Computer-Aided Surgery in Orthopedics: From Strength to Strength

Javad Parvizi, MD, FRCS

Total hip and knee arthroplasties continue to transform the lives of millions by offering arthritis-afflicted patients pain-free and functional lives. Total joint arthroplasty (TJA) is such an amazing surgical procedure that many have promoted this as the "operation of the century." The extensive energy and effort invested by surgeons, engineers, and the orthopedic industry have led to improvements in design, surgical implantation, and long-term survivorship. So much so, that TJA is now being offered to the very young and the very old, 2 groups who may not have been deemed acceptable candidates for this procedure in the early era of joint replacement.

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Despite the immense success of TJA, efforts have been made to refine it further and to prevent some of the complications associated with TJA. One such problem relates to suboptimal positioning of the components that may lead to instability, premature wear, reduced range of motion, and, ultimately, to patient dissatisfaction. With the amazing accomplishments in the computer industry, it is only natural that efforts be made to apply the marvels of computerization in the field of orthopedic surgery.

Dr. Parvizi is Professor and Vice Chair of Research, Rothman Institute of Orthopaedics, Thomas Jefferson Hospital, Philadelphia, Pennsylvania.

Address correspondence to: Javad Parvizi, MD, FRCS, Rothman Institute of Orthopaedics, Thomas Jefferson Hospital, 925 Chestnut St, Philadelphia, PA 19107 (tel, 267-339-3617; fax, 215-503-0580; e-mail, parvj@aol.com; research@rothmaninstitute.com).

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In recent years, navigation and computer-assisted surgery were born. Novel hardware and software specifically designed to improve accuracy of surgical procedures were developed. Whether it was the accurate localization of a brain tumor or vascular malformation in the brain, identification of a specific locus of metastasis in lymph nodes or organs, or accurate positioning of various prostheses, computers have come to our aid.

In this month's issue, we will read an elegant and concise article by Drs. Bauman and Dennis that outlines all the attributes of navigation pertinent to joint arthoplasty. The authors have discussed the findings of various recent studies that have proven beyond doubt that the use of navigation can improve positioning of knee (and to some extent hip) arthroplasty components. Almost every study evaluating the role of navigation has shown that the percentage of "outliers" is reduced when navigation is utilized. The improved positioning of the knee components appears to be in all planes, including rotation. It is speculated that the improvement in component position should intuitively lead to better performance of these implants in the long run. Orthopedic surgeons are familiar with the challenges that might be faced in appropriate positioning of components in some patients, particularly those with deformities. Navigation or computer-aided surgery appears to hold great promise in this group of patients also.

Drs. Bauman and Dennis also point out another attraction of navigation in total joint arthroplasty, namely, reduced marrow and fat embolization, since instrumentation of the intramedullary canal is avoided. They have also outlined some of the disadvantages of the navigation system, which includes pin-site fractures, prolonged operative time, and difficulty in correctly

identifying the appropriate anatomic landmarks for registration.

The study by Dr. Nogler's team from Innsbruck strikes at the heart of the latter problem. They have investigated the influence of a new externally fixated multimodality registration object (MRO) on the accuracy of an image-guided navigation system in a human cadaver pelvis. They have demonstrated that use of the MRO reduces the inaccuracy in registration. This finding is particularly encouraging as the use of navigation in pelvic surgery and hip arthroplasty has been hampered by difficulty in locating external anatomical landmarks.

These 2 articles published in this month's journal contain a wealth of information for the reader. These authors should be applauded for their vision and intellect in investigating a phenomenon, namely, computer-aided surgery, that is here to stay and likely to go from strength to strength.

Author's Disclosure Statement

Dr. Parvizi reports no actual or potential conflict of interest in relation to this article. He wishes to disclose, however, that he is a paid consultant (no royalties) to Stryker.