

Original article:

Correlation of histopathological osteoarthritis findings with the radiological findings in osteoarthritic patients

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Abstract:

Introduction: Our aim was to apply the Osteoarthritis Cartilage Histopathology (OACH) assessment system for the grading, staging and scoring of the osteoarthritic human knee and hip and correlate the findings with radiological grading system.

Method: Osteoarthritic knees of 23 patients and osteoarthritic hip of 2 patients were assessed applying OACH system and correlated with the Kellgren-Lawrence radiology scores.

Result: The OACH grading system correlated well with Kellgren-Lawrence X ray grading system.

Conclusion: The grading system implemented provided useful measures in the characterisation of knee and hip OA and correlated with the radiological results.

Keywords: osteoarthritis

Introduction

Osteoarthritis (OA) is one of the most prevalent conditions resulting to chronic disability, particularly in elderly. Worldwide, OA is the most common articular disease of people aged 65 years and older. It represents a major cause of disability in the United States. The prevalence of this disorder in certain elderly group is as high as 85%. The economic costs of OA are high, including those related to the treatment, for those individuals and their families who must adapt their lives and homes to the disease, and those due to lost work productivity [1]. According to the estimates for the global burden of disease 2000 study published in world health report 2002, OA is the 4th leading cause of disability at global level [2].

In India 5.3% males and 4.8% females are aged more than 65 years old. Although the proportionate percentage of elderly people in developing

countries is lesser but absolute number is more than the developed world [3]. The commonest obstacle for elderly to carry out activities of daily living is the problem of joint-pain and decreased mobility. The prevalence of OA in India is reported to be in range of 17-60.6% [3]. OA may be associated with decreased life span in view of threat on a person's physical function and the benefit of exercise on overall health.

OA is currently defined by the American College of Rheumatology as a heterogeneous group of conditions that lead to joint signs and symptoms, which are associated with defective integrity of articular cartilage, in addition to related changes in the underlying bone at the joint margins [4]. In other words OA is considered as the cumulative result of mechanical and biological events that induce an imbalance between the degradation and synthesis within articular joint tissues. The diagnosis of OA is mainly based on physical

examination and radiographs, which provide only a semi- quantitative assessment of the disease state. The current study intends to find out various cartilage changes in OA of knee and hip and its clinical and radiological co-relations in a given patient.

MATERIAL AND METHODS

Case Selection:

All consecutive patients who satisfied the inclusion criteria enumerated below, who had primary OA of knee and hip of varying severity, were considered eligible for the enrolment in the study.

Inclusion Criteria:

Both female and male patients with primary OA who satisfied the clinical criteria for knee and hip OA enumerated below -

Clinical criteria:

The presence of the following were regarded as signs of OA -

Joint line tenderness,

Crepitus on active or passive knee motion,

Limitation of range of motion,

Varus or valgus deformity of any degree.

These patients later underwent total knee replacement / total hip replacement in Mahara-ja.YeshwantRao Hospital, Indore and other private hospitals during period of september 2010 to september 2013.

Exclusion criteria:

(1) All cases having clinical and radiological features suggestive of inflammatory arthritis like Rheumatoid arthritis.

(2) All cases of secondary osteoarthritis.

All patients were informed about the aims of the study and the study protocol, and their informed consents were obtained prior to the study.

Radiological assessment was done by standing antero-posterior and lateral radiographs of the knee and hip using Kellgren-Lawrence grading scale. The Kellgren-Lawrence grading scale is a reliable and valid testing tool used in conjunction with radiograph. This method is widely used in the diagnosis as well as in epidemiologic studies on OA of the knee and is accepted by the WHO.

- 1) Grade 0 (none) :Normal radiographs
- 2) Grade 1 (minimal) :Minute osteophytes, possible lipping, doubtful significance.
- 3) Grade 2 (mild) : Osteophytes, joint space narrowing normal or questionable
- 4) Grade 3 (moderate) :Moderate joint space narrowing, multiple osteophytes, some evidence of subchondral sclerosis or cysts
- 5) Grade 4 (severe) : Large osteophytes, marked joint space narrowing, severe sclerosis, deformation.

For measuring the joint space, a vertical line is drawn from mid-femoral medial and mid-femoral lateral condyles to the tibial plateau. The lesser of the two measurement is taken into consideration as joint space.

Majority of the cartilage samples collected were from the femoral and the tibial condyles especially from the medial compartment during total knee replacement done for primary OA from 23 patients. 2 samples were also collected from the femoral head during hip replacement surgery. These specimen were labelled and immediately fixed in 10% neutral buffered formalin and sent to us in the department of pathology, M.Y. hospital for tissue processing and assessment.

OA cartilage histo-pathology was done and grading, staging and scoring was done using the OARSI system [5,6]

OA CARTILAGE HISTOPATHOLOGY GRADING

Grade= depth progression into cartilage.

Grade	Key features	Associated criteria (tissue reaction)
Grade 0	Surface intact, cartilage morphology intact.	Matrix: normal architecture Cells : intact, appropriate orientation.
Grade 1	Surface intact	Matrix: superficial zone intact, oedema/ superficial fibrillation, focal superficial condensation. Cells: death, proliferation (clusters), hypertrophy.
Grade 2	Surface discontinuity	As above + Matrix : discontinuity at superficial zone (deep fibrillation) Cells : death, proliferation (clusters), hypertrophy.
Grade 3	Vertical clefts (fissures)	As above + Matrix : vertical fissures into mid zone, branched fissures Cells : death, regeneration (clusters), hypertrophy, cartilage domains adjacent to fissures.
Grade 4	Erosion	Cartilage matrix loss ; delamination of superficial layer, mid-layer cyst formation, excavation ; matrix loss superficial and mid-zone.
Grade 5	Denudation	Surface : sclerotic bone or reparative tissue including fibrocartilage within denuded surface, micro-fractures with repair limited to bone surface
Grade 6	Deformation	Bone remodelling (more than osteophyte formation only); includes micro-fractures with fibro-cartilagenous and osseous repair extending above the previous surface.

OA CARTILAGE HISTOPATHOLOGY- STAGE ASSESSMENT

Stage	% involvement (surface area, volume)
STAGE 0	No OA activity seen
STAGE 1	<10%
STAGE 2	10-25%
STAGE 3	25-50%
STAGE 4	>50%

OA SCORE: OA cartilage score represents a combined assessment, based on both the severity (grade) and extent (stage) of OA in the articular cartilage. An OA cartilage score can be determined using either qualitative, semi-quantitative or quantitative methods. In

considering scoring methodology, the method selected should be as simple as that required to obtain the information needed to separate the OA from the controls or to compare one OA set with another.

To compare an OA test group to controls, qualitative or semi- quantitative methods are usually sufficient. To compare the extent of OA between the cartilage domains within a model, quantitative methods are recommended as a first choice.

Recommended OA Score Method:

The recommended score is an index of combined grade and stage.

The simple formula : Score = Grade X Stage is recommended.

This method produces an OA score with a range of 0-24 based on the most advanced grade and extensive stage present. This method provides equal ordinal number weight to severity (grade) and extent (stage). This method continues to bias OA assessment towards the most advanced disease observed.

Alternate OA score methods:

1. Qualitative score : simple method. This indicates the most advanced OA grade / stage observed in the section.e.g, grade 2, stage 3. This method has the advantage of one grade and one stage, which is indicative of most advanced grade and most extensive stage

present. With this method, OA severity is distinguished from OA extent.

2. Qualitative score : complex method. This measures the most advanced stage for each grade , e.g, G1S4,G2S3,G3S2. This method may give a more accurate portrayal of how much of OA is in the joint. However, this requires much more assessment time.

The alternate methods may be useful to indicate the amount of OA in special situations, for example, individual clinical samples. With these methods, comparison between patient samples is more cumbersome and must be restricted to counting the number of samples which are assigned to each score category.

Results-

(1) Age and sex wise distribution –

In our study of 25 cases, where 18 patients (72%) were females while 7 (28%, n=25) were males, maximum number of patients suffering from osteoarthritis belonged to the age group of 61-70 years. Maximum number of patients in our study were females.

(2) Comparison of K-L X ray grading with histopathology grading

KL X ray grade	OARSI histopathology grade						
	Grade 0	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Grade 6
Grade 0	-	-	-	-	-	-	-
Grade I	-	-	-	-	-	-	-
Grade II	-	-	-	-	-	-	-
Grade III	-	-	-	1	4	1	-
Grade IV	-	-	-	1	11	7	-

This table shows a comparison between K-L X ray grading and OARSI histopathology grading. We found that out of the 19 patients who had X ray grade IV, 11 patients (57.89%) also had OARSI histopathology grade 4. Out of 6 patients who had X-ray grade III, there were 4 patients (66.66 %) who also had OARSI histopathology grade 3.

This shows that both the X ray and histopathological findings can be correlated in some patients of OA.

Discussion

(1) Age and sex wise distribution –

- In our study of 25 cases, where 18 patients (72%) were females while 7 (28%, n=25) were males, maximum number of patients suffering from osteoarthritis belonged to the age group of 61-70 years. Maximum number of patients in our study were females.
 - Similar finding was noted in a study conducted by S. Avasthi, D. Sanghi *et al* [7] in department of orthopaedic surgery, CSMMU, Lucknow between 2006-2008. Patients of primary osteoarthritis knee were included in the study. 120 patients were enrolled out of which 46(38.3%) were males and 61.7% were females. So here also the incidence of osteoarthritis was higher in females than males.
 - Another study was conducted by F.A. Okanlawon [8], in University of Ibadan, Nigeria where study population consisted of 486 patients diagnosed with osteoarthritis knee, lumbar and cervical spine between July 2007 and June 2008. It consisted of 209 males and 277 females. Here the incidence in females was only slightly higher than males. In this study in the females, the incidence of OA of the knee joint was the highest, and found to be more common within the age groups of 56–60 yrs, followed by 45–50 yrs, 61–65 yrs, 81–85yrs and 71–75 yrs.
- In our study the incidence of osteoarthritis of the knee joint in females was found to be more common within the age group of 61-70 yrs. followed by 71-80 yrs. and 50-60 yrs.
- (2) **With respect to Kellgren-Lawrence grading-**
- In our study out of 25 cases studied, the most common K-L X ray grading obtained was grade IV followed by grade III. We found 76% of cases presented in grade IV followed by 24% in grade III.
 - Our findings does not match with a study conducted by S. Avasthi, D. Sanghi *et al* [7] in department of orthopaedic surgery, CSMMU, Lucknow where 120 patients were enrolled between 2006-08 and radiological grading was done as per Kellgren Lawrence scoring system. They found that 67.5% of cases presented in K-L grade III followed by 25.83% in K-L grade II and 6.67% in grade IV.
 - Another study conducted by Duygu Cubukcu *et al* [9] also got majority of K-L grade III changes. 114 patients were studied and radiographic grading was done as per Kellgren Lawrence scale. On the radiographic assessment, 12 patients (10.5%) were grade I on the Kellgren-Lawrence Index, 39 (34.2%) were grade II, 57 (50.0%) were grade III, and 6 (5.3%) had grade IV, showing that the subjects were mostly categorized as mild to moderate for radiographic features.
 - In our study 19 patients who had X ray grade IV, 11 patients (57.89%) also had OARSI histopathology grade 4. Out of 6 patients who had X ray grade III, there were 4 patients (66.66 %) who also had OARSI

histopathology grade 3. This shows that X ray changes cannot be always correlated with the histopathological changes.

- A similar finding was found in another study which was conducted by Brandt KD *et al* [10] in department of Medicine, Indiana University School of Medicine, Indianapolis. They examined knee radiographs of 92 patients who had chronic knee pain and radiographic evidence of mild to moderate OA, graded them according to the Kellgren-Lawrence criteria. Of 17 patients whose radiographic findings were normal by both the K-L criteria and JSN-weighted criteria, 7

had advanced tibiofemoral and/or patellofemoral compartment changes of OA seen at arthroscopy, emphasizing the insensitivity of the radiograph for detecting early articular cartilage loss. In addition, tibiofemoral JSN was common in the presence of normal articular cartilage. Here also the JSN and the Kellgren Lawrence criteria did not match with the severity of articular cartilage changes of OA.

Conclusion: The grading system implemented provided useful measures in the characterisation of knee and hip OA and correlated with the radiological results.

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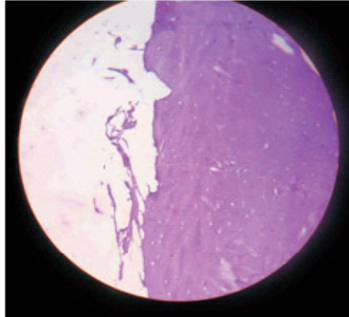
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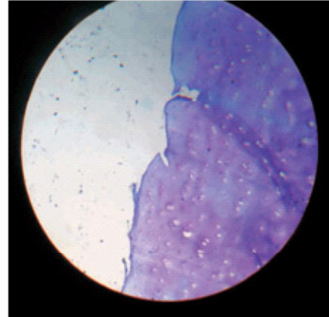
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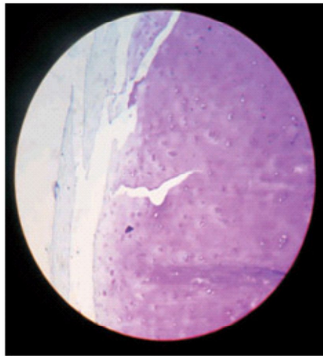
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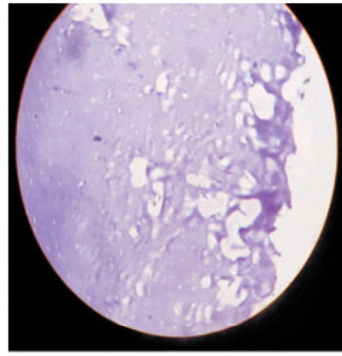
H & E stained section showing grade 3 osteoarthritis



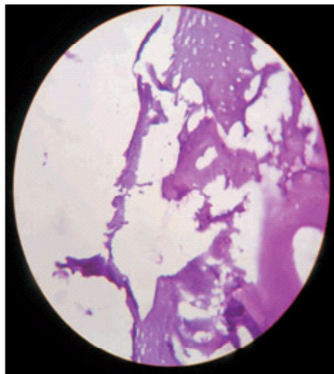
Toluidine stained section showing grade 3 osteoarthritis



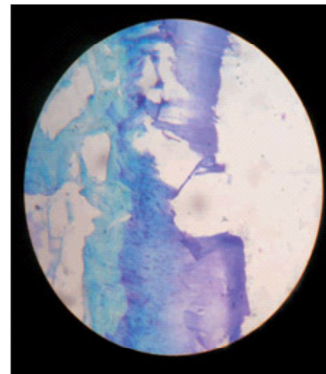
H & E stained section showing grade 4 osteoarthritis



H & E stained section showing grade 4 osteoarthritis



H & E stained section showing grade 5 osteoarthritis



Toluidine stained section showing grade 5 osteoarthritis