An in Vitro Study of Bone Drilling: Infrared Thermography and Evaluation of Thermal Changes of Bone and Drill Bit

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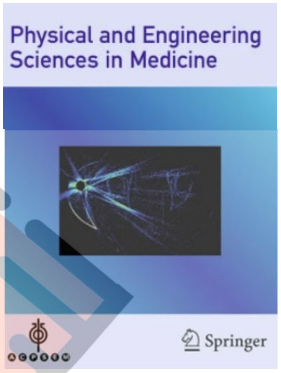

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Abstract

In complex fractures of bone, to immobilize the fracture location, internal and external immobilization tools and equipment are used. For connecting immobilizing equipment, drilling into bone should be done. During this operation, the forces required for plastic deformation of bone and chip formation, as well as friction factor cause elevation of temperature at the drilling site. If the temperature rise exceeds 47 ^{0}C, it results in thermal necrosis in the bone. Thermal necrosis causes failure in immobilization and in turn improper fracture treatment in the desired direction and angle. In the current study, attempts have been made to detect changes in the temperature of bone and drill bit during drilling process using infrared thermography. Drilling tests have been performed on bone samples of bovine femur and the thermal changes of the bone and drilling bit have been measured. Based on the results of the statistical analysis, it was found that the temperature rise of the drill bit was directly related to the feed rate, while the bone temperature rise was inversely associated with the rotational speed and feed rate. Also, the experimental results indicated that at the feed rate of 50 mm.min^{-1}, the only allowable speed for drilling has been 1500 r.min^{-1} and at feed rates of 100 and 150 mm.min^{-1}, application of speeds of 2000-3000 r.min^{-1} can be useful to prevent thermal necrosis. Infrared thermography is capable of determining bone and drill bit temperature changes during the drilling, so it can be used to study temperature in order to prevent of thermal necrosis.

Keywords

Bone, Internal Fixation, Drilling, Temperature Rise, Thermal Necrosis, Infrared Thermography