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Obesity Related Measurements and Joint Space Width in Patients with Knee Osteoarthritis

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ABSTRACT

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Background

The aim of this study is to analyze the relationship between body mass index and obesity related measurements and tibiofemoral joint space which have been the principal method of radiographic evaluation in progression and therapeutic trials of knee osteoarthritis.

Methods

Fifty-five female patients with the diagnosis of osteoarthritis in knees according to the criteria of American College of Rheumatology in knees were included in the study. The mean age of patients was 57,42±8,60(SD) years with a range of 42–77. Medial and lateral compartment joint space widths were measured on antero-posterior knee radiography. Body mass index, triceps, biceps, subscapular and suprailiac skinfold thickness, waist and hip circumference were measured. Body composition was determined by dual energy X-ray absorpsiometry (DEXA) (Norland XR 46) and total lean mass (g), total fat mass (g), trunk lean mass, trunk fat mass, abdomen lean mass, abdomen fat mass measurements were recorded.

Results

Patients with body mass index>30 were accepted as obese patients. According to these criteria 33 of the 55 patients were obese. Tibial medial compartment and tibial lateral compartment measurements of obese patients were significantly lower than nonobese patients (p=0,000, p=0,003 respectively). Body mass index was correlated with total lean mass, total fat mass, trunk fat mass, abdominal fat mass, leg fat

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mass. Tibial medial compartment and tibial lateral compartment space measurements were negatively correlated with body mass index.

Conclusion: Our results revealed significant difference in both medial and lateral joint spaces of obese and nonobese patients with knee osteoarthritis. Medial and lateral joint spaces of obese patients were narrower than nonobese osteoarthritis patients. The more body mass index had the patients the narrower joint space they had displayed. However body composition analysis and obesity related measurements did not show additional correlation with tibial compartment measurement.

INTRODUCTION

Osteoarthritis (OA) of the knee is a major cause of pain and disability in the community and imposes significant economic costs upon society. Estimated population prevalence varies from 4–30%, depending on the age, sex distribution, and disease definition (1). A number of factors such as obesity, physical activity, sex hormones, quadriceps strength and meniscectomy are known to predispose to the development of knee osteoarthritis. Obesity is defined as increased fat mass calculated by different methods. Obesity classification determined by World Health Organisation (WHO) is the commonly used method (WHO) (2). It is a modifiable risk factor seems likely to associate with clinical features of knee OA (3). Assessment of articular cartilage loss is important in the diagnosis and evaluation of disease progression and treatment of OA (4, 5). Articular cartilage loss can be determined by radiological evaluation and joint space measurements (6).

In this study we aimed to analyze the relationship between obesity related measurements and tibiofemoral joint space which have been the principal method of radiographic evaluation in progression and therapeutic trials of knee OA. We wanted to examine if the obesity related measurements and body composition analysis could give us further information than standard Body Mass Index (BMI) calculations about the effect of obesity on joint space width in OA.

MATERIAL AND METHODS

Subjects in this study consisted of 55 female patients seen in our physical medicine and rehabilitation outpatient clinic with the diagnosis of osteoarthritis in knees according to the criteria of American College of Rheumatology in knees (7). Demographic data and informed consent of patients were obtained by self report. The mean age of patients was 57.42±8.60 (SD) years with a range of 42–77. Patients stood with feet together with the knees in full extension for the standard anteroposterior radiography. With the aid of the positioning light of the X-ray tube, the central ray of the horizontal x-ray beam was centered on the inferior border of the patella. Distal convex margin of the condyle in the medial and lateral compartments was used as one of the margins. In order to measure tibial medial compartment (TMC) a line extending from near the tibial spine to the medial or outer margin,

Table 1. The mean demographic properties, obesity related measurements and joint space measurements of obese and nonobese patients.

	Obese (n=33)	Nonobese (n=22)	p
Age	58.55±8.54	55.73±8.62	0.259
BMI	33.37 ± 3.07	26.35 ± 2.30	0.000
Total Lean Mass	42 190 ± 7 043	34 405 ± 8 469	0.001
Total Fat Mass	41 344 ± 7 739	35 459 ± 11 531	0.034
Trunk Lean Mass	20 104 ± 5 862	15 446 ± 4 086	0.004
Trunk Fat Mass	19 592 ± 8 393	14 801 ± 4 945	0.028
Abdominal Lean Mass	9 527 ± 2 063	8 459 ± 1 466	0.054
Abdominal Fat Mass	8 154 ± 1 682	4 507 ± 2 102	0.003
Leg Lean Mass	14 599 ± 1 905	12 491 ± 1 749	0.000
Leg Fat Mass	12 209 ± 2 602	10 458 ± 3 291	0.041
Waist Circumference	100.58 ± 8.99	88.10 ± 8.79	0.000
Hip Circumference	114.48 ± 8.42	103.43 ± 5.38	0.000
Biceps Skinfold	22.56 ± 7.56	18.68 ± 6.59	0.051
Triceps Skinfold	31.19 ± 7.28	26.41 ± 6.44	0.014
Suprascapular Skinfold	32.81 ± 5.44	27.96 ± 7.96	0.018
Suprailiac Skinfold	31.97 ± 9.74	29.32 ± 6.35	0.232
Medial Joint Space	0.40 ± 0.18	0.60 ± 0.13	0.000
Lateral Joint Space	0.56 ± 0.19	0.72 ± 0.17	0.003

across the centre of the floor of the articular fossa in the mid-coronal plane of the joint. The line was defined by the superior margin of the bright radiodense band of the subchondral cortex, and appeared below the anterior and posterior articular margins of the tibial plateau. The proximal margin of the articular surface, defined by the superior margin of the bright radiodense band of the subchondral cortex extending from near the tibial spine to the lateral margin was accepted as the margins of the tibial lateral compartment (TLC) (4).

The patients were weighed on balance beam scales to the nearest 0.1 kg. Standing height was measured on a wall in centimetres (cm).

BMI was calculated as weight in kilograms divided by height in meters squared. Skinfold thickness was measured using standard skin fold calliper. Triceps, biceps, subscapular and suprailiac skinfold thickness were measured using standardised procedures and locations (8).

Waist circumference was recorded at the midpoint between the superior iliac crest and lower costal margin. Hip circumference was measured at the symphysis pubis and projecting part of the buttocks.

Body composition was determined by dual energy X-ray absorpsiometry (DEXA) (Norland XR 46) which is accepted as a valid estimation of fat and fat-free mass (9, 10). Total lean mass (g), total fat mass (g), percentage of total fat mass, percentage of soft tissue mass, total bone mineral content (TBMC)/fat free mass (FFM) (%), trunk lean mass, trunk fat mass, abdomen lean mass, abdomen fat mass measurements were recorded.

Statistical analyses were performed using SPSS. The comparisons of mean values

of groups were assessed using an independent samples t-test, chi-square test. Values were correlated using Spearman's and Pearson correlation analysis.

RESULTS

Patients with BMI>30 were accepted as obese patients. According to these criteria 33 of the 55 patients were obese.

The mean demographic properties, obesity related measurements and joint space measurements of obese and nonobese patients are given in Table 1.

Medial and lateral tibial compartment measurements of obese patients were significantly lower than nonobese patients (p=0,000, p=0,003 respectively).

TMC and TLC were correlated with each other (r=0,506, p= 0,000).

BMI was correlated with total lean mass, total fat mass, trunk fat mass, abdominal fat mass, leg fat mass.

TMC and TLC were negatively correlated with BMI.

TMC was correlated with leg lean mass.

DISCUSSION

The results of this study revealed significant difference in both medial and lateral joint spaces of obese and nonobese patients with knee OA.TMC and TLC of obese patients were narrower than nonobese osteoarthritis patients. The more BMI had the patients the narrower joint space they had displayed. Leg lean mass and leg fat mass of obese patients were significantly different from nonobese patients. However, leg lean mass measurement by DEXA also demonstrated relation with TMC. As fat free mass of patients with OA decreased, the TLC measurement values also decreased. The reduced lean mass and increased BMI can be considered as a bad prognostic factor for knee osteoarthritis.

Skinfold thickness, waist and hip circumference measurement results revealed correlation neither with TMC nor TLC. Similarly there was not any correlation between trunk fat mass, abdominal fat mass analysis and joint space measurements.

Adiposity is clearly associated with the development of knee OA. The increase in risk of knee OA between the highest and lowest fifths of the distribution of BMI lies between four-and seven fold. Until recently it was not clear whether obesity preceded or whether obesity resulted from sedentary lifestyle of patients with OA. There are studies now, suggest that the former is correct. It is known that, obesity is a major determinant of progression of hip and knee OA. Baltimore longitudinal study of aging determined that body weight is associated with both definite and bilateral knee OA in both sexes (11).

During activity when loads of 2–3 times body weight passes through the knee joint, the medial compartment takes the maximum force, whilst in knee flexion the loading on the patellofemoral joint can reach 7–8 times that of body weight, perhaps explaining why obesity is an important determinant in progression of knee OA.

Narrowing of the joint space is certainly the most direct indicator of cartilage destruction but its rate of progression together with the influencing factors has not yet been fully elucidated.

Measurement of the joint space nevertheless represents only one of the parameters used to monitor OA. Other techniques are needed to study the growth of osteophytes and to quantify sub-chondral sclerosis. Especially 3-dimensional imaging techniques should enable cartilage loss to be assessed not only in terms of thickness or surface, but also in terms of volume.

Lanyon et al. (1) demonstrated that, asymptomatic subjects without knee osteophyte have no reduction in mean joint space. In contrast with this finding there is a study which suggests that joint space width decreases with age until a symptomatic pain threshold is reached (12). Ledingham et al. (13) investigated factors affecting radiographic progression of knee OA. They concluded that, a high rate of radiographic change was seen more than clinical change.

On the light of our results, we can tell that, obese patients with knee OA have narrower joint space than nonobese patients. However further body composition analysis and obesity related measuremens did not show the same correlation. So, BMI alone can be considered as an adequate obesity parameter in patients with knee OA.

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