

Robot-assisted, patient-specific, unicompartmental knee arthroplasty: a pilot study

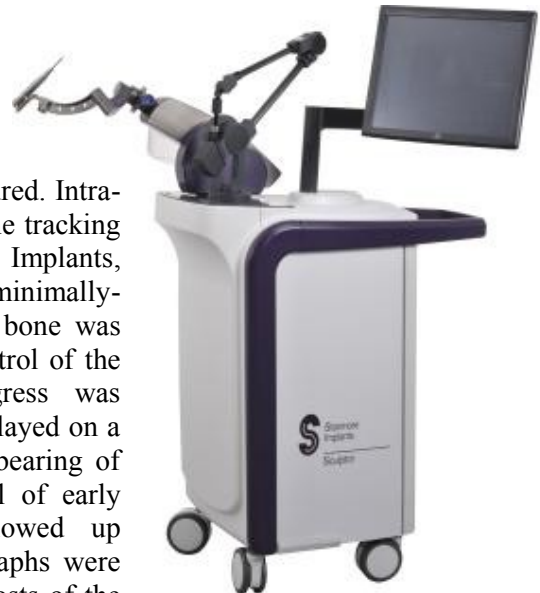
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Background: The combination of patient-specific “just-in-time” implant manufacture and robotic technology has not yet been reported. The robot enables accurate placement⁽¹⁾ of anatomically-matched implants. The technique should be cost-effective, simplify the procedure, and reduce instrumentation. The aims of this study were to determine whether robot-assisted unicondylar arthroplasty using a new patient-matched implant was safe, radiographically accurate, and comparable in both time and cost to conventional arthroplasty.

Methods: All patients over three months post-operatively were included. Component position, orientation and size were determined from 3D CT reconstructions in advance. The plan was confirmed, and adjusted as necessary, by the surgeon. Patient-specific femoral and tibial components were manufactured. Intra-operatively, the limb was connected via bone pins to the tracking arm of the Sculptor robot (Savile Row, Stanmore Implants, Elstree, UK). The robot is supplied free of cost. A minimally-invasive technique was used. Following registration, bone was milled away using a high-speed burr under haptic control of the robot. Tibial preparation preceded femoral. Progress was determined visually by the “painting” of an image displayed on a monitor. The implants were cemented and a mobile bearing of appropriate size inserted. A routine post-op protocol of early weight-bearing was followed. Patients were followed up clinically. Post-operative AP and lateral knee radiographs were taken. Oxford⁽²⁾ and EQ-5D⁽³⁾ scores were obtained. Costs of the implant, instruments, and consumables were calculated and compared to published data for conventional unicondylar knee arthroplasty and total knee arthroplasty⁽⁴⁾.



Results: 17 patients (7M: 10F) have reached three months follow-up. Mean age was 67 (range 49-84). Mean “robotic surgical time” was 25 minutes (range 14-39), subdivided into a mean registration plus verification time of 11 minutes (range 6-25) and a mean “sculpting” time of 14 minutes (range 7-29). This contributed to a mean tourniquet time of 79 minutes (range 57-105). Median length of stay was 3 days (range 1-8). Post-operative AP and lateral radiographs showed satisfactory component position. At a median follow-up of 4 months (range 3-6), mean Oxford score was 32 (range 23-41), mean EQ-5D VAS was 70 (range 40-90), and mean EQ-5D Index was 0.70 (range 0.59-0.8). There were no serious complications. Total cost of the implant, instrumentation, and consumables was £1665 per patient compared with £1334 for conventional unicondylar knee arthroplasty and £2620 for total knee arthroplasty.

Conclusions: Patient-specific unicondylar knee arthroplasty can be made and placed safely, with radiographical accuracy using a “no-cost” haptic robot. The time taken is comparable to other knee arthroplasty procedures, uses less instrumentation, and costs £1000 less than a typical total knee arthroplasty.

References

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