

Manual vs. robotic milling parameters for development of a new robotic system in cranial surgery

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Abstract. The milling of bone is a time-consuming and straining effort during surgery at the cranial vault. In order to determine possible advantages of a robotic system, the registration of different milling parameters during defined surgical procedures was the aim of this study. Eleven neurosurgeons were asked to mill a bovine scapula. The task consisted of geometric figures (one line and a circle) that had to be milled in a depth of 3 mm. Main focus was laid on the accuracy of the milling. In addition, the registered parameters such as forces, temperature and speed will be used as a reference for the design and validation of the robotic system. The same task was done by a robotic (hexapod) system, constructed at the Helmholtz-Institute Aachen (HIA). In comparison with the surgeon, the robotic system showed a higher accuracy at a greater velocity. The forces and temperatures showed minor differences. If further test results are consistent, it would be advantageous to use a robotic system to perform large craniectomies, especially in cosmetically relevant areas due to its advantage in accuracy and speed compared to a surgeon. © 2004 CARS and Elsevier B.V. All rights reserved.

Keywords: Bone milling; Craniotomy; Robot-assisted surgery

1. Introduction


In cases of metastatic involvement of the cranial vault or in some meningiomas the surgeon has to handle destructed or tumor-infiltrated skull during craniotomy and craniectomy, in a large number of cases located at the forehead of the patient. Due to the cosmetically relevant area a precise milling is needed, especially in case a template and a prefabricated implant has to be used. Resection of large pathologies is a time-consuming and straining surgical procedure.

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