Unexpected fenestration of the lateral femoral cortex during robot-assisted THA: the clinical importance of the location of bone-motion-monitoring device

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Introduction: Robot-assisted THA supposed to be safe and accurate. In most cases, it is true. However, an unextected problems can occur. Because we experienced unplanned fenestration of the lateral cortex of the femur during a surgery, we performed this study to find the possible explanation of the unwanted event and also, to investigate effect of the location of bone-motion monitoring device (BMM) during a surgery on surgical outcome of robot assisted THA

Case: We planned robot-assisted THA to the left hip of 73 year-old lady. The diagnosis was osteoarthritis of the hip. Preoperative CT was taken as usual sequence. The surgical planning was made uneventfully. At the operating room, calibrations, registration and verification were all made without any problems. During milling, we noticed that the sound was changed almost at the end of the milling. After stopping the robotic procedure, we found about 1.5 x 8cm sized fenestration at the lateral cortex of the femur. There was no additional fracture at or distal to the fenestration. The proximal femur was reconstructed with extensively coated long stem with the same size.The defect was filled with autogenous bone graft from removed femoral head and fixed with multiple circlage wires. After the surgery, we investigacted the possible causes of the problems. We found that the BMM was installed less than 5mm apart from the bone clamp.

Materials & Methods: Computed tomography was taken with a radio-opaque bone model of the femur. With those images, preoperative planning were made. The planned data was transferred to robot control cabinet. The femoral model was fixed to the robot with the same position as used at the surgery. The calibrations, registration and verification were made with the same pattern as used in a real surgery. Just before starting the milling, we moved the distal part of the femur in vertical direction and record the point when the robot detect the movement and stopped with the warning. Before the repitition of the procedures, we changed the relative location of BMM to the fixed bone clamp (1, 2, 3, 4, 5 and 6cm apart). Position change and record were repeated at each location, The procedure was made three times with the same person, but the record and analysis was made by different person.

Results & Conclusion: The amounts of the movement that the robot detected and stopped at each scenario were 45.3, 39.3, 25.3, 18.7, 15.7 and 16.7mm, respectively. Thus, to make the robot recognize the bone motion more than 2mm at the level of the tip of femoral stem, BMM should be placed at least 5cm apart from the most proximal of the bone clamp. Because we mostly cannot obtain absolute fixation of ipsilateral thigh and calf on the surgical table, and the technical guide from the manufacturer does not provide this issue, the surgeon should aware this possible problem during installing the instrument.