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BIOMECHANICAL EFFECT OF TRACTION FORCES ON FEMORAL FRACTURE REDUCTION AS CHANGES OF BMI BY REDUCTION-ASSISTIVE ROBOT SYSTEM

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Summary: Several robotic assist systems have been developed to support stable fracture reduction surgery while applying internal fixators to the fracture sites. It is important to provide adequate traction force to ensure alignment of the fracture site and to prevent further complications before and after surgery. Therefore, in this study, we investigated the biomechanical effects of traction force as changes of BMIs on femoral fracture reduction by using a human-like fracture dummy model considering the Korean Human Body Index (SizeKorea 2015). The range of BMIs (16.18~34.75) of HFD model was selected for body shapes to be applicable from underweight to obesity, and it was designed to be able to control length and weight as BMIs. In order to realize reduction assisting function through experiments using a 3-axis robot system (prototype), we performed the experiment by lifting the lower leg to some degrees (0~40) for disinfection and then applying the traction force to the tip of the foot for femoral fracture reduction. The magnitude of the traction force was increased by monitoring the angle of the fracture site with the motion analysis system so that the bending angle of the fracture site was less than 10 degrees and the joint load on each joint and the fracture site was measured. When a traction force was applied by the robot system, the bending angle of 9.05±1.06 was observed in lifting process at the fracture site. Considering the BMI range, the traction force measured on the foot connected to the robot system ranged from 22 to 38 kg and the joint force measured at the fracture site was 23 to 50 kg, with an average load greater than 28% at the fracture site. When using a reduction-assisting robotic system in the femoral fracture reduction surgeries for various BMIs, it is necessary to control the traction force considering BMI to avoid unexpected damage at the femoral fracture site. Also, it is desirable to limit the maximum traction force to less than 30 kg, considering that a larger load is generated on the femoral fracture site. (KIAT-MOTIE, #R0004486).