Scand J Rheumatol 1998;27:347–51

Validity of Cyriax's Concept *Capsular Pattern* for the Diagnosis of Osteoarthritis of Hip and/or Knee

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To analyse the validity of Cyriax's concept of the "capsular pattern" in the diagnosis of osteoarthritis (OA) of hip and knee, data on 200 patients were analysed. The capsular pattern with limitations of medial rotation, flexion, and abduction, was not present as a distinct pattern in patients with OA of the hip. In patients with OA of the knee, an indication of the existence of a capsular pattern of the knee, with limited ranges of motion for both flexion and extension was found in subgroups of patients. It is concluded that the capsular pattern cannot be regarded as a valid test for the diagnosis of OA of the hip or knee. Further investigations in subgroups of patients are recommended.

Key words: osteoarthritis, hip, knee, Cyriax, validity

Diagnosing joint and soft tissue lesions can be extremely difficult in general practice. A wellknown system for the diagnosis of these lesions is the one introduced by Cyriax in the late fifties (1). A central concept in his diagnostic system of joint lesions is the presence of the so-called "capsular pattern". A capsular pattern is a joint-specific pattern of restriction of passive movements. It indicates the existence of a contraction of the joint capsule. This capsular pattern of restrictions of passive joint movements is thought to be indicative of the existence of arthritis. The type of the capsular pattern, though, differs between the types of joints. It only exists in those joints that are controlled by muscles. These muscles jump to the rescue in order to prevent further joint movement when the tension on the joint capsule and on its synovial lining is about to cause pain.

According to Cyriax, in very early osteoarthritis (OA) of the hip, medial rotation is the first movement to become measurably restricted, soon followed by slight limitation of flexion. The full capsular pattern of the hip is characterised by gross limitation of medial rotation, flexion, and abduction. Furthermore, there is a slight limitation of extension and little or no limitation of lateral rotation. In the early stages of OA of the knee rotations remain unlimited and painless. The full capsular pattern of the knee is characterised by gross limitation of flexion and slight limitation of extension. In a recent textbook on orthopedic medicine, definitions of the capsular patterns of hip and knee for the diagnosis of OA were completely in agreement with Cyriax's concepts (2). Apparently, the original definitions of the capsular pattern are still being used.

Only very few studies have investigated the validity of the Cyriax diagnostic system. A Medline and Embase-search back to 1980 using the keywords *Cyriax-arthrosis – osteo-arthritis – capsular pattern* yielded one study on the issue of OA of the knee (3). In that study the reliability and validity of the capsular pattern for the diagnosis of OA of the knee was seriously questioned. Another study dealt with the intertester reliability of the Cyriax system in patients with shoulder pain (4).

In our study we compared joints of patients with OA of the hip and/or knee with those of patients without OA. Cyriax only gives specific values for range of motion (ROM) in the different directions of movement in the case of gross arthritis. In the apparent absence of exact criteria for the capsular pattern we would expect that the ROMs of medial rotation, flexion, and abduction of hip-joints with OA show lower values than ROMs of hip-joints without OA, and also lower values than normal ones. For lateral rotation, adduction, and extension we would expect to find no or only minor differences.

For the knee we would expect the ROM of flexion in joints with OA to show lower values than in joints without OA and also a lower value than the normal one. For the ROM of extension we would expect to find no or only minor differences.

This study examined the validity of the concept of the "capsular pattern" for the diagnosis of OA of hip and/or knee in general practice by testing the expectations mentioned above.

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Received 28 January 1998
Accepted 3 June 1998

Table I. Characteristics of patients.

	Hip OA	Knee OA	Total
Patients (joints)	122 (161)	161 (271)	200 (432)
Age: mean ± sd (years)	69.1 ± 8	69.2 ± 9	68.3 ± 9
Sex	35 M, 126 F	41 M, 230 F	43 M, 157 F
Duration of complaints: median (weeks)	52	78	–

Materials and methods

Our data come from a randomised, single-blinded trial on the effectiveness of exercise therapy in patients with OA of the hip and/or knee (5). This trial was conducted from May 1994 until February 1996.

Patients. Patients were recruited from general practices. Inclusion criteria for participation in the trial were based on Altmann's clinical classification criteria of OA of the hip (6) and the knee (7). For the hip these were pain in hip, buttock, or groin and either a medial rotation of less than 15° combined with an erythrocyte sedimentation rate (ESR) <45 mm/hour or a painfull medial rotation greater than 15° combined with stiffness lasting less than one hour and age >50 years. For the knee the inclusion criteria were knee-pain and compliance with at least three of the following six criteria: age >50 years, stiffness <30 minutes, crepitus, bone tenderness, bone enlargements, and no noticeable hotness.

Exclusion criteria were other pathology explaining the complaints, complaints in less than 10 out of 30 days, treatment for these complaints with exercise therapy in the last six months, age under 40 or over 85 years, indication for hip or knee replacement, contra-indications for exercise therapy, contra-indications for analgetics or non-steroidal anti-inflammatory drugs (NSAIDs), and language or communication problems.

Patients participated after written informed consent had been obtained. The trial was approved by the Ethics Committee.

200 patients meeting the inclusion criteria were willing to participate in the trial. Patient-characteristics are shown in Table I.

Testing of mobility. At the start of the trial all patients were examined by one of two physical therapists who took down their history and did a physical examination. This consisted of an examination of the mobility of both the hips and the knees. Mobility was tested by way of an assisted active movement till the end of the movement or until the painthreshold was reached. For the hip, measurement was made of flexion and extension, abduction and adduction, medial and lateral rotation. For the knee, flexion and extension were measured.

For each measurement three referencepoints were marked on the skin, according to Norkin and White (8). Subsequently, the range of motion was measured with a large goniometer with a waterlevel on one arm. The turningpoint of the goniometer was placed on the middle referencepoint.

Definition of capsular pattern of the hip. As Cyriax gives no exact criteria for the existence of a capsular pattern, except for gross arthritis, we tried to find whether our patients fulfilled a general definition of the capsular pattern: a combination of ROMs for medial rotation, abduction, and flexion that was significantly different from normal values and from hip-joints without OA; furthermore we expected that the ROMs of lateral rotation, extension and, adduction would not, or only slightly, be limited in comparison with significant differences of medial rotation, flexion, and abduction.

Definition of capsular pattern of the knee. According to Cyriax the capsular pattern of the knee is characterised by gross limitation of flexion and slight limitation of extension.

Subgroup-analyses

Two subgroup-analyses were performed for both the hip-joints and the knee-joints: one on the basis of duration of complaints and one on the basis of radiological evidence of OA.

Duration of complaints. Hip-joints with OA and longer than median duration of complaints were selected and the above mentioned analyses for the capsular pattern repeated. The analyses were also repeated for hip-joints with a shorter than median duration of complaints. The analyses were repeated for knee-joints with either longer or shorter than median duration of complaints.

Radiological evidence of OA. Radiological examination of the hip and knee was carried out according to the guidelines of the American College of Rheumatology (6). Features were scored on a 4-point scale. The outcomes of the radiological examinations were regarded as positive when at least a score greater than zero was scored on the item joint-space-narrowing. We identified joints that met this criterion and compared them with hip- and knee-joints without OA.

Statistical analysis. Units of the analyses were joints. Two-tailed independent Student t-tests were used for the comparison of ROMs between hip-joints

Table II. Range of motion (in degrees) of hip-joints with and hip-joints without OA, compared to AAOS-values.

	OA of the hip (n=161)	No OA of the hip (n=239)	Effect-size$	AAOS
Direction of motion	Mean (±sd)	Mean (±sd)		Normal val.
Flexion	112.6±13.2***	117.3±10.7*** ###	−0.4	120
Extension	0.7±7.1***	3.3±7.5*** ###	−0.4	30
Abduction	15.1±7.7***	19.5±6.3*** ###	−0.6	45
Adduction	11.1±4.7***	12.6±4.6*** ###	−0.3	30
Lateral rotation	32.5±9.6***	36.1±9.0*** ###	−0.4	45
Medial rotation	26.3±10.4***	30.8±9.1*** ###	−0.5	45

Independent t-test (two-tailed): ##p<0.01; ###p<0.001 (comparing hip-joints with OA and hip-joints without OA).
Paired t-test (two-tailed): ***p<0.001 (comparing hip-joints with OA and hip-joints without OA with AAOS-criteria).
$: effect-size: mean OA − mean no OA/sd of total.

with OA and hip-joints without OA; the same applied to the comparison of ROMs between knee-joints with OA and knee-joints without OA. Paired two-tailed t-tests were used for the comparison of the ROMs found with normal values of the American Academy of Orthopedic Surgeons (AAOS) (9). In order to determine the magnitude of the differences found, effect sizes were calculated according to Cohen (10).

Results

Patients and joints. There were 200 patients participating in the trial, representing 400 knee- and 400 hip-joints. There were 161 hip-joints with OA and 271 knee-joints with OA.

Range of motion of the hip. The comparison of the ROMs of hip-joints with OA (n=161) and without OA (n=239) is shown in Table II. Hip-joints with OA had significantly lower values for ROM in all six directions of movement than hip-joints without OA. Furthermore, joints with OA and joints without OA both had significantly lower values than the normal AAOS values. The effect sizes of the differences between joints with OA and joints without OA were all moderate and of the same magnitude and did not show the characteristics of the capsular pattern.

Range of motion of the knee. The comparison of the ROMs of knee-joints with OA (n=271) and without OA (n=129) is shown in Table III. Knee-joints with OA had significantly lower values than knee-joints without OA for flexion and extension. Furthermore, knee-joints with OA did not differ significantly in ROM for flexion compared to normal AAOS values. The effect sizes of the difference between joints with OA and joints without OA were moderate for flexion and small for extension.

Subgroup-analysis

1. *Duration of complaints. Hip-joints.* The median for the duration of complaints caused by OA of the hip was 52 weeks. 91 hip-joints with OA had caused complaints for more than 52 weeks. We repeated the above mentioned comparisons of these 91 joints. We found that all differences in ROMs of these joints compared with ROMs of hip-joints without OA were again statistically significant (p<0.001). The effect-sizes of the differences between joints with and joints without OA were again of the same magnitude and did not show the characteristics of the capsular pattern (effect sizes: flexion -0.4, extension −0.4, abduction −0.7, adduction −0.5, lateral rotation −0.5, and medial rotation −0.5).

Table III. Range of motion (in degrees) of knee-joints with and knee-joints without OA, compared to AAOS-values.

	OA of the knee (n=271)	No OA of the knee (n=129)	Effect-size$	AAOS
Direction of motion	Mean (±sd)	Mean (±sd)		Normal val.
Flexion	134.4±12.2	140.1±6.3*** ###	−0.5	135
Extension	−0.9±5.6	1.7±4.2 ###	−0.2	–

Independent t-test (two-tailed): ###p<0.001 (comparing OA of the knee with no OA of the knee).
Paired t-test (two-tailed): **p<0.01; ***p<0.001 (comparing knee-joints with OA and knee-joints without OA with AAOS-criteria).
$: effect-size: mean OA of the knee − mean no OA of the knee/sd total.

Furthermore, we repeated the comparisons of the 70 joints with equal to or shorter than median duration of complaints. We found that differences in ROMs of these joints compared to joints without OA were statistically significant for flexion, extension, abduction, and medial rotation, but not for adduction and lateral rotation ($p > 0.05$). The effect-sizes of the differences between joints with and joints without OA were: flexion –0.4, extension –0.3, abduction –0.6, adduction –0.1, lateral rotation –0.2 and medial rotation –0.4).

Knee-joints. The median for the duration of complaints caused by OA of the knee was 78 weeks (data for duration of complaints were missing for two knee-joints). There were 87 knee-joints with OA that had caused complaints for over 78 weeks. We repeated the comparisons of these 87 joints and found that the ROMs for flexion in knee-joints with OA were significantly different from normal values ($p < 0.01$). Also the differences in ROMs for flexion and extension of these joints compared with knee-joints without OA were statistically significant ($p < 0.001$). The effect-sizes of the differences between joints with OA and those without were: flexion –0.8 and extension –0.3.

Furthermore, we repeated the comparisons of the 182 knee-joints with equal to or shorter than median duration of complaints. We found that the ROMs for flexion were not significantly different from normal values. Furthermore, the ROMs for flexion and extension in joints with compared with joints without OA of the knee both were again statistically significant. The effect-sizes of the differences between joints with and joints without OA were: flexion –0.5 and extension 0.02.

2. Radiological evidence of OA. *Hip-joints*. X-rays were available for 150 of the 161 hip-joints diagnosed as OA-affected. There were 54 hip-joints that yielded at least one positive finding of joint-space narrowing on the X-rays. Again all ROMs of these joints compared to those of joints without OA were statistically significant ($p < 0.01$). The effect-sizes of the differences between joints with and joints without OA were: flexion –0.9, extension –0.4, abduction –1.0, adduction –0.6, lateral rotation –0.6, and medial rotation –1.0.

Knee-joints. X-rays were available of 242 of the 271 knee-joints diagnosed as OA-affected. There were 100 knee-joints that yielded at least one positive finding of joint-space narrowing on the X-rays. The ROM for flexion was statistically significant different from normal value ($p < 0.001$). All ROMs of these knee-joints compared to those of joints without OA were also statistically significant. The effect-sizes of the differences between joints with and joints without OA were: flexion –0.9 and extension –0.1.

Discussion

This study shows that in patients with OA of the hip, ROMs of medial and lateral rotation, extension and flexion, and adduction and abduction are significantly lower than ROMs of non-OA hip-joints. Hip-joints with and hip-joints without OA both have significantly lower ROM values for the six directions of movement compared with normal AAOS values. So, contrary to what Cyriax states, in our patients with OA of the hip limitation of ROM is not restricted to medial rotation, flexion, and abduction. The effect-sizes of the differences between hip-joints with and hip-joints without OA show that the typical capsular pattern of the hip as defined by Cyriax is not present in our population of patients with OA.

In joints of patients with OA of the knee the ROMs of flexion and extension were significantly different from ROMs of knee-joints without. The ROM for flexion in knee-joints with OA was not significantly different from normal values. The effect-sizes of the differences between knee-joints with and knee-joints without OA indicate that a capsular pattern of the knee might exist. However, the fact that in our population the ROM for flexion was not statistically significantly different from the normal value implies that the clinical relevance of the differences is absent.

Therefore, we conclude that the capsular pattern is not a useful test for the diagnosis of OA of hip and/or knee.

Until now only one study was published on the validity of Cyriax's passive motion tests in patients with OA of the knee (3). In that study, involving 79 patients with OA of the knee, only very few patients demonstrated a capsular pattern.

We have used normal values as proposed by the AAOS. These normal values are not age-specific and might be too rough to be used as a reference. However, in a recent study on the normal active ROMs of hips and knees in patients aged 25 to 74 years it was concluded that any substantial loss of joint mobility should be viewed as abnormal and may not be attributed to age (11).

It might be argued that the patients in our study were not representative of the population of patients with OA. The inclusion criteria we used had mainly been developed for the purpose of epidemiologic research and not for diagnosing OA in an individual patient. Furthermore, the criteria are only suitable for diagnosing symptomatic OA. In fact, these criticisms limit the external validity of our conclusions and the latter can only be applied to symptomatic OA-patients.

In addition, the spectrum of OA we examined was quite broad, ranging from patients with the beginnings of OA to patients with severe OA. Therefore,

we performed two subgroup-analyses. For both hip-joints and knee-joints with OA we would expect that with a longer than median duration of complaints and radiological evidence of OA, the capsular pattern might be more easily demonstrable. Contrary to our expectations we found that in hip-joints there was an indication of the existence of a capsular pattern only in joints with a shorter than median duration of complaints. In knee-joints ROM for flexion was not significantly different from normal values. The second subgroup-analysis, on the basis of radiological evidence of OA, showed stronger indications of the existence of a capsular pattern in both hip- and knee-joints.

Interpretation of the results of the subgroup-analyses is tricky. The fact that we found some indications of the existence of a capsular pattern in joints with radiological evidence of OA, but also in joints with a relatively short duration of complaints, is conflicting and puzzling. We had expected to find the capsular pattern in joints with radiological evidence of OA and in joints with a longer duration of complaints.

We conclude that the capsular pattern of the hip cannot be regarded as a valid test for the diagnosis of OA of the hip. An indication of the existence of a capsular pattern of the knee was found, but the clinical relevance is too small to recommend it as a valid test. Further investigations in patients with OA of the hip with relatively short duration of complaints and in patients with radiological evidence of OA are recommended.

Acknowledgements

Funding: The Dutch Fund of Investigative Medicine from the Dutch Health Insurance Council.

The authors thank the general practitioners, physiotherapists, and patients for participating in this study. We greatly acknowledge AH Hilvers, CR Visser, and GV Paalman for their contribution to the collection of the data.

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