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Influence of Lateralization and Distalization on Joint Function after Primary Reverse Total Shoulder Arthroplasty

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Faculty Disclosure Information

Nothing to disclosure

Bakground

- Reverse total shoulder arthroplasty (RTSA) is one of the most common surgical procedures performed in patients affected by several shoulder diseases
- Lateralization and distalization of prosthetic implants were previously identified as two main influencing factors affecting shoulder biomechanics after surgery[1]
- Lateralization and distalization have an impact on the position of the new center of rotation of the joint, the forces at the bone–implant interface, the implant stability, and the deltoid's lever arm and pre-tensioning[1,2]

Bakground

- Previous studies investigated how different radiographic measures of lateralization and distalization could be related to clinical and kinematic outcomes after RTSA[3-7]

- Lateralization shoulder angle (LSA) and distalization shoulder angle (DSA) were shown to be easily available and reproducible measures that provide an estimation of the overall lateralization and distalization with respect to anatomical reference points[3-5]

Aim

The purpose of this study was to investigate how **LSA** and **DSA** are related to **clinical and kinematic outcomes** after **RTSA**

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Methods

Study population[8]

33 patients (male/female: 14/19; mean age at surgery 73 years, BMI 27.29) undergoing RTSAs between 2021 and 2022.

Inclusion criteria

Age between 50 and 85 years, no alteration of mental state, ability to return to the hospital for medical evaluation (clinical and radiologic), radiographic diagnosis of rotator cuff tear arthropathy, massive irreparable rotator cuff tear, and primary glenohumeral osteoarthritis.

Exclusion criteria

Neuromotor disorders, diagnosis o rheumatoid arthritis or inflammatory arthritis, fracture or necrosis of the humeral head, fracture sequelae of the humeral head, presence of cancer in the treated area, revision of a previous shoulder prosthetic implant, and less than six months of follow-up.

Methods

Study protocol[8]

Clinical scores

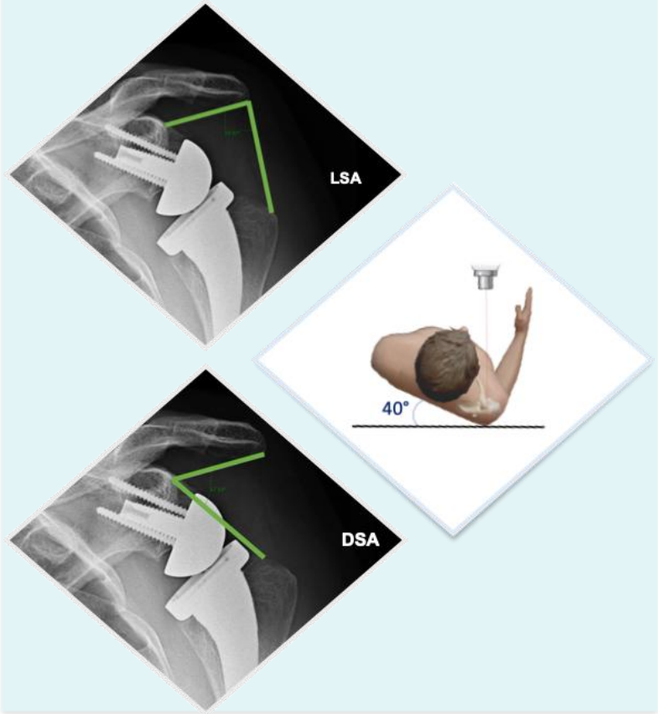
Single Assessment Numeric Evaluation (SANE)

Constant Murley Score (CMS)

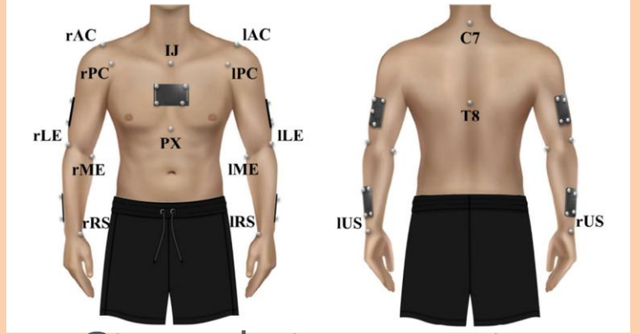
Simple Shoulder Test (SST)

Visual Analogue Scale (VAS)

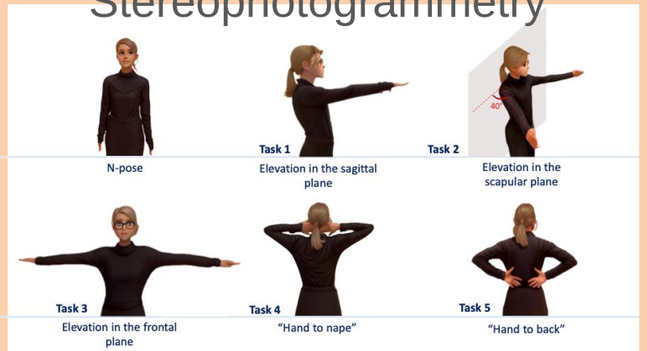
Radiographic indices



Shoulder kinematics



Stereophotogrammetry



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Methods

Statistical Analysis[8]

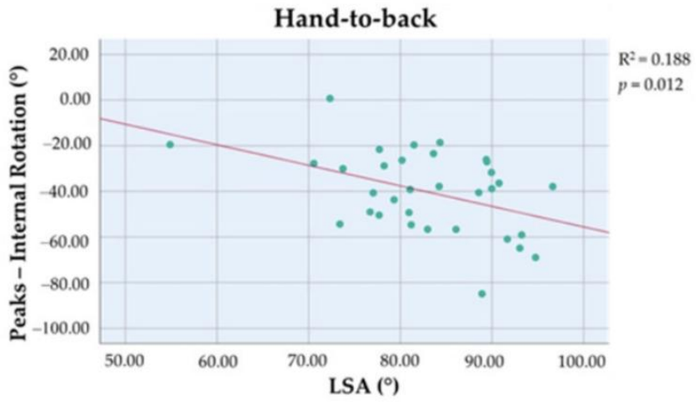
LSA and DSA inter-rater reliability was analysed through the interclass correlation coefficient (ICC).

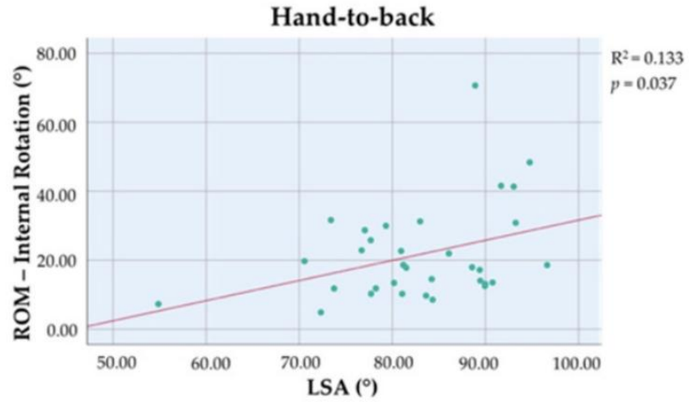
Stepwise forward linear regression analysis was conducted between LSA and DSA with clinical scales and kinematic measures, between which a correlation analysis was conducted.

Results

The inter-rater reliability analysis resulted in a good to excellent reliability for the LSA index (ICC mean: 0.93, range: 0.86–0.97) and an excellent reliability for the DSA index (ICC mean: 0.97, range: 0.95–0.99).

Greater LSA values were associated with higher peaks of IR, evaluated as negative values ($\beta_{unstandardized}$ = −0.90, 95% CI: −1.58 to −0.21, p = 0.012, R^2 = 0.188) and higher IR ROM ($\beta_{unstandardized}$ = 0.58, 95% CI: −0.04 to 1.13, p = 0.037, R^2 = 0.133)





Results

SANE (p = 0.009), CMS (p = 0.031), and SST (p = 0.026) were positively correlated to external rotation, while VAS (p = 0.020) was negatively related.

Peaks	VAS		SANE		CMS		SST	
	r	*p*	r	*p*	r	*p*	r	*p*
FE	0.138	0.444	0.105	0.561	0.083	0.645	−0.009	0.962
SCAP	−0.013	0.943	0.132	0.463	0.022	0.901	−0.045	0.805
ABD	−0.026	0.885	0.365	0.037 *	0.435	0.011 *	0.320	0.070
ABD_HN	−0.233	0.193	0.018	0.920	0.046	0.798	0.009	0.961
ER	−0.404	0.020 *	0.449	0.009 *	0.376	0.031 *	0.388	0.026 *
ABD_HB	0.151	0.401	0.202	0.912	0.209	0.244	0.165	0.358
IR	−0.237	0.184	−0.066	0.714	−0.129	0.473	−0.067	0.710

Results

Abduction peaks were positively related to CMS (p = 0.011) and SANE (p = 0.037), as well as abduction ROM (SANE, p = 0.031; CMS, p = 0.014).

ROMs	VAS		SANE		CMS		SST	
	r	p	r	p	r	p	r	p
FE	0.099	0.582	0.121	0.503	0.043	0.813	−0.012	0.948
SCAP	−0.078	0.644	0.261	0.142	0.015	0.934	0.017	0.927
ABD	−0.057	0.753	0.377	0.031 *	0.426	0.014 *	0.293	0.098
ABD_HN	−0.225	0.209	0.106	0.556	0.027	0.883	0.023	0.889
ER	−0.156	0.385	0.239	0.180	0.194	0.280	0.165	0.359
ABD_HB	0.040	0.827	0.134	0.459	0.158	0.381	0.191	0.287
IR	0.198	0.269	0.257	0.150	0.173	0.335	0.182	0.311

Discussion

- Identifying easily available and reproducible indexes of lateralization and distalization related to RTSA outcomes could provide surgeons with guidelines about optimal implant positioning.
- The study pointed out that positioning the prosthetic implant with higher LSA values could lead to higher IR peak values and IR ROM after RTSA.
- Identifying easily available and reproducible indexes of lateralization and The association of LSA and DSA with other kinematic and clinical outcomes was not statistically significant.
- Further studies are needed to assess the clinical significance of the results because of the small sample available for this analysis and the great number of variables that could influence RTSA outcomes.

References

1. Werthel, J.D.; Walch, G.; Vegehan, E.; Deransart, P.; Sanchez-Sotelo, J.; Valenti, P. Lateralization in reverse shoulder arthroplasty: A descriptive analysis of different implants in current practice. Int. Orthop. 2019, 43, 2349–2360.
2. Roche, C.P. Reverse Shoulder Arthroplasty Biomechanics. J. Funct. Morphol. Kinesiol. 2022, 7, 13.
3. Boutsiadis, A.; Lenoir, H.; Denard, P.J.; Panisset, J.C.; Brossard, P.; Delsol, P.; Guichard, F.; Barth, J. The lateralization and distalization shoulder angles are important determinants of clinical outcomes in reverse shoulder arthroplasty. J. Shoulder Elb. Surg. 2018, 27, 1226–1234.
4. Berthold, D.P.; Morikawa, D.; Muench, L.N.; Baldino, J.B.; Cote, M.P.; Creighton, R.A.; Denard, P.J.; Gobezie, R.; Lederman, E.; Romeo, A.A.; et al. Negligible Correlation between Radiographic Measurements and Clinical Outcomes in Patients Following Primary Reverse Total Shoulder Arthroplasty. J. Clin. Med. 2021, 10, 809.
5. Erickson, B.J.; Werner, B.C.; Griffin, J.W.; Gobezie, R.; Lederman, E.; Sears, B.W.; Bents, E.; Denard, P.J. A comprehensive evaluation of the association of radiographic measures of lateralization on clinical outcomes following reverse total shoulder arthroplasty. J. Shoulder Elb. Surg. 2022, 31, 963–970.
6. Carrazana-Suarez, L.F.; Panico, L.C.; Smolinski, M.P.; Blake, R.J.; McCroskey, M.A.; Sykes, J.B.; Lin, A. Humeral offset as a predictor of outcomes after reverse shoulder arthroplasty. J. Shoulder Elb. Surg. 2022, 31, S158–S165.
7. Roberson, T.A.; Shanley, E.; Abildgaard, J.T.; Granade, C.M.; Adams, K.J.; Griscom, J.T.; Hunt, Q.; Nix, Q.; Kissenberth, M.J.; Tolan, S.J.; et al. The influence of radiographic markers of biomechanical variables on outcomes in reverse shoulder arthroplasty. JSES Open Access 2019, 3, 59–64.
8. Longo, Umile Giuseppe, et al. "Influence of lateralization and distalization on joint function after primary reverse total shoulder arthroplasty." Bioengineering 10.12 (2023): 1409.