The Leverhulme Trust

Awards in Focus

Snake drilling for orthopaedic surgery and beyond

One of the biggest problems in orthopaedic surgery is the high level of inaccessibility which very often makes long incisions for the full exposure of the fracture site necessary. In the case of treating angulated mal-union/ non-union fractures of the bones and arthroscopic hip and shoulder impingement surgery, the angulation poses an insurmountable obstacle as there is no technology that allows the surgeon to drill across the facture site. Therefore, the fracture site has to be accessed from at least two different sides. Another problem is that the accurate provision of deep holes along the core of curved bones is currently not possible.

The lack of technology available results in a number of inherent problems, such as multiple entry-scars, high risk of infection, permanent tissue damage, irregular/ inaccurate hole paths, use of implants with a less-than-optimal geometry.

This Early Career Fellowship gives me the opportunity to prove the feasibility of an idea that will allow for drilling small-sized holes along an arbitrary path using a steerable drilling tool, similar to what is already being achieved – only on a much larger scale– in oil and gas exploration. This new technology, which I christened 'snake drilling', will allow full control of the tool over the entire path. My aim is to prove the concept by designing and building a prototype snake drilling system, capable of drilling holes of less than 15 mm diameter and a length several times their diameter. Various avenues with respect to the design of components and their operation (e.g. cutting section, propulsion, steering) will be explored in collaboration with the North West Wales NHS Trust in Bangor and the Robert Jones and Agnes Hunt Orthopaedic Hospital in Oswestry, who also support this project. Once a prototype system has been built, an appropriate steering algorithm will be developed to allow for its computer-controlled operation. Finally, its capabilities and limitations will be investigated, such as the smallest turning radius or the forces imposed upon the bone tissue, thus providing a fundamental understanding of this new technology.

Snake drilling will be a major contribution to the migration from open wound surgery to minimally invasive surgery ('keyhole surgery') and computer-assisted orthopaedic surgery. Snake drilling will therefore be of great benefit to the patient, as it will result in a higher accuracy of surgical procedures and reduced variability of implant placement, a reduced risk of infections, quicker patient rehabilitation with less postoperative pain and less time off work. It also has the potential to increase the efficiency of surgical procedures, thus reducing the costs for the NHS and waiting times for the patient.

The impact of snake drilling however will go far beyond surgery. Another major beneficiary will be the manufacturing industry, e.g. die/ mould and engine manufacturers, as snake drilling will allow them to produce holes, such as cooling channels, with a hole trajectory not possible hitherto.

Dr Robert Heinemann
University of Manchester

Robert was awarded an Early Career Fellowship grant in 2009, providing £87000 over 36 months.

An angulated mal-union of a lower limb bone: In this configuration current technology does not permit to drill along the core of the two bone segments and across the fracture site in one single drilling operation.