

## Surgery

# Digital tool boosts preoperative skill base

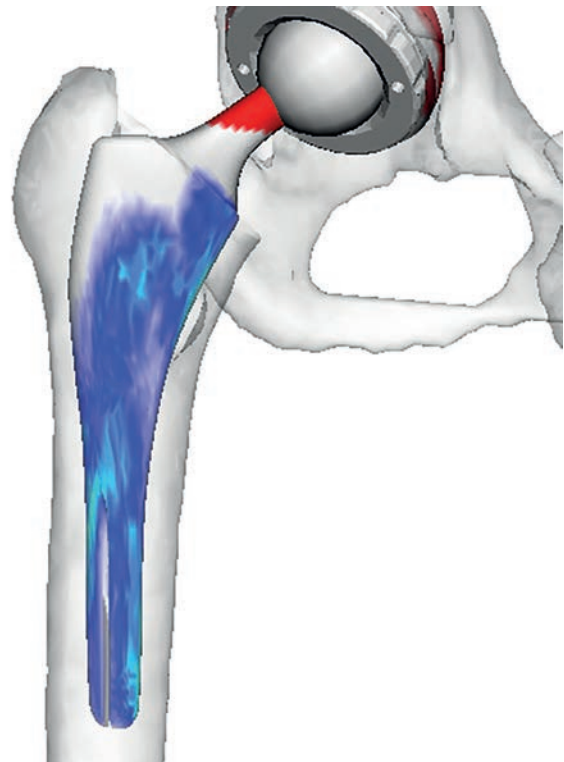
*Pooling the experience of many surgeons, an artificial intelligence tool can help novice surgeons prepare better preoperative plans*

**R**esearchers in Japan are developing automated systems that capture the skills of experienced surgeons to help novices plan for total hip replacements and other surgical techniques. “Most patients want to have surgery performed by an experienced surgeon rather than a beginner,” says Yoshinobu Sato of NAIST, who is part of a team developing artificial intelligence systems to give all surgeons the benefits of experience gained over many previous procedures.

Optimal planning for total hip replacement surgery requires careful consideration of each patient’s anatomy and requirements. The precise size of the implant and its position relative to the patient’s bones must all be considered to prepare the preoperative plan and select the best implant.

Working with colleagues at Osaka University and Kobe University, Sato — now at the NAIST Graduate School of Information Science — compiled computer-based ‘atlases’ that gathered and analyzed past surgical experience. The data came from selected preoperative plans that had already been prepared and used by experienced surgeons. The digital atlases analyzed the surgeons’ plans for the exact pattern of contact between the implant and the femoral canal inside each patient’s femur bone, which received the stem of the implant. The information in the digital atlases was then fitted to each new patient’s data to generate a preoperative plan based on the experience of many skilled surgeons, rather than just one.

The researchers tested their system by selecting 40 individual cases, and comparing the automatically generated plans with those prepared by experienced surgeons using existing interactive systems. They found that their automated system effectively reproduced the plans of highly experienced surgeons<sup>1</sup>. This confirms that the system could assist less-experienced surgeons in matching the skills of the best.



An automatically constructed surgical preoperative plan can help less-trained practitioners prepare for surgery.

Sato says that accumulating surgical data from all over the world in this way could develop what he calls a ‘super-experienced surgeon’ using statistical machine learning. The methods have now moved out of the theoretical and experimental stages. Although the data have not yet been published, Sato reports “promising initial results” from preliminary clinical evaluations conducted by orthopaedic surgeons at Osaka University Hospital.

“We would now like to evaluate our system at many hospitals via the Internet,” he adds, reflecting the obvious potential of digital

automated systems to travel effortlessly to many locations on demand, unlike an individual skilled surgeon. And with some actual surgical procedures also becoming automated and robotically performed, there seems scope for fully automating every critical step, from planning to surgery, in suitable cases.

### Reference

1. Otomaru, I., Nakamoto, M., Kagiya, Y., Takao, M., Sugano, N. *et al.* Automated preoperative planning of femoral stem in total hip arthroplasty from 3D CT data: Atlas-based approach and comparative study. *Medical Image Analysis* **16**, 415–426 (2012).