Infrared Thermography of High Speed Grinding of Bone in Skull Base Neurosurgery

Ehsan Shakouri*, Parham Mirfallah

https://journals.sagepub.com/doi/10.1177/0954411919845730

Institution of Mechanical Engineers

Field Code Changed

Abstract

For skull base tumor removal neurosurgery, skull bone grinding is required. During this process, temperature rise occurs which may result in an irrecoverable thermal damage. In the present research, temperature variations during bone grinding have been studied. Experimental tests have been conducted in 27 states in terms of the parameters of rotational speed (three states), feed rate (three states), and cutting depth (three states) on bovine femur bone samples. Attempts have been made to determine optimal processing conditions for minimizing thermal damage during the surgery through infrared thermography and measuring thermal variations of the bone. The results indicated that the temperature rise of the bone has a direct relationship with the parameters of rotational speed, feed rate, and cutting depth. In other words, with elevation of each of these parameters, temperature rise ~~has~~ was also intensified. Out of the cutting parameters, rotational speed ~~has~~ had the maximum impact on temperature rise, followed by cutting depth and feed rate. Therefore, to reduce the extent of thermal damage incurred to the neural tissue, the minimum values for the cutting parameters are proposed as follows: rotational speed=45000 $r.min^{-1}$, feed rate=20-30 $mm.min^{-1}$ with depth of cut=0.25 mm, and feed rate=20 $mm.min^{-1}$ with cutting depth=0.50 mm.

Keywords

Skull base neurosurgery, Grinding, Thermal effects, Infrared thermography

1. Introduction

The human skull is composed of different parts, whose main part protects different organs, including the brain, eyes, and ears. The skull base is the bottommost part, on which very important parts of the brain and brainstem lie. Twelve pairs of olfactory cranial nerves, visual nerves, nerves of eye movements, sensation and movement of face, auditory nerves, pharyngeal sensation as well as tongue and larynx movements, spine, and especially the main brain blood supply vessels are