Manual Therapy 25 (2016) 19–26

Contents lists available at ScienceDirect

Manual Therapy

journal homepage: www.elsevier.com/math

Original article

Validation of the movement system impairment-based classification in patients with knee pain

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ARTICLE INFO

Article history:
Received 20 January 2016
Received in revised form
24 May 2016
Accepted 26 May 2016

Keywords:
Classification
Impairment
Knee
Principal component analysis
Validity

ABSTRACT

Background: Categorizing patients with knee pain problems based on pathoanatomical sources has not proved to be the most effective method for directing physical therapy interventions. Movement system impairment (MSI) classification system may be an alternative in the assessment, diagnosis, and management of patients with knee pain. No previous study has been conducted to validate the proposed system in these patients.
Objective: To assess construct validity of the MSI classification system in patients with knee pain.
Design: A cross-sectional methodological study.
Setting: Rasul Akram Hospital.
Participants: One hundred eighty subjects with knee pain aged 18–65 years.
Methods: The MSI classification recognizes seven categories of knee pain problems based on the findings from the symptoms and signs assessment. Three physical therapists examined subjects with knee pain. A principal component analysis (PCA) was used to derive proposed categories. Eigenvalues and a scree plot were also used to determine the factor retention.
Results: Four factors related to three proposed categories were extracted from the PCA. Two factors were related to tibiofemoral rotation (TFR) category. The other two factors were related to proposed categories patellar lateral glide (PLG) and tibiofemoral hypomobility (TFHypo).
Conclusion: The results provided evidence for the construct validity of three (TFR, PLG, and TFHypo) of the seven categories proposed by MSI classification. In addition TFR was subcategorized into two groups which were named as tibial lateral rotation (TLR) and femoral adduction/medial rotation (FAdd/MR) in the present study.

1. Introduction

Conservative treatments have been recommended over surgical interventions for patients with knee complaints (Harris-Hayes et al., 2008). Different treatment strategies are described in the literature for conservative care including quadriceps strengthening (Phillips and Coetsee, 2009; Bolgla and Boling, 2010) hamstring and gastrocnemius flexibility exercises (Clark et al., 2000; Phillips and Coetsee, 2009), gluteal muscle strengthening (Tyler et al., 2006; Bolgla and Boling, 2010; Papadopoulos et al., 2015), neuromuscular training (Phillips and Coetsee, 2009; Rabelo et al., 2014), patellar tapping and bracing (Powers et al., 1997; Cerejo et al., 2002; Mascal et al., 2003; Bolgla and Boling, 2010), knee bracing (Mascal et al., 2003), and foot orthoses (Gross and Foxworth, 2003; Bolgla and Boling, 2010; Raja and Dewan, 2011). However, the literature shows conflicting results regarding the effectiveness of various types of conservative treatment (Bizzini et al., 2003; Harris-Hayes

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http://dx.doi.org/10.1016/j.math.2016.05.333
1356-689X/

et al., 2008). Researchers have proposed that the lack of consistent evidence to support the effectiveness of conservative treatments may be due in part to the use of heterogeneous groups of subjects with knee pain problems (Dankaerts et al., 2006; Billis et al., 2007; Fritz et al., 2007; Henry et al., 2012). Therefore, classifying the patients into homogeneous diagnostic groups may lead to more accurate diagnosis of impairments resulting in more effective intervention (Van Dillen et al., 2003; Harris-Hayes and Van Dillen, 2009; Henry et al., 2012). The consequence of not classifying patients with different features of pain problems is ineffective treatment because intervention planning is not tailored to meet the individual needs of patients with a wide variety of movement impairments (Van Dillen et al., 2003).

The movement system impairment (MSI) classification is a system based on clusters of signs and symptoms developed in order to categorize patients with musculoskeletal problems into homogenous subgroups through the assessment of the human movement system. This classification system may be useful in prognosis and intervention planning (Van Dillen et al., 1998; Harris-Hayes and Van Dillen, 2009; Henry et al., 2012; Sahrmann, 2014). Based on the theoretical basis of the MSI classification, sustained postures and repeated movements in one direction may result in the loss of precise motion of the joint surfaces, which can lead to abnormal stresses on specific tissues and contribute to pain problems (Elahi et al., 2000; Sahrmann, 2002; Caldwell et al., 2007). Conservation of movement precision requires variability in assuming the posture or the direction of movement (Henry et al., 2012). Therefore, any impairments in biomechanical or neuromuscular components of the human movement system that contribute to imprecise motion should be corrected to restore function and prevent re-injury (Sahrmann, 2002, 2010; Caldwell et al., 2007).

Based on the MSI classification system, a standardized examination consisting of a set of movements and position tests is developed to diagnose knee pain problems (Sahrmann, 2010). In this framework, the patient-preferred lower extremity alignments and movements associated with knee symptoms are identified. Symptom exacerbating tests are immediately followed by corrective tests which involved restricting the patient-preferred lower extremity alignment or movement pattern (Sahrmann, 2010). Next the effect of a given corrective test on patient's symptoms is assessed (Sahrmann, 2010). After interpretation of the symptom responses, the examiner judges the alignment and movement in different positions (Sahrmann, 2010). Initial physical examination items used in this study for classification of patients with knee pain are provided in Table 1.

The process of physical examination leads to classifying a patient with knee pain into one of the seven proposed MSI categories (Sahrmann, 2010). These categories are named according to the alignments or movement patterns that reproduce the patient's symptoms (Sahrmann, 2002; Caldwell et al., 2007).

These seven knee MSI categories are 1) tibiofemoral rotation (TFR) with varus (TFRVar) or valgus (TFRVal) syndrome, 2) patellar lateral glide (PLG) syndrome, 3) knee extension (Kext) and knee extension with superior glide (KextSG) syndrome, 4) knee hyperextension (Khext) syndrome, 5) tibiofemoral accessory hypermobility (TFAH) syndrome, 6) tibiofemoral hypomobility (TFHypo) syndrome, and 7) knee impairment (Sahrmann, 2010).

In a previous study, we assessed inter-tester reliability of the MSI classification test items in patients with knee pain. The items with adequate inter-tester reliability were included for the present validation study. To the best of the author's knowledge, there is only one study allocated to examine the validity of the MSI classification (Van Dillen et al., 2003). Van Dillen et al. (2003) assessed the construct validity of three of the five categories of the MSI system proposed for classifying patients with mechanical low back pain. Our main objective was to test the construct validity of the MSI-based classification in patients with knee pain problems. We hypothesized that the factors characterizing the knee MSI categories would emerge in the current study.

2. Methods

2.1. Subjects

One hundred eighty subjects with knee pain participated in the study. The sample size was estimated according to suggested subject to item ratio of 10:1 (Kerlinger, 1986) for the items which were found to have acceptable reliability and incidence in the intertester reliability study. Characteristics of the subjects are shown in Table 2.

All subjects were recruited through advertisements at the “X”. The inclusion criteria were: 1) age between 18 and 65 years, 2) sudden or gradual pain related to any knee structures or surrounding tissues. Subjects were excluded if they had: 1) any marked structural deformity of the spine and lower extremities, 2) pregnancy, 3) diabetes, 4) assistive device, 5) history of knee surgery in the last three months, 6) history of more than one knee surgical procedure, 7) constant severe pain, 8) analgesic and anti-inflammatory drugs at the time of testing. In addition, known cases of cancer, lumbosacral radiculopathy, neuromuscular disorders, rheumatoid arthritis, and cardiopulmonary disease were excluded from the study. All subjects signed consent forms approved by the Ethical Committee of the “X” before participation. The study began in May 2014 and ended in December 2014.

2.2. Examiners

Three physical therapy PhD candidates with three to ten years of clinical experience in managing patients with musculoskeletal problems participated as examiners. They were trained in the application of the MSI classification system through course work. They passed a 10 h practical course to master the details of the physical examination process based on the MSI approach.

2.3. Procedure

Of the three examiners involved for each subject, only one (which was selected randomly) performed the examination and the other two merely observed the process. Despite which one performed the examination, all three examiners recorded the findings and made the diagnoses. The assessment process contained two separate parts: a history and a physical examination. Self-reported data related to the patient's history included demographic information, previous knee pain, medical history, physical activity, site of pain, factors that affects pain severity, visual analog scale (VAS) for pain intensity during the last week and at the time of interview, and the “X” version of Tegner Activity Rating Scale (Negahban et al., 2011).

The physical examination contained symptom and sign data forms used to record findings. The symptom data form included patient's responses to different test positions or movements. In symptom items, the possible responses to the corresponding positions or movements could be “the same”, “decreased”, or “increased” with the scores of 1, 2 and 3, respectively. The examiners were not permitted to discuss amongst each other on the patient's responses. For the sign items, the examiners observed the patient's alignments and movement patterns in order to make a judgment. The judgments could be “no” or “yes” with the scores of 0 and 1, respectively. Signs judgments were made independently by