Comparative Study of the Age Related Structural Changes in the Knee between Sportspersons and Non Sportspersons

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Abstract

Knee joint degeneration is the major cause of disability among the Indian population. The structural changes subject to differ among the sportspersons and non sportspersons. The aim of the study was to compare the structural changes in the knee between age-matched sportspersons and non sportspersons. Thirty sportspersons and thirty non sportspersons aged ≥50 years were randomly selected on the basis of selection criteria. Physical examination that included effusion, tenderness, atrophy, knee joint range, lower extremity muscle strength, physical activity levels and knee injury and osteoarthritis status was done in all the sixty subjects. Digital X ray examination was then carried out for measurement of joint space width and Kellgren Lawrence grading. Statistically significant difference was found in the joint space width and Kellgren Lawrence grades between the sportspersons and non sportspersons. Also significant difference was found in effusion, tenderness, atrophy, knee joint range, lower extremity muscle strength, physical activity levels and knee injury and osteoarthritis status between the sportspersons and non sportspersons. The study concluded that sportspersons have less worsened structural knee changes, better knee joint range of motion, muscle strength, physical activity levels and a better quality of life as compared to the age-matched non sportsperson peers.

Key words: Structural changes, joint space width, sportspersons, non sportspersons.

Introduction

The most consistent knee structural changes with increasing age are increase in cartilage defect severity and prevalence, cartilage thinning and increase in bone size with inconsistent change in cartilage volume *(Ding et al, 2005)*. High-impact and torsional loads may increase the risk of degeneration of normal joints, and individuals who have an abnormal joint anatomy, joint instability, disturbances of joint or muscle innervation, or inadequate muscle strength or endurance probably have a greater risk of degenerative joint disease.

It is reported that exercise contributes to cartilage healing and reduces risk for injury, and that moderate exercise can even decrease the number of cases requiring arthroplasty. Conversely, excessive (harsh) exercise may be associated with increased cartilage damage or degenerative changes. Despite the presence of osteophytic changes in joint cartilage of athletes performing mild sports activities, these may not result in osteoarthritis due to the adaptive feature of joint cartilage. In contrast, the risk for osteoarthritis is increased in professional sportsmen exposed to acute repetitive impact and torsional loading *(Ozkan et al, 2007)*.

Therefore it is important to assess the athlete's risk of physical exercise and determine whether it is beneficial or detrimental to the joint structure. Consequently, the present study was conducted to evaluate the age related structural changes that occur in articular cartilage particularly of weight-bearing joints such as knee joint with special reference to sporting activities.

An age-related increase in calcification of the articular cartilage and the menisci in the knee has been demonstrated radiographically *(Loeser, 2009)*. Accordingly, the age related structural changes in the knee joint were evaluated in the present study largely with the help of radiographs. The measurement of joint space width (JSW) on radiographs is currently the best available surrogate for evaluation of the progression of cartilage destruction *(Vignon et al, 2003)* and the Kellgren-Lawrence radiographic grading scale is commonly used in epidemiologic and clinical studies to define the presence of and to estimate the severity of osteoarthritis of the tibiofemoral joint *(Kizoksi et al, 2006)*. Therefore, the present study compares the age related structural changes in knee, between sportspersons and non sportspersons, on the basis of the measurement of joint space width and the Kellgren-Lawrence radiographic grading scale.

Participants: A comparative study was conducted on a sample of 60 subjects. They were divided into two groups: Group A having non-sportspersons and Group B having sportspersons. The sample was collected from Patiala and Chandigarh. Thirty intervarsity or national level sportspersons aged ≥50 years, both men and women from different sports volunteered to participate in the group of sportspersons. The criteri for the selection of sportspersons were that most of them had played for over a decade and were still recreationally active. The non-sportspersons group containing thirty age matched subjects was drawn from a random sample of the population. All subjects signed the consent form prior to participation in the study. Exclusion criteria for both groups, included subjects with history of neurological problem, systemic illness, major reconstructive surgery of the lower extremities or involvement of multiple major joints, subjects with unilateral or bilateral TKR or any inflammatory arthropathy, subjects in whom radiographs are harmful or contraindicated.

Materials & Methods:

All subjects recruited for the study were assessed through clinical examination and pre-participation screening which included detailed medical, social, personal and family history and examination of the vital signs. Anthropometric measurements, namely, height and weight were carried out by using anthropometric rod and weighting scale. The scale for effusion (*Mckeag and Moeller, 2007)* and scale for tenderness *(Hubbard and Berkoff, 1993)* were used to assess the severity of effusion and tenderness respectively. Both active and passive range of

motion of the knee joint was assessed with the goniometer. The strength of the lower extremity muscles were assessed with a cable Tensiometer *(McArdle et al, 2001).* The knee injury and osteoarthritis outcome (KOOS) score was used which covers 5 patient-relevant dimensions: pain, other symptoms, activities of daily living (ADL), function in sports and recreation (Sports/Rec), and knee-related quality of life (QOL). KOOS is a self-administered instrument that can be used for short-term and long-term follow-up of several types of knee injuries including osteoarthritis. *(Lohmander et al, 2004)* The General Practice Physical Activity Questionnaire was used to assess the level of physical activity in the subjects *(Bull and Milton, 2010).* Then the subjects were made to undergo the digital X-ray examination for measurement of joint space width and Kellgren Lawrence grading. This technique is based on the MTP (metatarsophalangeal) view which measures the joint space width that can be readily used to track longitudinal changes in cartilage thickness *(Oksendahl et al, 2009).* Digitalized films of radiographs were read for narrowing, sclerosis and osteophytes in the medial compartment of each right knee using the standard Kellgren and Lawrence method for assessing progression of radiographic OA: joint space narrowing, sclerosis and osteophytes were each graded on the scale of 0 to 3 (normal, mild, moderate and severe). Joint space width (JSW) was determined as the joint width in millimetres of the medial knee compartment. The lower the JSW, the more severe is the radiographic progression of knee OA; knee OA is the severe most when JSW = 0.

Results & Discussion:

Unpaired t test was applied to compare the age related structural changes in knee joint between nonsportspersons and sportspersons. Karl Pearson correlation was used to find the correlation between joint space width and the study variables.

Table 1: Demographic details of the participants in the two groups

Study Variables	Group A (Non sportsperson)	Group B (Sportsperson)	t-value
	Mean±SD	Mean±SD	
Age (yrs)	56.43±6.39	54±6.6	1.44
Height, mtrs	1.67±0.08	1.70±0.10	1.37
Weight (kg)	67.36±8.81	75.16±12.35	2.81
BMI(kg/m^2)	24.36±2.57	25.95±3.77	1.91

*p<0.05

Table 1 compares the demographic details such as age, height, weight and body mass index (BMI) between the non sportspersons and sportspersons. Mean and standard deviation were calculated and statistically non-significant difference was found for age and BMI, suggesting that the two groups were homogenous.

Table 2 shows the comparison of various parameters between the non sportspersons and sportspersons. Unpaired t-test was applied between the group A and B. Statistically significant difference was found in

tenderness, atrophy, effusion, knee joint range of motion, knee muscle strength, K/L grading, joint space width, GPPAQ scores and KOOS parameters.

Table 2: Comparison of the mean values of study variables between non sportspersons (group A) and sportspersons (group B).

Study Variables	Group A (Non sportspersons)			Group B (Sportspersons)			
	Mean	SD	SEM	Mean	SD	SEM	t-value
Tenderness	0.73	0.78	0.14	0.27	0.52	0.10	2.71*
Atrophy	1.46	0.64	0.11	1.03	0.57	0.10	2.69*
Effusion	0.63	0.89	0.16	0.13	0.57	0.10	2.58*
AROM flexion	114.0	10.70	1.95	122.17	8.68	1.58	3.24*
AROM extension	2.53	4.09	0.75	0	0	0	3.39*
PROM flexion	119.00	10.37	1.89	126.0	6.49	1.18	3.13*
PROM extension	0.50	1.53	0.28	0	0	0	1.79
Quadriceps strength	9.66	3.47	0.63	16.10	3.63	0.66	7.01*
Hamstrings strength	10.80	3.77	0.69	17.73	4.56	0.83	6.42*
K/L Grades	2.47	0.94	0.17	1.63	0.81	0.15	3.68*
Joint space width	1.18	0.51	0.09	2.24	1.09	0.20	4.80*
GPPAQ scores	2.50	0.86	0.16	3.0	0	0	3.18*
KOOS symptoms	78.29	18.38	3.35	90.71	9.21	1.68	3.30*
KOOS pain	80.46	17.19	3.13	93.97	6.96	1.27	3.99*
KOOS ADLs	78.18	19.67	3.59	94.16	8.96	1.63	4.04*
KOOS sports	55.50	36.33	6.63	81.33	19.30	3.52	3.44*
KOOS Qol	65.41	24.49	4.47	85.28	15.32	2.79	3.76*

*p<0.05

Table 3: Correlation of JSW with study variables with reference to knee joint

Parameters	Correlation (r)
JSW Vs Quadriceps strength	0.3700*
JSW Vs Hamstrings strength	0.3238*
Active knee flexion	0.3544*
Active knee extension	-0.3715*
GPPAQ Scores	0.3490*
KOOS Symptoms	0.3788*
KOOS Pain	0.4002*
KOOS ADLs	0.3799*
KOOS Sports and recreation	0.4083*
KOOS QoL	0.4194*

*p<0.05

Table 3 depicts the statistically significant relationship of JSW with all variables studied with reference to knee joint.

The present study compared the age related structural knee changes between sportspersons and non sportspersons. It was found that participation in sports is not associated with accelerated incidence or severity of structural knee changes.

Rather it is interesting to note that the non sportspersons exhibited the worse structural changes in their knees leading towards the development of osteoarthritis. These results are consistent with the other studies of long distance running and vigorous activity in independent cohort of aging subjects *(Panush et al, 1986; Lane et al, 1986; Hannan et al, 2000; Chakravarty et al, 2008)*. Even at the elite-athlete level, data suggest that running may not be an independent risk factor of knee osteoarthritis *(Kujala et al, 1995)*. Several other studies have also suggested that participation in low to moderate level recreational activities is associated with decreased risk of knee osteoarthritis *(Manninen et al, 2001)*.

In contrast, a number of studies have shown that participation in specific sports at elite level does increase the risk of knee OA. Associations are more pronounced for premature symptomatic and radiographic OA among participants in professional ballet dancing, soccer and weight lifting *(Kujala et al, 1994; Teitz et al, 1998; Spector et al, 1996)*.

Thus, it is important to critically analyze the effects of sporting activities on structure of knee joint, particularly age related changes in articular cartilage that could lead to the development of osteoarthritis. The above mentioned studies were mainly the case control studies in which only symptomatic athletes were included *(Kujala et al, 1994)*. Other studies had taken only high impact sports and found high percentage of injuries *(Teitz et al, 1998)*. Conversely, in the present study the sportspersons were randomly selected who reported lower than the expected number of injuries suggesting less worsening of the age related structural changes in the knee.

In addition to this, the radiological findings of the present study have suggested that the sportspersons have preserved knee structure as compared to the non sportspersons. These findings are well in line with those of *Chakravarty et al (2008)* who found that there were no significant differences in the K/L grades and JSW in the long distance runners after two years of longitudinal study suggesting that sporting activity is not associated with increased structural changes in the knee. Nonetheless, *Spector et al (1996)* concluded that long term weight bearing sports are associated with radiological presence of hip and knee OA as measured via Kellgren Lawrence grades.

Accordingly, the data collected in present investigation, was analysed further and the local factors with regard to knee joint were compared between sportspersons and non sportspersons, demonstrating that sportspersons had lesser tenderness, effusion grades and atrophy of thigh muscles, and higher range of active and passive knee joint motion, stronger quadriceps & hamstirngs, better physical activity levels (GPPAQ scores) and lower incidence of knee injuries (KOOS scores). All these factors might have contributed to preserve the structure of knee joint in sportspersons, signifying that the sportspersons have less worsened structural knee changes. For example, the weaker quadriceps muscle of non sportspersons as compared to the sportspersons suggest the possibility that the age-related quadriceps-dominant muscle atrophy may play a role in the

pathogenesis of structural knee changes. *Ikeda et al (2005)* holds the similar view. The strength of the quadriceps is believed to be important in stabilizing the knee joint and protecting articular surfaces from high loads *(Urquhart et al, 2008)*. Another important factor was physical activity level. The sportspersons were fully active with better joint space width (JSW) in knee joint. *Manninen et al (2001)* examined the association between physical activity and risk of severe knee OA requiring arthroplasty and found that the risk decreased with increase in cumulative hours of recreational physical exercise.

More importantly, the present study has established a strong relationship of structural changes (JSW) in knee joint with Lower extremity muscle strength, knee joint range of motion, physical activity levels and KOOS scores suggesting that the larger JSW or better said, less worsened structural knee changes are strongly related with stronger quadriceps &hamstrings, greater knee joint range of motion, higher physical activity levels and a lower knee injury profile. These findings are supported by numerous studies. *Holla et al (2011)* in their study concluded that features of articular degeneration are associated with lower knee ROM in patients with early OA. *Ersoz and Erqun (2003)* found statistically significant negative correlations between range of motion and radiographic scores and suggested that reduced ROM is associated with reduced JSW. Various studies have been conducted which suggest that atrophy or muscle weakness is an important clinical factor in determining the structural knee changes *(Slemenda et al, 1997; Valderrabano and Steiger, 2011)*. Strong association between pain and structural knee changes were reported by *Hart et al (1991); Duncan et al, (2007) and Neogi et al (2009). Foley et al (2007)* measured the physical activity level and physical work capacity and assessed the structural knee changes by MRI and suggested that knee cartilage volume and tibial plateau area are dynamic structures that can respond to physical stimuli.

Thus, findings of the present study have demonstrated that the sportspersons have less worsened structural degenerative changes in the knees as compared to the age-matched non sportspersons. The muscle strength, knee joint range of motion and physical activity levels are notably higher in the sportspersons than the non sports sportspersons. Also the better scores of KOOS among the sportspersons suggest that the sportspersons enjoy a better quality of life as compared to the non sportspersons. Therefore the participation in sports should be encouraged in order to minimize the risk of progression of structural degeneration in knee joint.

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