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RESEARCH

Bone microindentation and pressure algometry applied to revision total knee replacement and tibial end-of-stem pain. Preliminary results in a group of twenty patients☆

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KEYWORDS
End-of-stem pain;
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Abstract
Objectives: To study the relationship between the appearance of end-of-stem pain with a preoperative decrease in local bone strength by using the bone microindentation technique. The potential usefulness of pressure algometry in the diagnosis and monitoring of this group of patients is also determined.
Materials and methods: A preliminary intra- and inter-rater correlation study was performed in a group of 50 healthy volunteers in order to validate the algometry technique. A prospective study was then conducted on 20 patients with a mean age of 74 years (range 57–84) undergoing knee prosthetic surgery with use of a cementless tibial stem. Bone microindentation and pressure algometry measurements were made preoperatively, and after one year of follow-up. The statistical analysis was performed using the Intraclass correlation coefficient and the Student's *t*-test for paired data.
Results: The intra- and inter-rater correlation values were excellent; 0.91 (0.84–0.95) and 0.86 (0.74–0.92), respectively. No significant variations were found in the microindentation ($P = 0.11$) or in the pressure algometry ($P = 0.6$) values after one year of follow-up. Nevertheless, a significant correlation was observed between the values for pressure algometry and the EVA ($P = 0.002$) and functional scale ($P = 0.02$) at the end of follow-up.

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Conclusions: Pressure Algometry is a useful tool to evaluate this group of patients. Bone microindentation does not seem to be useful in identifying patients with increased risk of developing tibial end-of-stem pain.

PALABRAS CLAVE
Dolor punta de vástago;
Algometría de presión;
Microindentación ósea

Técnica de microindentación ósea y algometría de presión aplicada al recambio protésico de rodilla y dolor en punta de vástago tibial. Resultados preliminares en un grupo de 20 pacientes

Resumen
Objetivos: Valorar la relación entre la aparición de dolor en punta de vástago tibial con una disminución de la resistencia ósea preoperatoria mediante microindentación ósea. En segundo lugar, conocer la utilidad potencial de la algometría de presión en el diagnóstico y seguimiento de este grupo de pacientes.
Material y método: Se realizó un estudio de correlación intra- e interobservador preliminar, para validar el método de la algometría en un grupo de 50 voluntarios sanos. Posteriormente se realizó un estudio prospectivo en un grupo de 20 pacientes con una media de edad de 74 años (57–84), sometidos a cirugía protésica de rodilla con utilización de un vástago tibial no cementado. Se realizaron mediciones de microindentación y algometría preoperatoriamente y después de un año. Para el análisis estadístico se utilizó el coeficiente de correlación intraclase y la t de Student para datos apareados.
Resultados: En el trabajo preliminar, los valores de correlación intra- e interobservador obtenidos fueron excelentes; 0,91 (0,84–0,95) y 0,86 (0,74–0,92), respectivamente. En el grupo prospectivo no se observaron modificaciones significativas en los valores de microindentación ($p = 0,11$) ni algometría ($p = 0,6$) después de un año. Se observó una correlación significativa entre los valores de la algometría y las escalas de EVA ($p = 0,002$) y funcional ($p = 0,02$) en el control anual.
Conclusiones: La algometría de presión fue una herramienta útil en el seguimiento de estos pacientes. La microindentación no fue adecuada para identificar pacientes en situación de riesgo de presentar dolor en punta de vástago tibial.

Introduction

One of the complications reported in relation to the use of cementless tibial stems in revision knee surgery is the onset of localized pain in the tip of the stem, which appears in 11–18% of the cases according to the different series.[1–4] One of the reasons proposed for this disorder is a decrease in bone mineral density (BMD) in the proximal tibia following the placement of the tibial stem due to an alteration of load transmission directly onto the distal end of the implant,[4,5] which in most cases is associated to a reinforcement reaction of the bone cortex at that level. It is currently unknown whether a decrease in preoperative tibial bone mechanical resistance could be considered as a risk factor for the onset of pain in the tibial stem tip. One of the techniques used recently in clinical practice to measure bone strength is microindentation, which, when applied on the tibial diaphysis, has proved useful in differentiating patients with increased risk of osteoporotic fracture.[6] The first objective of the present study was to assess the relationship between the onset of pain in the tip of the tibial stem and a decrease in preoperative bone resistance using the microindentation technique.

There is no objective and reproducible method which can measure pain in the tip of the tibial stem. Most published series are based on nonspecific assessment systems,[7–9] or they combine the use of a function and satisfaction test with anatomical diagrams in which patients locate the painful point.[3,4] In this sense, pressure algometry is a noninvasive technique developed several decades ago, which employs progressive pressure stimuli in order to define the pain threshold at a certain point of the human body.[10] The test stops when patients consider the pressure to be painful and the pain threshold at that point is recorded, usually in kilopascals (kPa). In recent years, the emergence of digital algometers has allowed greater measurement accuracy and the technique has been used to study various musculoskeletal disorders,[11–13] but never for the study of pain in the tip of the tibial stem. The second objective of the study was to assess the potential use of pressure algometry in the diagnosis of pain in the tibial stem tip, and for the monitoring of patients with cementless tibial stems.

Materials and methods

The study was divided into two parts. The first part studied intra- and interobserver correlation of pressure algometry applied on the tibial diaphysis among a group of 50 healthy volunteers by 2 researchers who had previously received training in the pressure algometry technique. The second