Radiological assessment of osteoarthritis in knee joints: optimization of patient positioning

P. Podsiadlo and G. W. Stachowiak
Tribology Laboratory, Department of Mechanical and Materials Engineering
The University of Western Australia, Crawley, Western Australia 6009

Introduction

An alignment of lower extremities (Cooke et al., 1997), a joint space width (Mazzuca et al., 1999) and a trabecular bone structure (Podsiadlo and Stachowiak, 2000) are used to assess the progression of osteoarthritis in knee joints. These anatomic features are usually obtained from conventional radiographs. Since these radiographs are 2D projections of 3D bones and joints the third dimension is lost. As a result, bone and joint details present in radiographs depend on the orientation of a patient body with respect to a X-ray source. This creates difficulties in subsequent measurement of anatomic features of lower extremities. In order to rectify these problems, a new radiographic rig has been designed and built.

Radiographic rig

The newly developed rig is similar to a QUESTOR Precision Radiography (QPR) system rig (Cooke et al., 1991; Siu et al., 1991) with two fundamentally different components:

- a film cassette holder mounted on an adjustable frame at the rear of the rig. The film holder can take a short-length cassette used to capture hips (35cm × 43cm) or knees (18cm × 43cm) and a full-length cassette (129cm × 43cm) used to capture entire legs (Fig. 1). and
- two pairs of calibration plexiglass sheets mounted on slides at the front of the rig (Fig. 1).

This adjustable frame is used to place a film immediately behind the patient's legs or knees (i.e. as close as physically practicable) (Fig. 1b). This reduces the scattering of X-rays passed through a patient's body to a film. Since the pairs of plexiglass sheets are mounted on slides they can be pulled to the right and left sides of the rig so that calibration patterns do not appear on the radiographs used for the analysis of trabecular bone. Only if the calibration patterns are needed for the measurement of leg alignment, the plexiglass sheets are placed in the front of the patient's legs.

Future work

Our next step is to develop a software package for the analysis of radiographs obtained on the radiographic rig, in particular the analysis of trabecular bone texture (Podsiadlo and Stachowiak, 2001). The software package in combination with the newly built radiographic rig would constitute a standardized radiography system. The accuracy and reproducibility of the radiographic system in the positioning of patients, the analysis of trabecular bone texture, the measurement of leg alignment and joint space width will be evaluated on a leg skeleton with known dimensions and then on a group of healthy volunteers.
Figure 1: A radiographic rig used to lock a patient in a standardized position. A full-length cassette is placed in a film holder immediately behind patient's legs; (a) front view, (b) side view.

References


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