Reverse Total Shoulder Replacement Reduces Compensatory Cervical Spine and Trunk Movements During Hairbrushing And Drinking Tasks

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INTRODUCTION:

Glenohumeral arthritis (GHA) with rotator cuff disease and rotator cuff arthropathy (RCA) are challenging conditions to treat. Reverse total shoulder arthroplasty (rTSA) allows for effective treatment of both pathologies, and incidence of rTSA nearly doubled from 2012-2017. GHA and RCA both result in limited range of motion of the shoulder, which may increase compensatory movements in the trunk and spine, potentially altering biomechanics and increasing pain during daily activities. The aim of the present study was to evaluate compensatory movements of the trunk and spine in activities of daily living (ADLs) in patients with GHA and RCA and the impact of rTSA on these movements.

METHODS:

The present study evaluated compensatory movements via motion analysis of the lumbar and cervical spine and pelvis in 26 patients with GHA with rotator cuff disease or RCA during hairbrushing and drinking tasks that emulate ADLS before rTSA (n=26) and again at 6 weeks (n= 14) and 3 months (n = 13) post-operatively. Motion capture evaluated movements of the cervical and lumbar spine and the pelvis, as well as shoulder flexion, adduction and rotation.

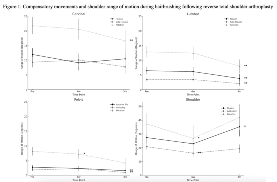
RESULTS:

Three months following rTSA, patients required significantly less movement of lumbar flexion, side flexion, and rotation, as well as less pelvis obliquity and anterior pelvic tilt to complete the hairbrushing task compared to pre-operatively (Figure 1, Table 1). This was accompanied by increased shoulder and rotation. During the drinking task, patients required significantly less cervical rotation and side flexion 3 months following rTSA, well as less lumbar rotation and pelvis rotation (Figure 2, Table 2). However, there was no significant increase in shoulder flexion or abduction during the drinking task, and shoulder rotation decreased by approximately 4 degrees 3 months following rTSA.

DISCUSSION AND CONCLUSION:

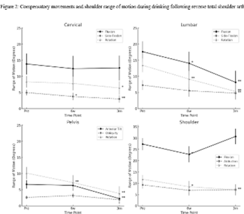
Reverse total shoulder arthroplasty successfully reduces the compensatory movements of the trunk and cervical spine during two separate tasks of daily living despite limitations in shoulder motion inherent in the surgery. There is a high incidence of concomitant neck and shoulder pain, yet little is known about the impact of shoulder arthroplasty on neck or back pain. Future research should evaluate if this reduction of compensatory movement of spine and pelvis continues or increases at later post-operative timepoints, and if it creates more efficient movement and therefore reduces incidence of pain in those areas.

Figure 1: Compensatory movements and shoulder range of motion during hairbrushing following reverse total shoulder arthroplasty



P values reflect comparison to pre-operative values. * indicates p<0.05, ** indicates p<0.01, *** indicates p<0.001.

Figure 2: Compensatory movements and shoulder range of motion during drinking following reverse total shoulder arthroplasty



Significance compared to pre-operative values. * indicates $p < 0.05$, ** indicates $p < 0.01$, *** indicates $p < 0.001$.

Table 1: Kinematic compensation ROM and Shoulder ROM during Hairbrushing. * p<0.05, † p<0.01, ‡ p< 0.001.

Movement	Range of Motion Degrees (95% CI)			P value	
Cervical	Pre	Post 6w	Post 3m	Pre- 6w	Pre- 3m
Flexion	11.97 (9.86, 14.08)	9.13 (6.55, 11.71)	10.48 (7.89, 13.08)	**0.032***	0.264
Side-Flexion	9.35 (7.57, 11.14)	10.09 (7.88, 12.31)	7.75 (5.52, 9.97)	0.528	0.171
Rotation	21.74 (18.86, 24.62)	20.61 (17.05, 24.17)	16.62 (13.05, 20.20)	0.543	**0.006†**
Lumbar					
Flexion	6.45 (5.13, 7.77)	6.14 (4.57, 7.70)	3.81 (2.25, 5.38)	0.670	**<0.001‡**
Side-Flexion	3.39 (2.85, 3.94)	3.44 (2.73, 4.16)	2.05 (1.34, 2.77)	0.902	**0.001†**
Rotation	12.86 (10.92, 14.79)	12.45 (10.20, 14.70)	7.99 (5.74, 10.25)	0.294	**0.003†**
Pelvis					
Anterior Tilt	2.73 (2.12, 3.34)	2.32 (1.57, 3.07)	1.55 (0.79, 2.30)	0.073	**<0.001‡**
Obliquity	1.82 (1.42, 2.22)	2.25 (1.77, 2.74)	0.94 (0.45, 1.42)	0.223	**<0.001‡**
Rotation	8.12 (6.70, 9.55)	7.21 (5.55, 8.86)	4.20 (2.54, 5.87)	**0.032***	0.264
Shoulder					
Flexion	27.32 (21.89, 32.76)	22.79 (15.85, 29.72)	35.15 (28.19, 42.10)	0.240	**0.043***
Adduction	20.71 (18.40, 23.01)	16.00 (13.00, 18.99)	19.27 (16.26, 22.27)	**0.006†**	0.404
Rotation	37.27 (29.29, 45.25)	26.76 (17.40, 36.13)	42.01 (32.61, 51.40)	**0.016***	0.278

Table 2: Kinematic compensation ROM and Shoulder ROM during Drinking. * p<0.05, † p<0.01, ‡ p< 0.001.

Movement	Range of Motion Degrees (95% CI)			P value	
Cervical	Pre	Post 6w	Post 3m	Pre- 6w	Pre- 3m
Flexion	13.84 (10.60, 17.08)	12.38 (8.46, 16.30)	12.59 (8.75, 16.44)	0.428	0.488
Side-Flexion	4.97 (4.08, 5.87)	3.76 (2.62, 4.90)	2.99 (1.87, 4.10)	**0.039***	**<0.001‡**
Rotation	8.31 (6.53, 10.10)	7.80 (5.69, 9.91)	6.39 (4.31, 8.46)	0.581	0.035*
Lumbar					
Flexion	17.64 (14.47, 20.82)	14.04 (10.44, 17.64)	8.16 (4.61, 11.72)	**0.010***	**<0.001‡**
Side-Flexion	7.27 (5.74, 8.81)	5.54 (3.67, 7.41)	4.79 (2.95, 6.62)	0.052	**0.004†**
Rotation	13.43 (11.32, 15.55)	9.14 (6.59, 11.70)	5.33 (2.82, 7.84)	**<0.001‡**	**<0.001‡**
Pelvis					
Anterior Tilt	6.66 (5.34, 7.98)	6.33 (4.74, 7.92)	2.24 (0.67, 3.80)	0.656	**<0.001‡**
Obliquity	2.61 (2.13, 3.09)	3.19 (2.51, 3.87)	1.89 (1.23, 2.55)	0.166	0.077
Rotation	10.14 (8.25, 12.03)	7.20 (4.90, 9.50)	3.83 (1.57, 6.08)	**0.007†**	**<0.001‡**
Shoulder					
Flexion	27.33 (24.67, 29.98)	22.77 (19.25, 26.30)	30.72 (27.29, 34.14)	**0.019***	0.075
Adduction	9.27 (7.64, 10.91)	6.85 (4.59, 9.11)	7.16 (4.97, 9.35)	0.068	0.104
Rotation	11.76 (9.91, 13.61)	8.47 (5.95, 10.99)	7.06 (4.62, 9.51)	**0.023***	**<0.001‡**