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Is arthroscopic videotape a reliable tool for describing early joint tissue pathology of the knee?

Giovanni Trisolino [a,b], Marta Favero [c,d,*], Antonello Lazzaro [e], Ermanno Martucci [a], Alessandro Strazzari [a], Elisa Belluzzi [c], Steven Robert Goldring [f], Mary Brennan Goldring [f], Leonardo Punzi [c], Brunella Grigolo [d], Eleonora Olivotto [d]

[a] Reconstructive Hip and Knee Joint Surgery, Rizzoli Orthopaedic Institute, Bologna, Italy
[b] Pediatric Orthopedic and Traumatology, Rizzoli Orthopaedic Institute, Bologna, Italy
[c] Rheumatology Unit, Department of Medicine, University Hospital of Padova, Padova, Italy
[d] Laboratory of Immunorheumatology and Tissue Regeneration/RAMSES, Rizzoli Orthopedic Research Institute, Bologna, Italy
[e] Orthopaedic Clinic, Department of Surgery, Oncology and Gastroenterology, University of Padova, Padova, Italy
[f] Hospital for Special Surgery and Weill Cornell Medical College, New York, NY, USA

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ABSTRACT

Background: The aim of this study was to assess the reliability of the videotape scoring system collected during knee arthroscopy for meniscal tears, and to test the consistency with intra-operative findings.
Methods: Fifty-seven patients undergoing arthroscopic treatment of meniscal tears were included in the analysis. The cartilage damage was assessed intra-operatively, at six sites, using the Outerbridge scoring system. The meniscal tears were graded according to the International Society of Arthroscopy, Knee Surgery and Orthopaedic Sports Medicine (ISAKOS) classification. The presence of synovial inflammation was scored, at four different sites, according to the macro-score method. The total cartilage, meniscal and synovial scores were calculated for each knee by the sum of the maximum grade of the lesions at each anatomic site. In order to assess the reliability of the arthroscopic scoring system, the videotapes recorded during the arthroscopy were reviewed by two independent observers one year after the surgery and compared with the scores completed by the surgeon during the operation.
Results: The total cartilage score showed substantial inter-rater and intra-rater reliability, and moderate consistency with the intra-operative score provided by the surgeon. The total meniscal score showed substantial inter-rater and intra-rater reliability, and good consistency with the intra-operative findings. The total synovial score showed substantial inter-rater agreement, substantial intra-rater reliability, and moderate consistency with intra-operative findings.
Conclusions: The videotape scoring system provided a reliable and reproducible system for recording the intra-operative state of the whole joint pathology in patients undergoing arthroscopic treatment of meniscal tears.

1. Introduction

Knee osteoarthritis (OA) is the most common form of joint disease, and the major cause of pain and disability in the adult population [1]. The definition of OA has changed dramatically in the last few decades and OA is no longer considered a disease

* Corresponding author at: Rizzoli Orthopaedic Institute, Via Barbiano 1/10, 40136 Bologna, Italy.
E-mail address: marta.favero@unipd.it (M. Favero).

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involving only the cartilage, but is recognized as a disorder affecting all components of the joint, including the meniscus, synovial membrane and subchondral bone [2]. The menisci play a critical protective role in the knee through the transfer and distribution of mechanical load; importantly, meniscal damage is associated with increased risk of OA [3]. Patients undergoing meniscectomy represent an ideal subset of individuals to study, and thereafter understand, the pathological mechanisms involved in the early phase of OA when the classical radiological signs are undetectable [4]. The development of new imaging techniques, such as 3-Tesla or Delayed gadolinium enhanced Magnetic Resonance Imaging of cartilage (d-GEMRIC) magnetic resonance imaging (MRI) and ultrasound with Power Doppler, has permitted more rigorous assessment of the changes, not only in the cartilage but also in the other joint tissues, involved in the pathogenesis of OA [5,6]. These tools hold the potential for novel applications in establishing the diagnosis and prognosis of the early stages of OA.

Radiographically invisible pathologies such as cartilage defects, meniscal tears, and synovial inflammation can be detected by arthroscopy [7]. The advantages of arthroscopic surgery include a direct magnified view of the entire visible components of the joint, decreased postoperative morbidity with a faster rehabilitation, and improved cosmetic and functional outcomes when compared with open techniques [8]. Arthroscopic procedures provide an opportunity to obtain joint images and videos that can be captured by fiber-optic instruments connected to a camera and displayed on a screen. The quality of the images has dramatically improved in the last few decades by the development of digital cameras and high-definition displays [8,9]. Although arthroscopy is performed for therapeutic reasons, it also provides diagnostic confirmation or anatomic verification of the pathology. In this respect, knee arthroscopy is operator-dependent and influenced by the pre-operative clinical information. Moreover, the videotape recorded during arthroscopy has the potential to become a valuable diagnostic tool.

Several scoring systems have been developed for the assessment of meniscal [10,11], chondral [12–18], or synovial pathology during knee arthroscopy [19–21]. Additional studies have correlated the observed arthroscopic joint pathology with the MRI findings and histopathologic characteristics of joint tissues [6,22,23]. However, there is a need for a system that captures the real time intra-operative findings of knee pathology, and permits reliable and validated comparisons between the findings in individual patients. Therefore, the purpose of the present study was to assess the intra-observer reliability and inter-observer reliability of the arthroscopic videotape, and the consistency with the intra-operative findings (cartilage, meniscus, synovial membrane) detected during the real time surgery.

2. Material and methods

2.1. Study sample

Patients undergoing knee arthroscopy for symptomatic meniscal tears were recruited within the framework of a multicenterprospective cohort study, entitled 'The role of the meniscus in OA pathology and symptoms', funded by the Italian Ministryof Health between 2012 and 2015 (Project code: GR-2010-2317593). The study obtained extensive records of preclinical, intra-operative and postoperative data from patients undergoing meniscectomy or meniscal repair for degenerative or traumatic meniscal tears. The local Ethical Committees approved the study. Patients were enrolled from two different centers (Hospital A and Hospital B) after providing written informed consent, and if eligibility criteria were met.

2.2. Eligibility

Inclusion criteria were: meniscal tear identified on pre-operative MRI and considered to be the cause of symptoms; adult patients (age >18 years); and ability to provide informed consent for participation. All inclusion criteria needed to be satisfied for patient enrollment. Exclusion criteria were: malignancies and overall poor general condition of health; presence of coagulation disorders; and presence of tumors, infections, rheumatic or metabolic diseases or other conditions involving the knee joint. In addition, patients with history of previous surgery on the affected knee, or showing symptoms that suggested systemic inflammatory arthritis (multiple joint complaints, concurrent back pain, etc.) were also excluded in order to limit potential biases.

2.3. Sample size calculation

The sample size was based on previous studies evaluating the reliability of knee arthroscopy in scoring meniscal tears [10], chondral damage [15], and synovial inflammation [19]. These studies indicated that the inter-rater Cohen's kappa ranged between 0.65 and 0.75 in meniscal lesion pattern and location [10], and averaged 0.72 for chondral damage estimate (among raters having ≥5 years of experience in knee arthroscopy) [15]. Thus, hypothesizing a Cohen's kappa of at least 0.65 and admitting a relative error of ±0.1 at a confidence level of 95%, a final sample number of 57 videos was required for analysis; this sample was also sufficient to analyze agreement in synovial inflammation hypothesizing a percentage of close to perfect agreement (PCA) between raters of at least 82% [19], and a confidence interval of ±10%.

2.4. Surgical procedure

In both hospitals, the operation was performed under spinal anesthesia. The leg was placed into a leg holder, and a tourniquet (300–350 mm Hg) was used. In Hospital A, the constant irrigation pressure of Ringer's lactate solution for arthroscopy was obtained by gravity, placing the bags of Ringer's lactate solution about one meter above the level of the knee, and passing the inflow through the

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