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Sonographic Comparison Of Femoral Articular Cartilage Size In Normal Knee Joint In Various Age Groups And Gender

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Abstract: ***Background:*** *Although musculoskeletal ultrasound is a successful initial screening tool for measuring articular cartilage thickness, we often find typical patients who have no diagnosis knee pathology (i.e. OA), or any knee surgery.* ***Objective(s):*** *To compare the size of the femoral articular cartilage in normal knee joint in different age groups and gender by ultrasonography.* ***Methodology:*** *All the normal patient without knee surgery or any history of knee pathology were included minimum and maximum age were 20 to 50years .and Toshiba xerio 2000 ultrasound machine using a higher-resolution linear probe 7-15Mhz to test the knee's superficial structure the data was analyzed and calculated using SPSS and for qualitative data percentage was calculated and pie chart were also shown Mean + S D and percentage.* ***Results:*** *A total of 236 normal knee joint [left and right] were subjected, Gender reported in frequency and percentage, males were-114 [48.3%], and females were 122 [51.7%]. Gender explained change in the size of femoral cartilage at the medial facet as compared with the lateral and central facet with non-sign of differences in both gender p=value 0.228% 0.737% 0.027%. While regarding the age group it was characterize in six groups and the result were consider the significance change in the lateral facet of both gender when compered between the ages of six group of 20 to 45years, similarly the central and medial facet for all the six group were all same. In final out of 236 subjected patient regarding the side of the scanned patient in left and right side to compare the mean of articular cartilage in male and female through the intercondylar fossa (IF) in lateral, central, and medial mean was (L=1.93±05), (C=2.31±53), and (M=1.93±31). While the Right side n=118 mean were (L=1.8822), (C=2.2814), and (M=2.0008).* ***Conclusion(s):*** *We detected a significant difference in age group at lateral and medial facet and also there is significant number in medial side on gender using ultrasound parameters no other laboratory or population of metrics have proven useful for discrimination. The future comparison study will be helpful for early diagnosis of articular cartilage in such a patient.*

Keyword: Diagnostic screening, of knee, femoral articular cartilage size, cartilage comparison

INTRODUCTION

Articular cartilage in the knee joint is affected in various disease, however it's affected by normal joint. Ultrasound is the noninvasive modality for its evaluation. The current study is an effort to compare the size of articular cartilage at the knee joint with different age groups and gender by ultrasound. Which will subsequently be used to distinguish normal cartilage from pathologic .Ultrasound is a risk-free, non-invasive, imaging procedure which can be used to scan articular cartilage. Ultrasound imaging is a medical test that is non-invasive and helps doctors diagnose and treat medical conditions. Ultrasound photographs of the musculoskeletal system include representations of the whole body of muscles, tendons, ligaments, joints, nerves and soft tissues[1,2].

A musculoskeletal (MSK) ultrasound (US) has become a proven imaging technique for measuring the normal joint cartilage size, diagnosing and tracking rheumatic disease patients over the past decade. Musculoskeletal ultrasonography (US) is a strong tool to screen joint area and soft tissue pathology and easily becomes an important part of routine rheumatology treatment and management[3,4]. Articular cartilage is generally characterized as a tissue that consists of up to eighty per-cent liquid [water], is free from blood vessels, nerves and lymph nodes, and is inhabited by just one type of cell, the chondrocyte[5].

It has the function of providing a smooth, low friction contact surface between the ends of articulating bones. The interstitial water contributes approximately sixty to eighty percent to the wet weight of the cartilage, while the remaining twenty to forty percent are the structural macromolecules, i.e., collagens, proteoglycans and noncollagens[6].

Nevertheless in several of these studies, "natural" cartilage was largely excised from areas of poorly intact cartilage in a degenerated end-stage joint, which was exposed to the inflammatory and catabolic mediators present in OA synovium and synovial fluid. Furthermore, normal-looking and degenerated cartilage is not always taken from the same place in the joint, a potentially significant confounder for any comparison[7].

Articular cartilage is the connective tissue that connects two bones together, and provides a barrier for articulating bones that is low-friction, low-wear. This consists largely of extracellular matrix, which consists mainly of collagen and aggregate proteoglycan, aggregate. Dry-weight adult articular cartilage is two-thirds of collagen. The roles of collagen IX and XI in the heteropolymer are far from simple, but they are clearly critically important as mutations in COLIX and COLXI genes may lead to syndromes of chondrodysplasia.[8,9].

The knee is clinically shows with a fat-suppressed three-dimensional sequence, and the cartilage volumes were determined by computer processing. The factors examined were age, body weight, height, leg length, foot size, thigh and lower leg circumference, medial and lateral femoral condyle width, tibial head diameter, body mass index, general joint laxity, quadriceps angle, and leg heel alignment[10].

Osteoarthritis (OA) is the most common chronic musculoskeletal condition affecting around 40 per cent of adults over seventy years of age It is known to be a steadily progressive disease weakening all tissues of the affected joint, presenting as cartilage loss, a hallmark of OA, but also a mild to moderate synovial inflammation and alteration of the subchondral bone structure[11].

Knee osteoarthritis is the most common cause of impairment in humans and is a chronic joint condition that can cause cartilage damage[12].

The knee is a synovial weight-bearing hinge joint composed of two condylar joints (between the femoral and corresponding tibial condyles); and a saddle joint (between the patella and the femur's patellar surface). Tibio-femoral joints are isolated by articular cartilages and menisci; with small contributions from cruciate ligaments[13]. Ultrasonography US Is a non-invasive imaging technique widely used for the identification articular cartilage position in joints and to detect the inflammatory changes in joints. It is relatively cheap, widely available and does not bear any radiation or contraindications[14].

According to C.Ding et-al an article was published in 01-November 2003 Sex differences in knee cartilage volume in adults: role of body and bone size, age and physical activity. The sensitivity specificity [SS], Positive predictive value [PPV], Negative predictive value [NPV], Where gender define 33–42% of the variation in knee cartilage volumes (all $P < 0.001$). Males consist up 33–42% higher cartilage volume compared with females at all sites. In the whole group, the majority of gender differences diminished to 8–18% Upon customization for body height, weight and bone size, but remained significant (all $P < 0.05$). Further customization for physical activity were no curse on the gender differences. The gender differences in cartilage volume were greater in those aged over 50 compared with those aged under 50 ($P < 0.05$ for age–sex interaction at all sites) and were independent of ROA[15].

Although musculoskeletal ultrasound is a good initial screening method for the identification of joint inflammatory area and help to measure the articular cartilage size. Using MSK identification, also it sometime encounter who have the US finding of osteoarthritis [OA] without a specific symptoms of knee pathologies [surgery].

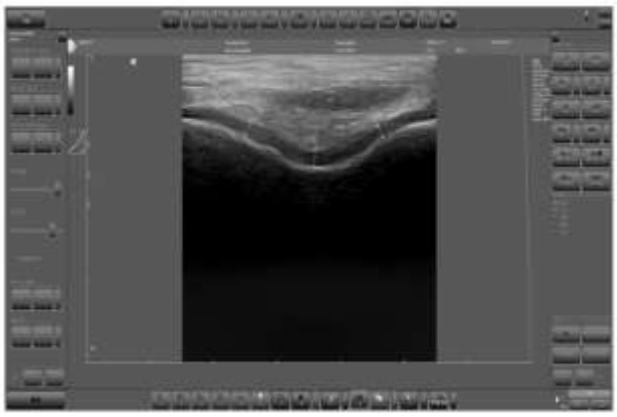
Method

It was a comparative study to measure the size of femoral articular cartilage n knee joint from the normal patient. 236 normal patient of both gender age were 20 to 50years were selected during the study. Data was collected from university of Lahore ultrasound lab defense road Lahore, and ultrasound clinic green town Lahore. During 6 month from December 2019 to june 2020. The inclusion criteria was. All the individuals normal knee joint and Patient of above age of 20 to 50years and in both gender Uncooperative and Patient with the history of knee joint surgery were excluded. The songraphic comparison of femoral articular cartilage size in normal knee joint in various age group and gender was measured Use of a higher-resolution probe 7-15Mhz to test the knee's superficial structure Written consent had been obtained before US scans were collected. In the course of this study a total of 236 images from 118 healthy volunteers were collected (2 scans per subject) .with a 3.5 cm depth setting and a 0.15 mm image resolution. Various cartilage scans were obtained from both the left and right joints of the knee. Posterior fossa=Patient prone to bed, knee bent slightly with a pad under the ankle to support. Anterior Knee=Patient lies supine on a knee bent 20-30 degrees. Alternatively patient can sit for support on the side of an elevated bed with foot resting on Sonographer's knee. Lateral, Central and Medial Knee = Scanning may be as above. Assess the ligaments and meniscal margins of the Medial and Lateral Collateral. Joint lines (thickening or ligament tears, meniscal bulging / cysts, joint effusion, gross bony changes). Participants lying in a supine position and with a maximum flexing knee, The upper edge of the patella was located and a line was drawn on the skin using a washable marker at the point immeuble above the upper edge of the patella and at 1 cm intervals in

the upper edge. The transducer was positioned in a suprapatellar transverse position, perpendicular to the bone surface and angled to maximize the ultrasound image.

Transducer positioning for knee ultrasound scan

The location where the intercondylar knotch's cartilage thickness appeared to be the highest was marked on the skin and registered so that the examiner could return the transducer to the exact location for all subsequent scans. Picture program has analyzed ultrasonic images to assess the minimum cartilage



Ultrasound view of minimum knee cartilage

The gap from the thin hyperechoic line established at the synovial space. cartilage boundary to the line formed at the cartilage-bone boundary was used to reduce cartilage thickness in the lateral facet, medial facet, and intercondylar notch.

Result

A total of 236 normal knee joint [left and right] were subjected, Gender reported in frequency and percentage, males were-114 [48.3%], and females were 122 [51.7%]. (Table 1, Figure 1)

Regarding the ages of the scanned knee joint, out of (n=236 patients) mean $\pm$ S.D of age were 32.53 $\pm$ 8.9yrs, minimum age was 20yrs and maximum age were 50yrs given in (Table 2) and (Figure 2).

The group frequency distribution of age is presented in table 3. The six age groups were 20—25, 26—30, 31—35, 36—40, 41—45, and 46—50 with frequencies and percentages (58, 24.6%), (63, 26.7%), (34, 14.4%), (28, 11.9%), (24, 10.2%), and (29, 12.3%) respectively. (Table 3, Figure 3).

Means of lateral, central and medial sizes of knee femoral in males and females were compared. Means of lateral and central sizes of knee femoral were not found statistically different in males and females as p-values were 0.228% and 0.737% respectively. While a statistical significant difference found between the two means of medial sizes of knee femoral in males and females with p-value 0.027 < 0.05. (Table 4)

Comparison of means of lateral, central and medial sizes of knee femoral in different age groups was conducted by ANOVA (Table 5). Multiple comparison was made by applying LSD and their results were presented in figure 2 and 3. Mean of lateral size of knee joint for Age group (20—25) is significantly different from mean for age group (26—

30) with p-value 0.04 < α =0.05. Mean of lateral size knee joint for Age group (26—30) is significantly different from the mean of lateral size of knee joint for age group (41—45) with p-value 0.19 < α = 0.05% and means of central and medial sizes of knee joint for all six age groups were same. (Table 3 and (figure 3).

Out of 236 subjected patient regarding the side of the scanned patient in left and right side for the measurement of articular cartilage through the intercondylar fossa (IF) in lateral, central, and medial facet the information were characterize i. Left side n= 118. There mean ± S.D was (L=1.93±05), (C=2.31±53), and (M=1.93±31). While the Right side n=118 mean were (L=1.8822), (C=2.2814), and (M=2.0008). (Table 6)

Descriptive statistics of gender in frequency and percentage

Gender	**Frequency**	**Percent**
Male	114	48.3
Female	122	51.7
Total	236	100.0

Table 1: Frequencies and percentages of gender

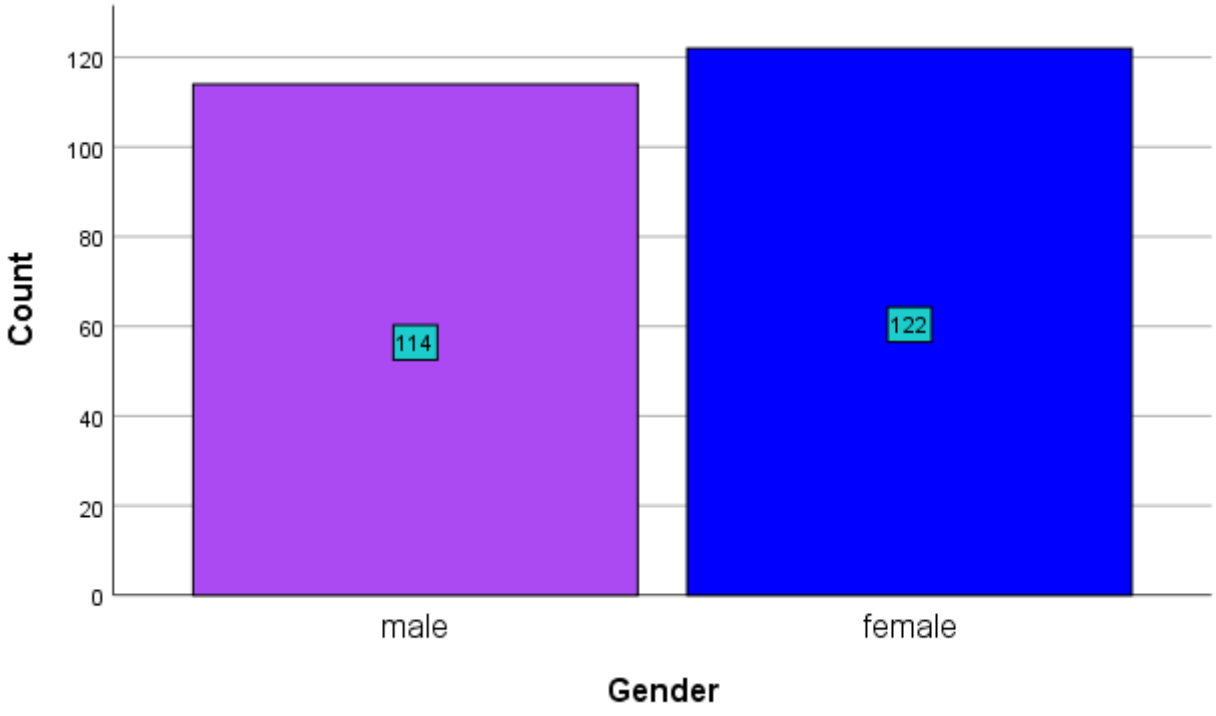


Figure 1: Descriptive statistics for gender patient

Descriptive Statistics

Descriptive Statistics

	N	Range	Minimum	Maximum	Mean		Std. Deviation
	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic
Age	236	30.00	20.00	50.00	32.5339	.58214	8.94302

Table 2: Descriptive Statistic age patient

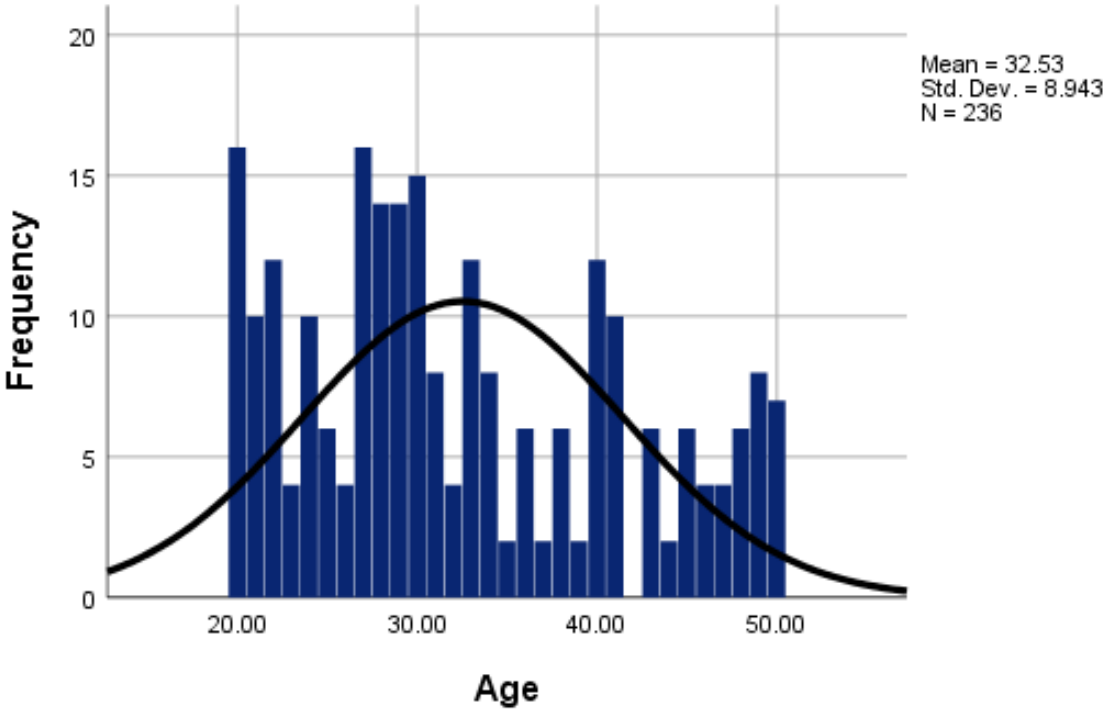


Figure 2: Descriptive Statistic foe age patient

Age group

		Frequency	Percent
	20—25	58	24.6
	26—30	63	26.7
	31—35	34	14.4
	36—40	28	11.9

	41—45	24	10.2
	46—50	29	12.3
	Total	236	100.0

Table 3: Descriptive statistics of age groups of patient

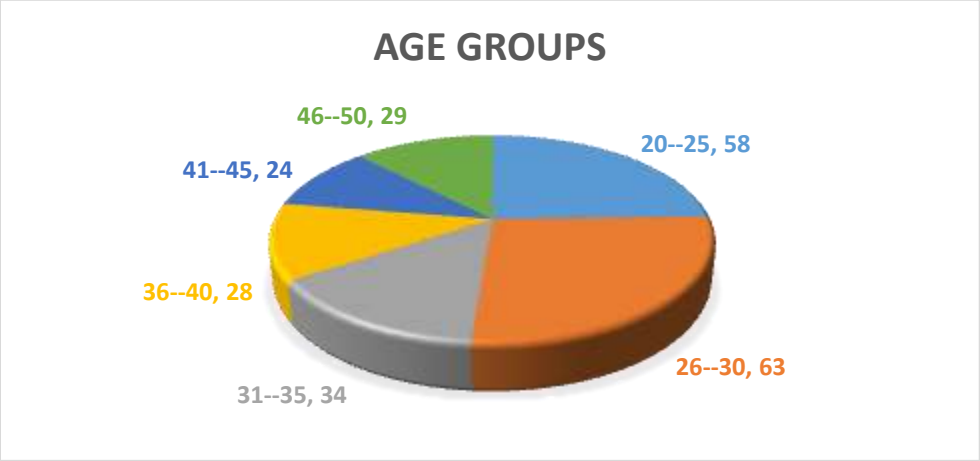


Figure 3 Pie Chart of age groups of patient

Statistical Mean of lateral central and medial side

Side	Gender	N	Mean	Standard deviation	t-test	p-value
Lateral	Male	114	1.9404	0.48091	1.209	0.228
	Female	122	1.8746	0.33687		
Central	Male	114	2.3088	0.48873	0.337	0.737
	Female	122	2.2885	0.43488		
Medial	Male	114	2.0298	0.41752	2.227	0.027
	Female	122	1.9082	0.42125		

Table 4: Mean differences in measurements of Lateral, central and Medial size of knee femoral

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Lateral	Between Groups	1.367	5	.273	1.622	.155
	Within Groups	38.754	230	.168		
	Total	40.120	235			
Central	Between Groups	.442	5	.088	.411	.841
	Within Groups	49.457	230	.215		
	Total	49.899	235			
Medial	Between Groups	.711	5	.142	.791	.557
	Within Groups	41.332	230	.180		
	Total	42.042	235			

Table 5: Results of Analyses of variance

Cross tabulation between lateral, central and medial sizes and Sides

Side		Lateral	Central	Medial
Left	Mean	1.9305	2.3153	1.9331
	N	118	118	118
	Std. Deviation	.41231	.45940	.40426
Right	Mean	1.8822	2.2814	2.0008
	N	118	118	118
	Std. Deviation	.41441	.46353	.43999
Total	Mean	1.9064	2.2983	1.9669
	N	236	236	236
	Std. Deviation	.41319	.46080	.42297

Table 9: means of lateral, central, and medial facet for left and right sides

DISCUSION

The use of ultrasound sonography to determine the size of the femoral articular cartilage thickness is a novel technique that warranted further analysis of its reliability and precision**.** Joint cartilage plays a part in reducing frictional stress during joint workouts, and biomechanical factors play an significant role in preserving the integrity of joints[16]

During this effort of study we measured the size of femoral articular cartilage in normal left and right knee joint at different age group and gender, our target effort is to compare the size of articular cartilage at the knee joint with different age groups and gender by ultrasound, the study population was predominantly females [51.7%].

Out of 236 subjected patient the highest frequency age group was between 20 to 50years. And were characterize six age groups and were 20—25, 26—30, 31—35, 36—40, 41—45, and 46—50 with frequencies and percentages (58, 24.6%), (63, 26.7%), (34, 14.4%), (28, 11.9%), (24, 10.2%), and (29, 12.3%) respectively[17].

According to the gender we noted that there is no significant statistical difference between the mean femoral cartilage size in lateral and central facet and were p-value 0.228 and 0.737 respectively as compered with the medial facet which is significantly difference with p-value 0.027. Lad et al (2016) reported that after a 20-minute walk on the treadmill, the medial femoral cartilage decreased by 1.2 per cent, whereas in the present study it decreased by 2.22% This indicates a larger deformation in the flatland walk group than that reported by Lad et al. (2016)[18].

In fact, the femoral articular cartilage thickness did not vary between the right and left intercondylar notches or the right and left lateral and central facets. While medial variations between left and right knees in both male and female have been reported as significant. This disparity has not been found to the same degree in many other studies[19.20]. And it may be linked to variations in biomechanical loading

In addition, ultrasound is believed to have produced post-assessment results faster than that by other imaging modalities Moreover In the current study, the mean thickness of the cartilage according to the side could be measured in a larger proportion of knees on the lateral, central, and medial side 1.9305, 2.3153, 1.9331 compared to the study by Yoon et al[21] Given the high level of treatment used to standardize the ultrasound measurement of the knee and to repeat the orientation of both the patient and the transducer between tests, other causes, such as inadequate placement of the transducer or movement artefacts, can also lead to poor image quality

Naredo E.et-al[22]. In the present sample, of the 2 knees that could not have a clear tested, individuals were all male, often older, and had low image quality. Özçakar L et-al in the previous effort recorded marginally higher femoral articular cartilage thicknesses in young (25–40 years of age)[23]. individuals relative to the current study we hypothesize the mean of the femoral cartilage size between the six groups age of 20 to 50years were all non-significant as shown in (table 6,7,and 8) It has been shown that age is adversely correlated with cartilage thickness in the lateral facet but only in males. Similarly, several studies have previously shown that ageing is adversely correlated with femoral cartilage thickness measured by all sonographs.

CONCLUSION(S)

The objective my study was to compare the size of the femoral articular cartilage in normal knee joint in different age groups and gender by ultrasonography. According to the gender I concluded that there is change in the size of femoral cartilage at the medial facet as compared with the lateral and central facet with non-sign of differences in both gender. While regarding the age group it was characterize in six groups and the result were consider the significance change in the lateral facet of both gender when compered between the ages of six group of 20 to 45years, similarly the central and medial facet for all the six group were all same. In final out of 236 subjected patient regarding the side of the scanned patient in left and right side for the measurement of articular cartilage through the intercondylar fossa (IF) in lateral, central, and medial facet we notice the higher mean p=value of central facet size of the cartilage using ultrasound parameters no other laboratory or population of metrics have proven useful for discrimination. The future comparison study will be helpful for early diagnosis of articular cartilage in such a patient.

Recommendation

Using ultrasound modalities that has non-ionization, radiation as compared to other imaging protocols (i.e CT, x-ray) is recommended for the measurement of articular cartilage and it will be helpful for the comparison and early diagnosis in such patient. ultrasound procedure is a timely approachable tool that can detect early deformation of lateral central and medial femoral cartilage. Nevertheless, only the front portion of the medial femoral cartilage could be measured in accordance with the MRI and other imaging modalities study, which could detect a mean improvement in the thickness of the joint cartilage and did not evaluate the thickness of the joint cartilage between the shinbone and the femur and between the knee bone and the femur. Third, this study measured only the thickness of the lateral central and medial femoral cartilage, and an additional study on the different divisions of the femoral joint cartilage was required. Fourth, in this sample, people walked with self-chosen rhythm. However, there is a need for work to measure speed and distance in the future. Fifth, the stepper walk is similar to the climbing stairs, but may be different from the real climbing stairs in terms of the reaction of the joint cartilage. It is therefore important to research the reaction of the joint cartilage after the actual climb of the stairs.

LIMITATION(S):

There are many drawbacks to this work. First the research was performed in restricted data for a more reliable finding that could indicate an improvement in the precision of the sample size of the ultrasound. The size of the sample is insufficient for generalization. Further study with a wider sample size, however, focuses on the reaction of normal joint cartilage in patients with knee joint thickness in mature adults.

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SONGRAPHIOCS IMAGES

Female leftArticuler Cartilage of knee

Male right Articular cartilage of the knee

Male right Articuler cartilage of the knee

Male left Articuler cartilage of the knee