

An Intelligent Steerable Drill System for Orthopedic Surgery

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Abstract : A steerable and flexible drill is needed in orthopaedic surgery. For example, osteoarthritis is a common condition affecting millions of people for which joint replacement is an effective treatment which improves the quality and duration of life in elderly sufferers. Conventional surgery is not very accurate. Computer navigation and robotics can help increase the accuracy. For example, In Total Hip Arthroplasty (THA), robotic surgery is currently practiced mainly on acetabular side helping cup positioning and orientation. However, femoral stem positioning mostly uses hand-rasping method rather than robots for accurate positioning. The other case for using a flexible drill in surgery is Anterior Cruciate Ligament (ACL) Reconstruction. The majority of ACL Reconstruction failures are primarily caused by technical mistakes and surgical errors resulting from drilling the anatomical bone tunnels required to accommodate the ligament graft. The proposed new steerable drill system will perform orthopedic surgery through curved tunneling leading to better accuracy and patient outcomes. It may reduce intra-operative fractures, dislocations, early failure and leg length discrepancy by making possible a new level of precision. This technology is based on a robotically assisted, steerable, hand-held flexible drill, with a drill-tip tracking device and a multi-modality navigation system. The critical differentiator is that this robotically assisted surgical technology now allows the surgeon to prepare 'patient specific' and more anatomically correct 'curved' bone tunnels during orthopedic surgery rather than drilling straight holes as occurs currently with existing surgical tools. The flexible and steerable drill and its navigation system for femoral milling in total hip arthroplasty had been tested on sawbones to evaluate the accuracy of the positioning and orientation of femoral stem relative to the pre-operative plan. The data show the accuracy of the navigation system is better than traditional hand-rasping method.

Keywords : navigation, robotic orthopedic surgery, steerable drill, tracking

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