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Original article

Evaluation of benefits and accuracy of a mobile application in planning total knee arthroplasties☆

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ABSTRACT

Objective: To evaluate the usefulness of an application when planning total knee arthroplasties (TKA), besides the accuracy when measuring the anatomical-mechanical femoral angle (AMFA), comparing, also, the time spent during planning a TKA manually and by using the application.

Methods: An interdisciplinary team involving health and computer science areas established activities in order to develop the application. After development, 24 physicians underwent an application usability test. Each one planned a primary total knee arthroplasty (TKA) initially, in a conventional manner and then by using the application. Data concerning AMFA measurement and time spent during planning were collected, in both manners. The Mann–Whitney and Wilcoxon tests were used to evaluate statistical significance related to angle and time.

Results: Users considered it important checking AMFA and drawing the bone cut lines orthogonal to the mechanical axis, when planning TKAs. They also assessed that the application could be useful for training surgeons and for specialists. There was no statistically significant difference between the AMFA, as measured by the application and by the conventional manner. The planning time was shorter when the application was used (39% of the time spent manually).

Conclusions: The application has proved to be useful in planning TKAs and has revealed accuracy when measuring the AMFA when it was compared to the manual form of preoperative planning. The application was able to reduce planning time by more than half and it demonstrated reliability in measuring the AMFA.

☆ Study conducted at Santa Casa da Misericórdia de Fortaleza, CE, Brazil.

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Avaliação de utilidade e acurácia de aplicativo móvel no planejamento de artroplastias totais do joelho

Palavras-chave:
Aplicativos móveis
Artroplastia do joelho
Tempo de cirurgia

RESUMO

Objetivo: Avaliar a utilidade de aplicativo no planejamento de artroplastias totais do joelho (ATJ), além da acurácia em relação à aferição do ângulo anatômico-mecânico femoral (AAMF), e comparar o tempo dispendido no planejamento de ATJ através da forma manual e do aplicativo.

Métodos: Uma equipe interdisciplinar das áreas de saúde e ciências da computação estabeleceu um fluxo de atividades, a fim de desenvolver um aplicativo. Após desenvolvido, 24 médicos participaram de um teste de utilidade desse. Cada usuário planejou uma cirurgia de ATJ, inicialmente, de forma convencional e, posteriormente, através do aplicativo. Foram coletados dados de aferição do AAMF e do tempo dispendido durante o planejamento entre as duas formas. Os testes de Mann–Whitney e Wilcoxon foram usados para avaliar a significância estatística entre os resultados de medição de ângulo e tempo.

Resultados: Os usuários julgaram importantes a aferição do AAMF e o traçado de linhas de corte ósseo ortogonais aos eixos mecânicos, no âmbito do planejamento de ATJ. Também avaliaram que o aplicativo poderia ser útil para cirurgiões em formação e especialistas. Não houve diferença estatisticamente significante entre o AAMF aferido através do aplicativo e da forma convencional. O tempo de planejamento foi menor quando o aplicativo foi usado (39% do tempo gasto pela forma manual).

Conclusões: O aplicativo evidenciou-se útil no contexto de planejamento de ATJ, mostrou-se acurado quanto à medição do AAMF. Foi capaz de diminuir em mais da metade o tempo de planejamento, mostrou-se, mesmo assim, confiável quanto à medição do AAMF.

Introduction

Total knee arthroplasty (TKA) surgery is one of the most frequently performed orthopedic interventions. This procedure has many goals, among which pain reduction and the gain of joint mobility are noteworthy.[1,2] The main cause of failure in TKA continues to be poor alignment of the prosthetic components.[3]

Preoperative surgical planning may contribute to a shorter surgical procedure and longer survival of the prosthetic implants. During planning, the surgeon usually estimates the anatomical and mechanical axes of the femoral and tibial bones. The angle formed between the anatomic and mechanical axes of the femur (AMFA) is also measured, and the bone cutting planes are estimated.[4]

There are several methods of estimating bone alignment, including clinical examination, computed tomography (CT), magnetic resonance imaging (MRI), conventional knee radiographs (CKR), fluoroscopy, and intraoperative navigation. The use of lower limb panoramic radiography (LLPR) is a well-established method for measuring bone alignment.[5] The manual preoperative planning uses marking and measuring instruments, such as a 2B pencil, a 50 cm ruler, a protractor, and a negatoscope, as well as printed radiographs. These tools may not be widely available in all environments where surgical planning occurs.

In turn, with the increase in the number of computing resources applied to healthcare (mHealth), various solutions have been developed in order to assist the surgeon in his routine. This study is aimed at evaluating whether the mobile application, developed by the present authors, was useful in TKA planning and was capable of making an accurate measurement of the AMFA. The preoperative planning time, both manually and through the application, was also compared, and the speed of planning through the application was ultimately evaluated.

Materials

The study included 24 physicians, divided into three groups: eight knee surgeons, members of the Brazilian Society of Knee Surgery (Sociedade Brasileira de Cirurgia do Joelho [SBCJ]); eight non-SBCJ orthopedists; and eight third-year residents of orthopedics and traumatology. The exclusion criterion was orthopedists who were not members of the Brazilian Society of Orthopedics and Traumatology (Sociedade Brasileira de Ortopedia e Traumatologia [SBOT]).

A conventional negatoscope and a printed LLPR originating from one of the authors' clinical cases was presented to the participants; the LLPR had not been modified in its request or execution to fit the study in any way. In addition, manual preoperative planning tools such as a 2B pencil, 40 cm ruler,

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