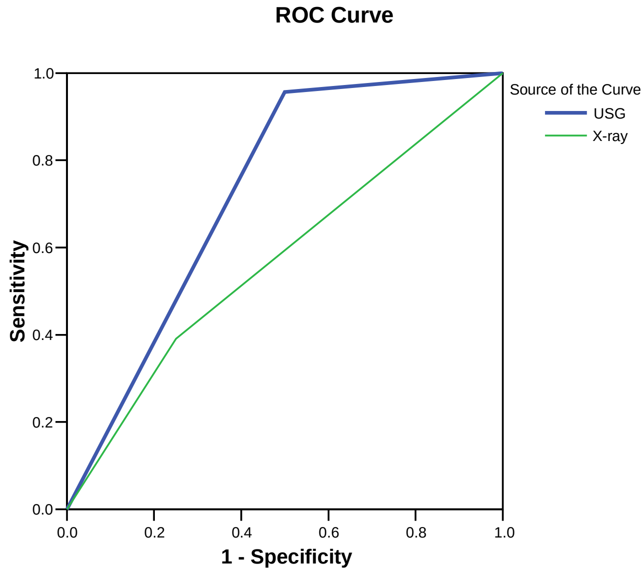

Fig. 3. Receiver operating characteristic (ROC) curve for diagnostic accuracy of Achilles tendon pathology using ultrasonogram and X-ray foot

On plain radiograph tendons appear as soft tissue structures and can only be demarcated if the surrounding tissues contain fat. Abnormalities visible on plain films mainly refer to major changes of the silhouette of the tendon. Standard radiography can not directly display nodules or textural alterations in cases of nodular tendinitis [16]. Nevertheless, one advantage of radiography is the complete visualization of calcification; structural abnormalities within a tendon are generally not visible on X-ray, unless calcifications occur. Radiographs are also beneficial in showing ossification at the insertion of the tendon in cases of enthesitis. Besides, Minor changes of the paratendon in the form of low-grade thickening or slight irregularities are obvious on cross-sectional images with higher sensitivity than on plain films [17]. In Achlles tendinopathy, radiographic findings commonly show insertional proliferative spurring and or erosion [18]. However, calcaneal spur is lacking neither prognostic nor therapeutic importance, henceforth a radiographic search for such is not warranted [18]. In the present study out of 50, only 19 (38.0%) patients had X-ray changes: fat plane distortion 11 (57.9%), soft tissue swelling 10 (52.6%), erosion of calcaneus at the site of Achilles tendon 4 (21.1%), calcification 4 (21.1%). And calculated sensitivity, specificity, positive predictive value, negative predictive value, and accuracy was for diagnosing Achilles tendon pathology using X-ray was 39.0%, 75.0%, 94.7%, 9.7%, and 42.0% respectively.

Fat suppression MRI with or without contrast is the most sensitive method for identifying active tendinopathy at any site. MRI can show peri-entheseal inflammation with adjacent bone marrow edema in fat suppressed T2-weighted sequences [6]. It is also useful to evaluate various stages of chronic degeneration and for differentiation between peritendinitis and tendinosis. An excellent documentation focusing relationship between MRI and pathological findings after Achilles tendon surgery had been reported by Maffulli and colleagues [10]. According to Kane et al. in diagnosing heel pathology, ultrasonography and bone scintigraphy are equally effective. Likewise, Khan et al. documented similar diagnostic accuracy of both USG and MRI in diagnosing Achilles tendon pathology [7]. But, USG is cost-effective than MRI and therefore is being used increasingly to assess musculoskeletal apparatus including tendons [19]. Blankstein et al. [4] evaluated 41 patients with achillodynia using diagnostic ultrasound that enabled heel pathology diagnosis in 19 (46%) cases: complete rupture 2 (5%), partial rupture of the Achilles tendon 3 (7%), various degrees of tendon calcification 7 (17%), and peritendinous lesions discerned by the tendon's hypoechoic regions with disorganized arrangement of collagen fibrils 4 (10%). Other lesions included tendinitis, retrocalcaneal bursitis, lipoma, and foreign bodies. In a retrospective study by Azzoni and Cabitza [20], the sonograms revealed 67 (42.40%) cases of tendinosis with peritendinitis, 40 (25.31%) cases of peritendinitis and 30 (18.98%) cases of tendinosis; however in 21 (13.29%) patients with achillodynia had no significant changes on sonograms. In the present study, a higher 92.0% patients had USG findings in and around Achilles tendon compared to above two; Achilles tendinitis (62.0%), rupture (14.0%), retrocalcaneal bursitis (6.0%), tendon xanthoma (2.0%). Moreover, we documented increased tendon thickness, irregularities of tendon margin, hypoechoic focus within tendon, and fluid collection in the retrocalcaneal area as well.

According to Hartgerink et al. [21], sonogram can be used accurately in 92% cases to differentiate full-thickness tear from partial-thickness tears or Achilles tendon tendinosis, tendon retraction. Among them, 14 were surgically proved full thickness tears and 12 were surgically proved partial-thickness tears or tendinosis; in differentiating full- from partial-thickness tears USG was 100% sensitive, 83% specific, 92% accurate, 88% positive predictive, and 100% negative predictive. There were two false-positive findings (full-thickness tear at sonography with a partial-thickness tear or tendinosis at surgery) and no false negative findings. In Fornage series [16] one out of 26 Achilles tendinopathy diagnosed as calcific tendinits on sonogram, though it is higher in our study (17 out of 46). Calcification most frequently developed after surgical repair (two of seven patients). Tendons that had been operated on appeared markedly thickened and often inhomogeneous, which made ultrasound evaluation for recent inflammatory changes difficult. In addition, as per Kayser et al. [22] series, sensitivity of USG in diagnosing partial rupture was 50%, specificity was 81%, and the overall agreement of the ultrasound examination was 61.5%. Moreover, Kainberger et al. [13] determined the diagnostic accuracy of sonography for the assessment of injury to the Achilles tendon. They found USG was 72.0% sensitive and 83.0% specific.

In the present study, sensitivity of USG in overall Achilles tendon pathology was 95.7.0%, specificity 50.0%, positive predictive value 95.7%, negative predictive value 50.0% and accuracy 92.0%. However, sensitivity of USG to diagnose Achilles tendon rupture was 87.5%, specificity 100%, positive predictive value 100%, negative predictive value 97.7% and accuracy 98%. To be more, sensitivity and specificity of USG in the diagnosing following conditions around heel is as follows: Achilles tendinitis, sensitivity 86.7%, specificity 75.0%; retro-calcaneal bursitis, sensitivity 50.0%, specificity 100.0%. Diagnostic accuracy was determined as receiver operating characteristic (ROC) curve, suggesting that the area under the curve (AUC) of USG and X-ray was 0.728 and 0.571 respectively. This finding concludes USG is far better diagnostic tool to diagnosis Achilles tendon pathology than conventional X-ray, henceforth, accepting our hypotheses; and can be handy in a set-up where MRI facility is not available.

5. LIMITATION

We used both USG and X-ray in various Achilles tendon pathologies and compared them with clinical diagnosis. Since, mere clinical diagnosis is not a gold standard in diagnosing heel pathologies; we contrast the validity tests of USG and X-ray in this fact. Though, MRI provides valuable information regarding osseous tissues in and around Achilles tendon, its role in defining soft tissue pathologies is as equal as ultrasound, so we did not use former modality. Recent time, there are huge advancements as to Achilles tendinopathy treatment, but this submission we did not stress any of them since it was our study limitation.

6. CONCLUSION

Ultrasound findings concerning Achilles tendinopathy significantly correlate with the clinical diagnosis than that of conventional X-ray. High frequency USG can be handy in defining various heel pathologies, in facilities where MRI is not available.

ETHICAL APPROVAL

We hereby declare that appropriate ethics committee approved the research proposal; and therefore the study has been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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