Impact of Patient Posture on Clinical Outcomes and Range of Motion after Reverse Total Shoulder Arthroplasty: A Clinical Study

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INTRODUCTION:
Movement limitations following implantation of reverse total shoulder arthroplasty have been observed in some patients postoperatively, with implant design and positioning recognized as important influential factors. Recent analyses have identified patient's posture, measured as scapula internal rotation on computed tomography, as an additional factor influencing the functional outcome following implantation of a reverse total shoulder arthroplasty. However, no study has yet correlated the preoperative, photo documented posture with functional outcome. Furthermore, to the best of our knowledge, the relationship between clinical posture and internal rotation of the scapula is unknown. It was the aim of this study to evaluate the association between photo documented posture and clinical outcome and to correlate photo documented posture with measurement of scapula internal rotation on computed tomography. The main hypothesis was that severe kyphotic posture would result in inferior outcomes.

METHODS:
A prospectively enrolled database of patients who received a reverse total shoulder arthroplasty at an academic, tertiary care center was retrospectively reviewed to include a total of 360 patients between 2014 and 2021 with a minimum follow-up of 2 years. The inclusion criterion was the primary implantation of a reverse total shoulder arthroplasty, excluding secondary implantations for revision cases. Additionally, all patients with relevant complications (e.g., infection, periprosthetic fracture, dislocation, loosening) were excluded. Patient´s posture was analyzed using standardized preoperative photo documentation. The posture was defined following the classification system of Moroder et al as Type A (upright posture, retracted scapulae), type B (intermediate), type C (kyphotic posture with protracted scapulae) (Figure 1). Additionally, computed tomography data were used to evaluate posture through measurement of scapula position (internal rotation). Correlation analyses between both modalities was conducted using Spearman rank correlation.
All photo documentations and computed tomography data were analyzed by two readers, and interrater reliability was calculated using Cohens kappa or intraclass correlation coefficient. Postoperative range of motion and clinical outcomes (absolute and relative Constant Score) were compared between the different posture types using Kruskal-Wallis-rank test and Mann-Whitney-U test , as appropriate.

RESULTS:
According to the photo documented posture types, the 360 patients (Mean age 71 ± 9 years, 61% female) were divided into posture types A (n=59), B (n=253) and C (n=48). The mean follow-up duration for clinical outcome analysis was 24.5 ± 1.4 months. Average Constant-Murley scores differed significantly among the groups (69±16 vs 69±14 vs 64±16 for groups A, B and C, respectively, p 0.014) favoring patients with posture types A and B over type C (Figure 2).
In terms of range of motion, flexion, abduction and internal rotation significantly differed among the groups. Types A and B exhibited better flexion and abduction (Flexion 124±26º and 123±23º vs. 113±25º, p = 0.003, abduction 140±34º and 137±30º vs 128±34º, p = 0.012). Patients with posture type A demonstrated superior internal rotation (Constant Score points: 5.9±2.9 vs 5.0±2.7 vs 4.4±2.8, p 0.020). External rotation was better for type A compared to type C (A: 33±17° vs B: 30±16° vs C: 28±18°).
Interrater reliability for analysis of photo documentation revealed a high correlation (Cohens kappa of 0.865). Similarly, the measurement of internal rotation on computed tomography revealed a good correlation (Intraclass correlation coefficient of 0.779, 95% Confidence Interval 0.735 to 0.816). Correlation analysis of posture classification using photo documentation and computed tomography showed poor reliability (Spearman rank test r=0.35) (Figure 3).

DISCUSSION AND CONCLUSION:
Patients with clinical posture types A and B exhibited improved range of motion values compared to type C postures. Clinical outcome scores were also notably superior in types A and B. However, the measurement of scapula internal rotation on supine CT does not reliably correlate with photo documentation of patient's posture. To the best of our knowledge, these findings are novel and may be relevant for preoperative planning to achieve optimal outcome and range of movement. This information might also be valuable for predicting outcomes and counseling patients accordingly.
However, this new information might need to be integrated in more sophisticated prediction models also including the reverse total shoulder arthroplasty components in much more detail. The authors acknowledge the deliberate exclusion of these relevant arthroplasty-related data as a limitation of the study.

Posture type A Posture type B Posture type C