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Evaluation of Accuracy and Reproducibility of Patient-specific Guides Using 3-dimensional Reconstruction in Reverse Total Shoulder Arthroplasty

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Accurate glenoid component placement is of major importance in both anatomic and reverse total shoulder arthroplasty (TSA). Positioning of a glenoid component is often technically demanding due to severe wearing of the glenoid cavity in shoulder rotator cuff tear arthropathy.[1] Improper glenoid baseplate positioning, such as excessive retroversion or inclination, and glenoid vault perforation may lead to abnormal loading of glenoid areas; such issues are common causes of poor shoulder function, scapular notching, instability, and early revision surgery.[2-4]

Various systems have been developed to assist in glenoid component implantation including the use of computer-assisted surgery (CAS) and patient-specific instrumentation (PSI). Numerous papers have reported a superiority in the accuracy of CAS; however, CAS is hampered by a significant increase in operation time and a lack of reliability.[5,6] Using custom-made patient-specific guides prepared from preoperative 3-dimensional computed tomography has grown in popularity due to their capacity to reduce surgical time and their reported great accuracy.

The paper by Yoon et al. "Patient-specific guides using 3-dimensional reconstruction provide accuracy and reproducibility in reverse total shoulder arthroplasty" (Clin Shoulder Elbow. 2019;22(1):16-23) was a cadaveric study evaluating the accuracy and reliability of glenoid and humeral component implantation with the assistance of their novel patient-specific guide (PSG) system. Although there have been several cadaveric and in vivo studies revealing the accuracy of implantation of glenoid components using a PSI system, the Yoon et al. paper is the only study to assess the accuracy of both glenoid and humeral component implants. The importance of proper implantation of humeral components has been underestimated in the current literature. Incorrect entry points may lead to the varus alignment of humeral components, which can affect the durability of the implant. The Yoon et al. study also revealed significantly improved humeral stem alignment when using PSI guides ($p=0.009$). Moreover, Yoon et al. enrolled a reasonably sufficient number of cadavers compared to those in previous studies. None of the cadavers had a shoulder pathology or bony deformity of the glenoid area or humerus. As an abnormal glenoid morphology has been seen in 40% of cases undergoing arthroplasties, it would have been helpful if the authors had provided the innate preoperative version and inclination of the glenoid.

The variations in retroversion and inclination of the glenoid components in their study were within the previously reported range and the results did not show significant superiority of the PSG group. However, the PSG group did show better consistency than that from the conventional method. Levy et al.[7] was able to show that PSI enabled accurate prosthesis implantation compared to that from preoperative planning models in a cadaveric study. A larger study of 70 cadaveric shoulders by Throckmorton et al.[8] showed better accuracy than that from conventional instrumentation in both anatomic and reverse TSA with a mean retroversion of 5° and a mean inclination of 3°. Other cadaveric studies by Walch et al.[9] reported mean retroversion ranged from 0.9° to 1.5° and mean inclination from 1.6° to 1.64°.

Several other studies have demonstrated improved accuracy using a PSI system in in vivo settings. A prospective study by Heylen et al.[10] showed their PSI group to have improved implantation of glenoid prostheses in a randomized controlled trial of 31 patients. They reported mean retroversion of 4.3° and

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inclination of 2.9° in the PSI group, with significantly reduced mean variations compared to those in the conventional group. Smaller in vivo studies reported by Suero et al.[11] and Dallalana et al.[12] have found excellent implant positioning results using patient specific instrumentation.

Recent study results, however, have been counter to the emerging consensus that a PSI approach produces improved glenoid positioning. Lau and Keith[13] performed 11 consecutive TSAs (7 TSAs and 4 reverse TSAs) using PSI guides. Five of their cases (45%) were outliers, showing more than 10° anteversion or retroversion, which suggests that the in vivo accuracy of PSI-guided glenoid positioning is not as successful as suggested by previous literature. To demonstrate the superiority of the PSI system in shoulder arthroplasty, further large-scale, prospective, randomized, and controlled studies are required.

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