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Reproducibility Of The Kellgren And Lawrence Radiographic Scale And Its Association With The Intensity Of Pain, A Look From The Physiotherapy.

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ABSTRACT

To evaluate the intra-evaluator reproducibility and the association of the radiographic scale with the intensity of pain at rest, on palpation, and after performing functional activities. This was a cross-sectional study. The population was made up of people with medical diagnoses of OA at the knee (tibiofemoral) between 40 and 75 years of age. An orthopedist evaluated the X-rays who was blind; images were evaluated in physical form, and they were randomly sorted. The pain intensity was evaluated once, by an experienced physiotherapist while the radiographic images were evaluated twice with a period of 8-15 days between the two evaluations. Intra-evaluator reproducibility was calculated using Cohen's Kappa coefficient. The correlation between the grade of severity and clinical variables of pain intensity was determined using Spearman's correlation. Intra-evaluator reproducibility was good 0.72 (0.484 - 0.767) and the association of the grade on the radiography scale and the intensity of pain at rest, on palpation, and after engaging in functional activities was very low, at 0.3, -0.07, and 0.1. The application of the radiographic scale requires previous training and its correlation with pain in any of its attributes is very low.

Keywords: Osteoarthritis, pain, reproducibility, kellgren y Lawrence.

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INTRODUCTION

Osteoarthritis (OA), is a chronic degenerative pathology characterized by the wearing down and loss of joint cartilage. Its principal symptoms are pain, decreased joint mobility, decreased muscle strength, rigidity, and joint effusion at advanced stages of the disease (Mobasheri, Bay-Jensen, Spil, Larkin, & Levesque, 2017). OA can be classified based on anatomical criteria such as OA of the hip, OA of the knee, or OA of the hand. The disease can also be clarified using etiological criteria as primary or idiopathic or secondary (Altman et al., 1986), or by radiographic criteria, which are the most commonly used for the classification of the pathology (Altman et al., 1986), because radiography allows the pathology to be classified based on the degree to which joints are compromised and there is bone loss.

Among radiographic criteria, those proposed by the Kellgren and Lawrence Scale in 1957 are the most widely used and accepted. This scale was adopted by the World Health Organization in 1961 (Altman et al., 1986) as standard for epidemiological studies of OA. The scale defines five grades of severity for the pathology, considering certain significant changes including the formation of osteophytes at the margins of the joint, at ligament insertions and in tibial tubercles; narrowed joint space associated with sclerosis of subchondral bone, cystic areas with sclerotic walls within subchondral bone, and deformity of bone ends (van Oudenaarde et al., 2017).

According to a review of the literature, this scale is considered the gold standard for the OA classification, with reports of good intra- and inter-evaluator reproducibility ($k:0.79-0.86$), low to moderate sensitivity (53.8 and 64.3), and high specificity (75.3 and 77.9), when compared with clinical criteria (Dieuwke Schiphof, 2012).

Despite the fact that the Kellgren and Lawrence Scale provides the most commonly used radiographic criteria, principally in the research context in rheumatology medicine, and orthopedics, no research exists on their use in physiotherapy. The treatment plan and the intervention objectives depend among others on the medical diagnosis and the severity of the patient's clinical signs. In the literature reviewed, the relationship of this scale with the variables commonly used in physiotherapy such as pain at rest, on palpation and at the end of functional activities has not been evaluated.

In spite of the fact that little association of the scale with the pain of movement has been reported, nothing is known about pain on palpation, at rest and at the end of functional activities such as walking (Park et al., 2018). Exploring this association would be important because this scale could be an important diagnostic test of disease progression or prognosis of patients treated in physiotherapy.

In 1981, the osteoarthritis subcommittee of the Committee on Diagnostic and Therapeutic Criteria of the American College of Rheumatology (ACR) developed the clinical criteria for the classification of knee, hip, and manual OA (Luyten, Denti, Filardo, Kon, & Engebretsen, 2012). The clinical criteria for the classification of the knee include a combination of factors such as pain for days or months, marginal osteophytes, synovial fluid typical of OA, age, and osseous rigidity and crepitation in reaction to active movement (Madry et al., 2016). This diagnostic proposal includes radiography, but the association between clinical variables and radiographic criteria has not been extensively evaluated.

In the clinical context, a decision regarding orthopedic treatment does not depend solely on the extent to which joint function is compromised. On the contrary, clinical variables including the intensity of pain with the joint at rest, when is palpated, and when engaging in functional activities such as walking play an important role in making clinical decisions in orthopedics and physical therapy. Nonetheless, the literature reviewed included no study that reported on intra-evaluator reproducibility of the results of the Kellgren and Lawrence radiography scale in relation to severity of pain at rest, on palpation, and the end of functional activities has not been evaluated.

The goal of this study, therefore, is to evaluate intra-evaluator reproducibility and the association between the grade of severity and the intensity of pain at rest, on palpation and the end of functional activities, experienced by patients.

EXPERIMENTAL METHODS

This was a descriptive study of the reproducibility of the Kellgren and Lawrence radiography scale and explored the association between the degree of severity of OA as measured by radiographic criteria and the intensity of participants' pain.

The protocol was approved by the Committee on Research Ethics of the *Universidad Industrial de Santander*, and patients participated in the study voluntarily by signing an informed consent document.

All participants were 40-75 years old and had a medical diagnosis of tibiofemoral knee OA. They had simple radiography of the knee taken with support using anteroposterior and lateral projection no more than six months previously. Participants were recruited from patients in a private orthopedics practice and from within the university community of the *Universidad Industrial de Santander*.

Criteria for exclusion were having received an intra-articular injection of hyaluronic acid or corticoids at the knee within the six months prior to the study, because this intervention can decrease the intensity of pain in patients with OA up to six months after it takes place and having had orthopedic surgery with osteosynthetic material for reduction of fractures at the knee joint because this can affect the variable intensity of pain for reasons other than the OA.

The simple knee x-rays taken with support using anteroposterior and lateral projection of patients who met the selection criteria and agreed to participate in the study were evaluated. This evaluation was conducted by an orthopedist and traumatologist previously trained in the use of the Kellgren and Lawrence Scale. The evaluation was blind and was carried out twice, with 8-15 days between the first and second evaluation. Images were evaluated in physical form and they were randomly sorted.

The x-rays were classified on the Kellgren and Lawrence scale for osteoarthritis of the knee (Gonçalves et al., 2016), table 1. Radiography was evaluated twice with 8-15 days between evaluations.

Table 1: Version of Kellgren and Lawrence scale used for the classification of osteoarthritis of the knee

Grade	Description
0	Absence of osteophytes.
1	Doubtful osteophytes.
2	Minimal osteophytes, possible narrowing of joint space, cysts, and sclerosis.
3	Moderate or definite osteophytes with moderate joint space narrowing.
4	Large osteophytes and clear joint space narrowing

Intensity of pain is defined as the quantitative estimation of the severity or magnitude of perceived pain. For its evaluation at rest, participants were given the Visual Analogue Scale (VAS) and told to mark an x at the point that represented the intensity of pain that they felt on the day of the test, and for purposes of reference, to also mark the point that represented the worst pain that they could remember having felt at any time in their lives.

The intensity of pain upon palpation was measured by palpating the medial aspect (the insertion of the Pes anserinus), the lateral aspect (femoral epicondyle over the insertion of the fascia lata); in the back, palpating the anteroinferior aspect (tibial condyle, insertion of the quadriceps tendon) and back of the knee joint (popliteal fossa). After palpating these zones, the VAS was given to the participant, who was asked to mark the point that represented the intensity of pain felt during palpation.

The intensity of pain felt after completing functional activities was evaluated at the end of a six-minute walking test. This test was carried out in a corridor 30 meters long, which was marked with colored tape every 3 meters to provide feedback to participants and facilitate the measurement of distance walked at the end of the test. The starting line and 30 meter finish line were demarcated and time elapsed was measured with a digital watch (Enright, 2003). Cones were placed at a distance of 50 cm from the beginning

and end of the corridor to communicate that the participant should make a U-turn for an additional lap (ATS Committee on Proficiency Standards for Clinical Pulmonary Function Laboratories, 2002).

The participant was seated in a chair near the initial position 10 minutes prior to the test. Arterial tension and heart rate were measured at this time and the patient was later given the SAV and asked to mark the point that represented the pain felt at the end of the walking test.

The intensity of the pain was evaluated once by a physiotherapist with a master’s degree in physical therapy, who was previously trained in the standardization and use of the research instrument.

The data that was obtained was analyzed using Stata 12 statistical software. Intra-evaluator reproducibility was calculated using Cohen’s Kappa coefficient, which compared classifications made by the same evaluator. The results for the Kappa coefficient were interpreted with Landis and Koch values (Landis & Koch, 1977): Between 0.81-1.0 agreement is considered almost perfect, 0.61-0.8 is substantial, 0.41-0.6 is moderate, 0.21 - 0.4 is fair, 0-0.2 slight and <0 is poor. The correlation between the grade of severity and clinical variables of pain intensity and function was determined using Spearman’s correlation.

RESULTS

Radiographic images were evaluated for 23 participants. The general characteristics of the population that was evaluated are presented in table 2.

Table 2: General Characteristics of the Population Evaluated

Variable		Total n:23(100%)*
Age		61.1±5.4**
Sex	Female	82.60*
	Male	17.39*
Grade of severity	0	0
	1	21.74*
	2	52.17*
	3	13.04*
	4	13.04*
Intensity of pain	At rest	30.91±23.6**
	On palpation	30.22±22.1**
	After functional activities	43.56±23.2**

Data presented as average ± standard deviation, ** mm: millimeters

Intra-evaluator Reproducibility

Global intra-evaluator reproducibility was substantial at Kappa 0.72 (0.484 - 0.767). Table 3 shows weighted values of the Kappa coefficient, which evaluates intra-evaluator agreement for each evaluation of each grade of the scale.

Table 3: Weighted Kappa coefficients of intra-evaluator agreement between the first and second evaluation session for each of the grades on the scale.

		Grades on the scale in test 2				
		Grade 1	Grade 2	Grade 3	Grade 4	Total
Grades on the scale in test 1	Grade 1	3 (1.00)	2 (0.88)	0 (0.55)	0 (0.00)	5
	Grade 2	1 (0.88)	10 (1.00)	1 (0.88)	0 (0.55)	12
	Grade 3	0 (0.55)	1 (0.88)	2 (1.00)	0 (0.88)	3
	Grade 4	0 (0.00)	0 (0.55)	3 (0.88)	0 (1.00)	3
	Total	4	13	6	0	23

Data presented in relative frequencies and agreement values between first and second evaluation.

Association with the intensity of pain

The association of the grade of severity determined by the radiography scale and the intensity of pain at rest, on palpation, and after functional activities was very low at 0.3, -0.07 and 0.1, respectively.

DISCUSSION

Accurate classification of a condition like osteoarthritis of the knee allows us to standardize the language used by researchers and facilitates treatment plans appropriate to the needs of the patient in the clinical context. This study evaluated intra-evaluator reproducibility and the correlation between grades on the Kellgren and Lawrence scale with the intensity of pain at rest, on palpation, and at the end of functional activities.

Although the radiography scale proposed by Kellgren and Lawrence has been adopted by the World Health Organization, orthopedists and rheumatologists have not reached consensus on the appropriate classification of osteoarthritis of the knee, and other classifications such as that of Ahlbäck (Ahlbäck, 1968) are available. Even with regard to the Kellgren and Lawrence classification, there are at least four extant versions of the original scale (D. Schiphof et al., 2011),(Kellgren & Lawrence, 1957).

This study evaluated the reproducibility of the original version of the radiography scale, primarily focused on the presence or absence of osteophytes. The results obtained on intra-evaluator reproducibility show that there is considerable reproducibility, and the results are consistent with those reported by researchers in other countries.

The prevalence of disease has an effect on the considerable reproducibility of Kellgren and Lawrence scale achieved in this study. This is due to the statistical tests like Kappa are most efficient in circumstances with mild or high prevalence like Knee OA in our study (Streiner, 2003).

On the other hand, in the revised literature, the reproducibility of this scale has changed. Gonçalves FB et al. (Gonçalves et al., 2016) reported a Kappa coefficient between 0.35 and 0.92 for intra-evaluator reproducibility using the same version of the scale as in this study. This, however, is not necessarily related to the appropriate classification of the disease, considering that one of the limitations that has been discussed in the literature involves the slow rate of osteophyte alteration, even in cases followed for a period of up to 16 years (Danielsson & Hernborg, 1970).

This leads some experts to consider this classification inadequate for determining the progression of OA and may in part explain the low association of clinical symptoms with pain.

The American College of Rheumatology (ACR) recommends including clinical and radiographic criteria in diagnosing OA because the use of radiological classification criteria as a diagnostic method may tend to

underestimate the epidemiological weight of the disease. This is because radiological changes may be present long before the appearance of symptoms such as pain (Noble & Hamblen, 1975).

Clinical and radiological criteria allow for a diagnosis of the disease, but classification of the grade of severity is based primarily on radiological criteria. The use of clinical and radiological criteria to determine the grade of severity of the disease is not standardized (Luyten et al., 2012). Standardization would be a significant factor in proposing and deciding on orthopedic and physiotherapeutic interventions.

For the reasons stated above this is the first one study in the revised literature in to explore the relation between the radiographic criteria and the clinical criteria used by physiotherapist such as the intensity of pain that occur most frequently among patients, this study explored the intensity of pain in the three contexts most frequently evaluated by physiotherapists in the physical rehabilitation of patients with this disease, and considered the relation of these clinical criteria to the grade of severity as determined by orthopedists using the Kellgren and Lawrence radiography scale (Felson, 2005).

This is relevant, taking into account the importance of the medical diagnosis and the classification of the severity of our patients for the approach of the therapeutic objectives and the treatment plans in physiotherapy.

Structural changes to the joint generate excessive traction on the articular capsule, and at intermediate and advanced states produce synovitis, sclerosis of the subchondral bone and the formation of osteophytes, which can cause pain in most cases. The prevalence of these clinical manifestations is between 38% and 62% among patients with this condition (Gondhalekar & Deo, 2013). Although these structural changes to the joint can be related to the intensity of patients' pain, the findings of association were very low across the three different dimensions evaluated. These results were consistent with those reported in the literature (Peat et al., 2006).

There may be another way to associate clinical and radiological criteria to determine the severity of the disease. For example, the intensity of knee pain may increase in proportion to factors such as those that determine the metabolic syndrome including three or more of the following components: 1) waist circumference of 90 cm or greater in men and 85 cm or greater in women; 2) triglyceride level of 150 mg / dl or greater, or use of medication; 3) HDL cholesterol level less than 40 mg / dL in men and less than 50 mg / dL in women, or use of medication; 4) BP of 130/85 mm Hg or greater, or use of medication; and 5) fasting blood sugar level of 100 mg / dl or greater, or use of medication (Niu, Clancy, Aliabadi, Vasan, & Felson, 2017), (Chang Dong Han, Ik Hwan Yang, Woo Suk Lee, Yoo Jung Park, & Kwan Kyu Park, 2013)

An association between the intensity of pain and these components has been reported in cases where the presence of these components of metabolic syndrome have shown a strong association with clinical symptoms such as pain in patients whose structural alteration of the joint has led to complete knee replacement (Stannus, Jones, Blizzard, Cicuttini, & Ding, 2013), (Hill et al., 2007).

This association has not been evaluated, however, in the literature that was reviewed.

Future studies could evaluate intra- and inter-evaluator reproducibility using alternative variants of the Kellgren and Lawrence scale, with sample sizes that could determine the appropriate scale for classifying osteoarthritis among the Colombian population. Future studies with longitudinal cohort design should investigate the association between clinical variables such as the components of metabolic syndrome and the grade of severity as indicated by radiographic representations of OA.

Finally, it is important that physiotherapists investigate in scales of classification of the severity of the clinical signs of the disease, taking into account the variables commonly evaluated in physiotherapy consultation and why not, these studies being the basis of regression models of the functional prognosis of our patients.

CONCLUSIONS

There is considerable intra-evaluator reproducibility in the use of the Kellgren and Lawrence radiographic scale. This scale has low association with pain intensity at the rest, on palpation and the end of functional activities.

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