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AUTOMATED METHODS TO STUDY FEMUR ALIGNMENT

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Surgeons have been measuring bones on medical images for decades for various purposes. Numerous anatomical points and axes have been described and through morphological studies, reference values for many distances and angles have been determined. Coordinate systems have been defined to represent kinematical data. Limb alignment is studied to plan joint replacement surgery and study failed prostheses.

While measurement were originally made on 2D X-ray images, advancements in computer and imaging technology (CT, MRI …) have lead to the increasing use of virtual 3D bone images and an increasing number of 3D definitions. However, manual analyses can be time-consuming and are prone to variability, as no two observers will obtain exactly the same results. These limitations may be dealt with by the use of automated measurement techniques.

In this study, a number of points and axes were automatically extracted from the thighbone (femur) and, in addition, alignment was calculated. CT scans were used to obtain 10 femurs. Several feature extraction tools were implemented in our software pyFormex, such as cylinder and sphere fitting, curvature analysis and extreme points. The extracted axes are shown in the figure. Finally, 7 planar angular measurements were made to study femur alignment. Most measurement values are in agreement with those found in other studies. Manuel measurements are now performed by different physicians on the same femurs to further evaluate the computed values. The automated methods could be used for large morphological and kinematical studies, diagnosis of pathologies and planning and evaluation of surgery.