Laboratory Evaluation of Total Knee Replacements (TKRs) to Restore Normal Function

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In a composite of various activities, the normal knee moves through a range of flexion of up to 155 deg, while at all angles there are normal ranges of "laxity," both in an anterioposterior direction and in internal-external rotation. The ideal goal is that after a total knee replacement (TKR), the knee moves in a similar way, hence, providing the same amount of stability and freedom of motion. Our goal was to device a standardized testing method for evaluating proposed new TKR designs or existing designs. We developed a desktop knee machine, which subjects knees to combinations of forces and moments at a range of flexion angles. The proposed test method would compare the laxity motions of a given design model with the data from normal knee specimens. The TKRs were designed in the computer and then SLA models were made for testing. Computer analysis used RAPIDFORM software to calculate the laxities. In order to specify the testing method, in particular, the compressive, shear, and torque loads, we tested three different knee models with a range of loads. The magnitudes of the loads were proportionately less than in vivo due to the limitations of SLA models. When testing normal knee specimens, there were no frictional effects due to the exceedingly low coefficient of friction at the joint surfaces. However, in metal-plastic TKRs, the friction can affect the laxity and, hence, the kinematics, considerably. Hence this behavior had to be reproduced in our test method. The conclusion from our experiments was that testing should be carried out at a minimum of two compressive loading conditions, one representing low shear/torque ratios and the other, high shear/torque ratios, in order to obtain a realistic representation of the behavior of new TKR designs.

Development of a Product for Reducing Orthodontic Treatment Duration

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The commercialization of university-developed technology is described in this paper, which is predicated on the application of pulsating, low magnitude forces (cyclic forces) to the teeth and surrounding bone as a means of accelerating orthodontic tooth movement. The resulting product is a compact device with an external activator that houses the electrical, mechanical, and energy components that apply cyclical mechanical forces to a mouthpiece that is put in a patient's mouth.

