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นิพนธ์ต้นฉบับ **Original Article**

Assessment of the Size and the Direction of Osteophyte in Knee Osteoarthritis : A radiographic study

การพิเคราะห์ขนาดและทิศทางของกระดูกที่งอกในโรคข้อเข่าเสื่อมทางรังสีวิทยา

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ABSTRACT

Objective : 1. to assess the size and the direction of osteophyte in knee osteoarthritis.

2. to determine the correlation between the osteophyte size and the bony collapsed and the chondrocalcinosis.

Methods : Knee radiographs (routine AP and lateral views) were examined from 101 patients who came to hospital with symptomatic knee osteoarthritis (74 women, 27 men, mean age 61.94, range 42-83 years) during June 2003 to March 2006. A single observer assessed the films for osteophyte size and direction at 6 sites, chondrocalcinosis and bony collapsed, using standard atlas, direct measurement or visual assessment.

Results : From 3 grades of osteophyte size and 5 categories of osteophytes direction, there were positive correlation between the size and the direction ($p < 0.005$). There were also strong positive correlation between osteophyte sizes with chondrocalcinosis and bony collapsed (odds ratio at 95% confidence interval > 2).

Conclusion : In hospital-based patient knee osteoarthritis radiographs, the smaller osteophyte predominating upward and horizontal as well as larger one predominating vertical direction due to restriction by surrounding soft tissue structures. Larger osteophyte size is association to more opportunity to detect the chondrocalcinosis and the bony collapsed, which is correlation to the severity.

Key words : osteophyte, knee osteoarthritis.

บทคัดย่อ

การศึกษาย้อนหลังในผู้ป่วยที่เป็นโรคข้อเข่าเสื่อมซึ่งได้รับการเอกซเรย์เข่าที่แผนก กระดูกและข้อในโรงพยาบาลประจวบคีรีขันธ์ ตั้งแต่มิถุนายน 2546 ถึง มีนาคม 2549 จำนวนทั้งสิ้น 101คน โดยทำการศึกษาขนาดและทิศทางของกระดูกที่งอก รวมทั้งศึกษาความสัมพันธ์กับความผิดปกติอื่นได้แก่ การที่กระดูกยุบตัวและการมีการเกาะตัวของหินปูน พบว่าขนาดของกระดูกงอกมีความสัมพันธ์กับทิศทางโดยกระดูกงอกขนาดเล็กมีแนวโน้มจะมีทิศทางตามแนวนอนมากกว่ากระดูกงอกขนาดใหญ่เนื่องจากมีเนื้อเยื่อปกคลุมโดยรอบเข่าทำให้ไม่มีพื้นที่ที่จะขยายตัวออก นอกจากนี้ยังพบว่ากระดูกที่งอกขนาดใหญ่ยังมีโอกาสที่จะพบกระดูกยุบและการเกาะตัวของหินปูนมากกว่ากระดูกงอกขนาดเล็กกว่าซึ่งแสดงว่าระดับความรุนแรงของโรคมากกว่า

Introduction

The osteoarthritis (OA) of knee is a major cause of pain and disability in the elderly. The estimated prevalence was varied from 4 to 30% depending on age, gender and disease definite.[1] The risk of the knee OA is comparable in men and women up to 50 years of age, after that the incidence and prevalence of OA increases more rapidly in women than men.[2]

The radiographic defining features of OA are 1.) focal cartilage loss, resulting in joint space narrowing and 2.) accompanying endochrondral ossification at the joint margin that produces marginal osteophyte.[3,4] The factors determine osteophyte formation and growth are unknown except at the femorotibial angle which shows the correlation with age, arthrosclerosis, and obesity in orderly.[5]

Osteophyte may also develop as an isolated feature associated with age and progress rather than follow cartilage loss in animal studies.[6] Joint instability has been emphasized as a biochemical trigger to osteophyte formation.[7]

Assessment of the radiographic features is the measures for evaluating the structural changes in OA.[8] The size of the osteophyte influences the severity of the OA.[8] Large osteophyte is a strong correlation to the mal-alignment to the side of the osteophyte but do not affect the risk of the structure progression.[10] Nagosa et al support that small osteophyte predominate outward exception in the lateral tibial plateau which are extending upwards whereas the larger one predominated extend upwards or downward due to anatomical limitation in lateral growth imposed by the restrained of adjacent fibrous structure or the need to widen and strengthen the osteophyte base to protect against fracture. Correlation between the size and the direction of the osteophytes which may be influence structural change are still less information.[9]

Osteophyte size are not only association with local compartmental narrowing and local alignment and also bone attrition (bony collapsed).[9] There were some clinical studies confirming an association between chrondrocalcinosis and OA especially calcium pyrophosphate crystal, the usual cause of chrondrocalcinosis and the hypertrophic end of the OA.[14] Transformation growth factor B1 enhance production of extracellular pyrophosphate by chon-

drocyte and mechanical perturbation of chondrocyte increases the release of ATP, thereby predisposing to pyrophosphate crystal formation.[14,15] In summary, chrondrocalcinosis due to pyrophosphate crystals were suggested to be associated with the tendency to osteophyte formation and a hypertrophic form of OA.

This study aimed to determine the correlation between the osteophyte size, the direction and other radiographic findings as bony collapsed and chrondrocalcinosis.

Methods

Routine radiographs of 101 patients with knee symptomatic OA in orthopedics clinic of Prachuab Kirikhun Hospital during June 2003 to March 2006 were retrospectively reviewed for this study. All radiographs were obtained in routine supine AP and lateral views. Radiographic knee OA was defined as the presence of joint space narrowing and osteophyte in any knee compartment.

Radiographic assessment

Individual radiographic features were assessed for the lateral and medial tibiofemoral joints in AP view. In the lateral views, the superior and inferior patellofemoral joints were assessed. The osteophytes size were graded 0-3 according to a standard atlas[8] and any not included in any photographic atlas, they will be grading by using a line drawing systems. The osteophyte side was graded at 6 sites in each knee. The direction of the osteophytes alignment at the 6 sites in AP view was divided by visual inspection into 5 categories : upward, upper middle, horizontal, lower middle or downward and vertical. Bony collapse and the chrondrocalcinosis were graded 0-1 (absent or present).

Statistics evaluation

To minimize any bias by similarity between right and left knees of the same person, all analyses were performed for one knee selected at random from each patient. Correlation between all sites osteophyes size and direction were analyzed with Spearman rank correlation. Odds ratios were calculated according to the presence or absent of grade 1 or more osteophyte as relation to present or absent of the chondrocalcinosis and bony collapsed

Results

Radiographs of 101 patients (74 women and 27 men ; mean age 61.94 years ± 10.638 months, range 42-83 years) were included in the study. There were 47 left knees and 57 right knees. Radiographs were reasonable for contrast and alignment.

Sites and Direction of the osteophytes

Osteophytes were found at the sites as follows

Sites	Number (%)
Lateral femur	56 (55.4)
Medial femur	64 (63.4)
Lateral tibia	66 (65.3)
Medial tibia	75 (74.3)
Superior patella	72 (71.3)
Inferior patella	75 (74.3)
Anterior femoral trochlea	35 (34.7)

Table 1 Number and percentage of the osteophyte grade at multiple sites (N = 101).

Sites \ Grade	0	1	2	3
Lateral femur	45 (44.6%)	39 (38.6%)	15 (14.9%)	2 (2.0%)
Medial femur	37 (36.6%)	37 (36.6%)	26 (25.7%)	1 (1.0%)
Lateral tibia	35 (34.7%)	42 (41.6%)	21 (20.8%)	3 (3.0%)
Medial tibia	26 (25.7%)	52 (51.5%)	19 (18.8%)	4 (4.0%)
Superior patella	29 (28.7%)	44 (43.6%)	22 (21.8%)	6 (5.9%)
Inferior patella	26 (25.7%)	40 (39.6%)	31 (30.7%)	4 (4%)
Anterior femoral trochlea	66 (65.3%)	14 (13.9%)	16 (15.8%)	5 (5%)

Table 2 Number and percentage of the direction of the osteophytes at multiple sites (N = 101).

Sites \ Direction	None	Upward	Upper middle	Horizon.	Lower middle	Vertica
Lateral femur	45 (44.6%)	8 (7.9%)	15 (14.9%)	33 (32.7%)	0 (0%)	0 (0%)
Medial femur	38 (37.6%)	6 (5.9%)	13 (12.9%)	38 (37.6%)	6.0 (5.9%)	0 (0%)
Lateral tibia	35 (34.7%)	11 (10.9%)	25 (24.8%)	29 (28.7%)	1.0 (1.0%)	0 (0%)
Medial tibia	26 (25.7%)	3 (3%)	16 (15.8%)	49 (48.5%)	5 (5%)	2 (2%)
Superior patella	29 (28.7%)	23 (22.8%)	40 (39.6%)	7 (6.9%)	2 (2%)	0 (0%)
Inferior patella	26 (25.7%)	3 (3.0%)	6 (5.9%)	8 (7.9%)	26 (25.7%)	32 (31%)
Anterior femoral trochlea	66 (65.3%)	23 (22.8%)	4.0 (4.0%)	8 (7.9%)	0 (0%)	0 (0%)

Spearman's rank correlation coefficients at $p < 0.005$

There were positive correlation between grades of the osteophytes and direction of the osteophytes in all sites by Spearma's rank correlation coefficients at $p < 0.005$.

There were 28 patients (27.7%) with chrondrocalcinosis and 42 (41.6%) with bony collapsed.

Table 3 Odds ratios at 95% confidence interval for chrondrocalcinosis (CC) and bone collapses as correlation to the size of the osteophytes at multiple sites.

Sites / Condition	Lateral femur	Medial femur	Lateral tibia	Medial tibia	Superior patella	Inferior patella	Anterior femoral trochlea
CC	2.05	2.09	1.87	2.59	1.29	1.86	2.48
Bony collapsed	2.21	6.64	4.52	5.65	2.35	13.72	7.21

Discussion

Osteophytes are one of the major radiographic finding in knee OA[16] There is multiple factors influence the progression of the osteophytes.[17] It has been proposed that local instability is an important biochemical trigger to osteophyte formation.[7] In experimental models of OA, osteophyte formation in an unstable joint was promoted by joint movement and inhibited by immobilization.[18] The osteophyte can stabilize the OA joint[13] To be the best achieve in this splinting, the osteophyte needs to grow laterally to widen the articular surface.[7] Pottenger et al showed that a vertical osteophyte especially at the lateral tibial plateau can stabilized the joint due to creating newly raised tibial surface and reducing excessive valgus motion[13]. In this research, the small osteophyte generally has upward direction and horizontal but larger osteophyte has more vertical direction. There is presumption that the larger osteophyte, which represents more severity, stabilizes the knee joint better than smaller osteophyte.

Nagaosa et al concluded that osteophytes size is associated with local compartment narrowing, bone collapses and local alignment. Small osteophyte predominated outward and the larger one predominate upwards and downwards due to anatomical limitation to alter growth imposed by the restrained of the adjacent fibrous surface or the need to widen and strengthen the osteophye base to protect against fracture[9].

In this research, there was positive correlation of the osteophyte size and direction. The small osteophyte has upward direction and horizontal but larger osteophyte has more vertical direction. The

different in results may be due to different radiographic position in routine AP and lateral knee radiographs. Nagaosa et al preferred the standing extended AP view[9] but in this retrospective study, there were routine supine AP knee radiographs. Because of the skyline views which are useful for evaluation the patellofemoral view were not the routine use, this study used the routine lateral knee radiographs instead.

This represent that different radiograph position makes different interpretation especially for direction. So far this will be encouraged the clinician for request proper knee radiographs such as standing AP knee position instead of routine supine AP knee radiographs. Another assumption, the results ; due to knee OA was the clinical diagnosis disease. The knee radiographs was performed only when the surgical intervention was needed or clinical doubtful. So there were a few sample sizes of films for evaluation.

The definition of knee radiographs is not only osteophyte formation but also cartilage loss. Van Osch et al speculated that cartilage damage and the osteophyte formation are not directly linked but that both are induced by same factors and develop independently in each other[12]. In plain radiograph, the cartilage loss represent with local space narrowing and in more severe, there will be bony collapsed. Nagoasa et al showed that there is strong correlation between the osteophyte size, local space narrowing and also bone attrition (reduction in bone contour)[9].

In this study, the local space narrowing can not be determined because the routine knee radiographs using for evaluation that were not standard standing views and skyline views which are proper for evaluation. This study assumed the severe local space narrowing relation to the bony collapse. There were supporting that correlation between the osteophyte size and the bony collapse. If there was larger osteophyte formation, there would be more bony collapsed. The osteophyte size represents the severity of the OA. The larger osteophyte is representing more severity in OA, there are loss of entire the cartilage and loss of joint space. Eventually, the adjacent bony structures crush each other and become bony collapsed in the radiograph.

Although community surveys had confirmed an associated between the chrondrocalcinosis and OA knee, clinical study suggested a more specific associate between the calcium pyrophosphate crystals, the usual cause of chrondrocalcinosis and hypertrophic end of the OA. Presumably, there might be individual growth factor B and bone morphologic protein -2 that play a part in osteophyte formation and also enhance production of the extracellular pyrophosphate by chondrocyst and mechanical perturbation of chrondrocyst increased releasing of ATP, predisposing to pyrophosphate crystal formation[15]. This study results also supports the correlation between osteophyte formation and the chondrocalcinosis.

In summary

This hospital base radiography study revealed that there was positive correlation between the osteophyte size and direction. The small osteophyte has upward direction and horizontal but larger osteophyte has more vertical direction. The results in

this research differ from previous research results mainly due to different radiographic position which made different assessment. The clinician would be encouraged for proper request knee radiographic position. Larger osteophyte is correlation to more opportunity to detect the chondrocalcinosis and bony collapsed, which is representing more severity.

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References

1. Lanyon P, O'Reilly S, Jones A, Doherty M. Radiographic assessment of symptomatic osteoarthritis in the community : definitions and normal joint space. Ann Rheum Dis 1998 ; 57(10) : 595-601.
2. Zhang Y, Mclindon TE, Hannan MT. Estrogen replacement therapy and worsening of radiographic osteoarthritis of the knee : the Framingham study. Arthritis Rheum 1998 ; 41(10) : 1867-73.
3. Van Sasse JLCM, van Romundle LKJ, Cats A, Vadenbrouke JP, Valkenburge HA. Epidermiology of osteoarthritis: Zoetermeer survey. Comparison of radiological osteoarthritis in a Dutch population with that in 10 other populations. Ann Rheum Dis 1989 ; 48 : 271-80.
4. Lawrence JS, Bremner JM, Bier F. Osteo-arthrosis : prevalence in the population relationship between symptoms and X-ray changes. Ann Rheum Dis 1966 : 25 : 1-23.
5. Kobayashi T. Osteophyte formation in the knee joint : a radiographic study. Nippon Seikeigeka G akkai Zasshi 1994 ; 68 : 139-50.
6. Hernborg J, Nilsson BE. The relationship between osteophytes in the knee joint, osteoarthritis and aging. Acta Orthop Scand 1973; 44 : 69-74.
7. Marshall JL, Olsson SE. Instability of the knee. A long term experimental study in dogs. J Bone Joint Surg Am 1971 ; 53 : 1561-70.
8. Altman RD, Hochberg MC, Murphy WA, Wolfe F. Atlas of individual radiographic features in osteoarthritis. Osteoarthritis Cart 1995 ; 3 : 3-70.
9. Nagoasa Y, Lanyon P, M Doherty. Characterisation of size and direction of osteophyte in knee osteoarthritis: a radiographic study. Ann Rheum Dis 2002; 61 : 319-24.
10. Felson DT, Gale DR., Elon Gale M, Niu J, Hunter DJ, Goggins J, La velley MPI. Osteophytes and progression of knee osteoarthritis. Rheumatology 2005 ; 44(1) : 100-4.
11. Nagoasa Y, Mateus M, Hasssen B, Lanyon P, Doherty D. Developmental of logically devised line drawing atlas for grading of knee osteoarthritis. Ann Rheum Dis 2000 ; 59 : 587-95.
12. Van Osch GJ, van der Kraan PM, van Valburg AA, Vasn den Berg WB. The relation between cartilage damage and osteophyte size in a mutine model for osteoarthritis in the knee. Rheuatol Int 1996 ; 16 : 115-9.
13. Pottenger LA, Phillips FM, Draganich LF. The effect of marginal osteophyte on reduction of varus-valgus instability in osteoarthritis knee. Arthritis Rheum 1990 ; 33 : 853-8.

14. Doherty M, Dieppe PA. Clinical aspects of calcium pyrophosphate dehydrate crystal deposit, Rheum Dis Clin North Am 1988 ;14 : 395-414.

15. Felson DT, Anderson JJ, Naimark A, Kannel W, Meenan RF. The prevalence of chrondrocalcinosis in the elderly and its association with knee osteoarthritis: the Framingham study. J Rheumatol 1989 ; 16 : 1241-5.

16. Resnick D, Niwayama G. Degenerative diseases of the extra spinal locations. In : resnick D et al, eds. Diagnosis of bone and Joint Disorders. 3rd. Philadelphia : W. Saunders, 1995 : 1273-371.

17. Hart DJ, Doyle DV, Spector TD. Incidence and risk factor for radiographic knee osteoarthritis in middle-aged women : the Chingford study. Arthritis Rheum 1999 ; 42(1) : 17-27.

18. Palmoski MJ, Brandt KD. Immobilization of the knee prevents osteoarthritis after anterior cruciate ligament transaction. Arthritis Rheum 1982 ; 25 : 1201-8.