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Shoulder joint arthroplasty in young patients: Analysis of 8742 patients from the Australian Orthopaedic Association National Joint Replacement Registry

Andrew Phillip McBride[1], Mark Ross[2], Phil Duke[2], Greg Hoy[3], Richard Page[4], Chelsea Dyer[5] and Fraser Taylor[1]

Abstract

Background: Shoulder replacement is a reliable treatment for the relief of pain and improvement of function in patients with glenohumeral arthritis, rotator cuff arthropathy, osteonecrosis and fracture. Limited data is available comparing revision rates for the different types of shoulder replacement when used in younger patients. This study aims to compare the survivorship of hemi resurfacing, stemmed hemiarthroplasty, total shoulder arthroplasty and reverse total shoulder arthroplasty in younger patients using data from a large national arthroplasty registry.

Methods: Data from the Australian Orthopaedic Association National Joint Replacement Registry was obtained for the period 16 April 2004–31 December 2018. The study population included all shoulder arthroplasty patients aged <65 years. These were stratified into two groups: <55 years and 55–64 years. A total of 8742 primary shoulder arthroplasty procedures were analysed (1936 procedures in the <55 years and 6806 in the 55–64 years age group).

Results: In the <55 years age group, there was no difference in revision rate for total shoulder arthroplasty versus reverse total shoulder arthroplasty at any time point. Reverse total shoulder arthroplasty had a lower revision rate after six months when compared to hemi resurfacing (HRA) ($p = 0.031$). Also, reverse total shoulder arthroplasty had a higher early rate of revision in the first 12 months compared to hemiarthroplasty ($p = 0.018$). However, from 2 years reverse total shoulder arthroplasty had a lower revision rate overall ($p = 0.029$).

In the 55–64 years patient age group, reverse total shoulder arthroplasty had a lower earlier revision rate. This was statistically significant compared to hemi resurfacing (HRA) ($p = 0.028$), hemiarthroplasty ($p = 0.049$) and total shoulder arthroplasty ($p < 0.001$).

Conclusion: This study demonstrated that for patients aged <55 years there was no significant difference in the rate of revision when total shoulder arthroplasty and reverse total shoulder arthroplasty were compared. reverse total shoulder arthroplasty had a lower rate of revision when compared to hemi resurfacing and hemiarthroplasty after 2 years. reverse total shoulder arthroplasty had the lowest comparative revision rate in patients aged 55–64 years overall.

Keywords

Shoulder joint, arthroplasty, less than 65 years, joint registry, young patient, replacement, revision rate

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Introduction

Shoulder replacement is a reliable treatment for the relief of pain and improvement of function in patients with glenohumeral arthritis, rotator cuff arthropathy, osteonecrosis and fracture.[1] The use of shoulder arthroplasty is increasing as surgeons become more familiar with its use and the indications expand.[1–3] However, concern exists around shoulder arthroplasty in younger patients with higher demands expected to lead to higher revision rates.[4] Younger patients have been shown to both have greater expectations following shoulder arthroplasty and are more likely to participate in

[1]Gold Coast University Hospital, Southport, Australia
[2]Brisbane Hand and Upper limb Research Institute, Brisbane, Australia
[3]Melbourne Orthopaedic Group, Windsor, Australia
[4]University Hospital and St John of God Hospital Geelong, Barwon Centre of Orthopaedic Research and Education, Deakin University; Australian Orthopaedic Association National Joint Replacement Registry, Queensland, Australia
[5]South Australian Health and Medical Research Institute (SAHMRI), Adelaide, South Australia

Corresponding author:
Andrew Phillip McBride, Department of Orthopaedics, Gold Coast University Hospital, 1 Hospital Blv Southport Qld 4215, Australia.
Email: amcbrideortho@gmail.com

sporting activities.[5,6] This has the potential to result in higher rates of revision due to glenoid wear, loosening of the components and rotator cuff failure.[4] In 2018, data from the Australian Orthopaedic Association National Joint Replacement Registry showed high rates of revision in younger patients undergoing shoulder joint arthroplasty compared to older cohorts.[7]

Varying rates of osteoarthritis, post traumatic arthritis, chondrolysis, osteonecrosis, instability and rheumatoid arthritis are reported as the primary indication for shoulder arthroplasty in young patients.[4,8,9] The causative pathology is an important consideration as a diagnosis other than osteoarthritis or rheumatoid arthritis has been linked with higher revision rates and the potential for early revision in younger patients.[4,10]

Hemi resurfacing (HRA), stemmed hemiarthroplasty (HA), TSA and reverse total shoulder arthroplasty (RTSA) are the four main categories of shoulder reconstruction for patients with end stage shoulder pathology that require surgical treatment. Hemiarthroplasty has been used for the management of non-reconstructable proximal humerus fractures with satisfactory results.[11] Studies suggest that its use in the treatment of glenohumeral arthritis has been less satisfactory compared to TSA with respect to functional outcomes and revision rate.[12–14] However, along with HRA, HA remains an attractive option in younger patients as it removes some of the concern around loosening of the glenoid component which has been shown to be the primary cause of late failure in TSA.[4,15] RTSA is commonly used to treat end stage arthritis in older patients with a deficient rotator cuff. The low revision rates have led to a widening of the indications for RTSA and increasing use in younger patients with successful outcomes.[16–18]

Shoulder arthroplasty in younger patients both with and without an intact or functional rotator cuff remains an area of controversy and a complex and difficult clinical situation for shoulder surgeons. This study aimed to compare the revision rate of shoulder arthroplasty for younger patients using data from the Australian Orthopaedic Association National Joint Replacement Registry (AOANJRR). Secondary aims were to compare the effect of age, revision diagnosis and type of revision between the four categories of shoulder replacement.

Materials and methods

This was a large prospective cohort study of patients who have undergone shoulder arthroplasty for all diagnosis using data from the AOANJRR. The AOANJRR began data collection on 1 September 1999 and includes data on almost 100% of the hip and knee arthroplasty procedures performed in Australia since 2002. Data collection was expanded to include shoulder arthroplasty procedures in April 2004 and has documented almost all shoulder arthroplasty procedures Australia-wide since November 2007. This data is externally validated against patient-level data provided by all Australian state and territory health departments. A sequential, multilevel matching process is used to identify any missing data which are subsequently obtained by follow-up with the relevant hospital. Each month, in addition to internal validation and data quality checks, all primary procedures are linked to any subsequent revision involving the same patient, joint and side. Data are also matched bi-annually to the Australian National Death Index data to identify patients who have died.

The study population included all primary total shoulder arthroplasty procedures undertaken for any reason and reported to the registry between 16 April 2004 and 31 December 2018. Procedures were grouped into the class of primary shoulder arthroplasty; HRA, HA, TSA or RTSA. For each type of shoulder arthroplasty, patients were grouped into age categories; <55 years, and 55–64 years. Additional analysis was undertaken to identify the reason for revision for each class of arthroplasty in each of the age groups outlined above.

Statistical analysis

Kaplan-Meier estimates of survivorship were used to report the time to revision, with censoring at the time of death and closure of the dataset at the end of December 2018. The unadjusted cumulative percent revision (CPR), with 95% confidence intervals (CI), were calculated using unadjusted point wise Greenwood estimates. Age and gender adjusted hazard ratios (HR) were calculated from Cox proportional hazard models to compare the rate of revision between groups. The assumption of proportional hazards was checked analytically for each model. If the interaction between the predictor and the log of time was statistically significant in the standard Cox model, then a time varying model was estimated. Time points were selected based on the greatest change in hazard, weighted by a function of events. Time points were iteratively chosen until the assumption of proportionality was met and HRs were calculated for each selected time-period. For the current study, if no time-period was specified, the HR was calculated over the entire follow-up period. All tests were two-tailed at 5% levels of significance. Statistical analysis was performed using SAS software version 9.4 (SAS Institute Inc., Cary, North Carolina).

Results

Age and class of shoulder replacement

A total of 8742 shoulder arthroplasty procedures were identified. These included 1936 procedures undertaken in patients aged <55 years and 6806 procedures in patients aged 55–64 years (Table 1).

In the <55 years age group, there were 347 (17.9%) HRA procedures, 525 (27.1%) HA, 708 (36.6%) TSA, and 356 (18.4%) RTSA procedures (Table 2). In the 55–64 years age group, 433 (5.4%) were HRA procedures, 974 (14.3%) were HA, 3059 (44.9%) were TSA, and 2340 (34.4%) were RTSA procedures. Overall, for patients aged <65 years, procedures were most often undertaken in males (51.9%) (Table 2).

The mean age for patients undergoing HRA was 53.9 years (SD 8.4), 55.1 years (SD 8.6) for HA, 58.4 years (SD 5.9) for TSA and 59.3 years (SD 5.7) for RTSA. The mean follow-up was 5.8 years (SD 3.5) for HRA, 5.3 years (SD 3.5) for HA, 5.0 years (SD 3.2) for TSA and 3.0 years (SD 2.7) for RTSA (Table 1).

Primary diagnosis

The class of shoulder replacement varied according to primary diagnosis. TSA was the most common arthroplasty performed for osteoarthritis in patients aged <55 years and patients aged 55–64 years accounting for 52% and 64%, respectively (Tables 3 and 4). Fracture was the main indication for HA in the <55 years group (46.9%) and the 55–64 years age group (60%).

Revision rates by age

In the <55 years age group RTSA has the lowest CPR at 5 years. The 5-year CPR rate for HRA was 10.0% (95% CI 6.9, 14.3), for HA it was 13.9% (95% CI 10.8, 17.8), for TSA it was 12.0% (95% CI 9.6, 15.0) and for RTSA it was 8.4% (95% CI 5.3, 13.3). The 10-year CPR for this age group was for HRA, HA and TSA, 23.2% (95% CI 17.0, 31.2), 21.2% (95% CI 16.3, 27.3) and 21.1% (95% CI 16.5, 26.8), respectively (Figure 1) (Table 5). Insufficient data was available to calculate a CPR for RTSA at 10 years in this age group.

In the <55 years age group, HRA had a lower early CPR rate compared to RTSA in the first 12 months (HR = 0.23 (95% CI 0.07, 0.78), p = 0.018). After this time, there was no difference until two years when HRA had a higher revision rate (HR = 2.02 (95% CI 1.07, 3.82), p = 0.029) compared to RTSA (Figure 1) (Table 5). Similarly, when compared to RTSA, HA had a higher revision rate after six months (HR = 1.81 (1.06, 3.10), p = 0.031) (Figure 1). There was no difference in the revision rate for TSA compared to RTSA at any stage for patients in this age group (Figure 1).

In the 55–64 years age group RTSA again had the lowest CPR at 5 years. The 5-year CPR rate for HRA was 15.6% (95% CI 12.3, 19.8), for HA it was 12.5% (95% CI 10.5, 14.9), for TSA it was 9.5% (95% CI 8.4, 10.7) and for RTSA it was 7.1% (95% CI 5.9, 8.5). The 10-year CPR rate of HRA, HA, TSA and RTSA was 20.9% (95% CI 16.7, 26.1), 16.5% (95% CI 13.6, 19.8), 15.9% (95% CI 13.9, 18.3) and 9.7% (95% CI 7.4, 12.6), respectively (Figure 2). In the 55–64 years age group, RTSA had a higher rate of early revision compared to HRA (0–6 months), HA (0–2 weeks) and TSA (0–3 months) (Figure 2). After this early period, the rate of revision switched with HRA (6 months–6 years), HA (6 months–2.5 years) and TSA (3 months+) having significantly higher rates of revision compared to RTSA, with no difference at all other time points (Figure 2).

Reason for revision

The reason for revision varied depending on the class of shoulder replacement used. For HRA, glenoid erosion and pain were the most common reasons for revision for the <55 years age group (27.3% and 25.0% of revisions, respectively) and the 55–64 years age group (27.8% and 22.2%, respectively). For HA procedures in the <55 years age group, infection was the main reason for revision (21.4%) followed by glenoid erosion (17.1%). In the 55–64 years age group for HA procedures, rotator cuff insufficiency was the main reason for revision (24.4%) (Figures 3 and 4).

For TSA instability/dislocation was the most common reason for revision in the <55 years age group (21.6%) compared to rotator cuff insufficiency in the 55–64 years age group (22.9%) (Figures 3 and 4). Implant loosening was the second most common reason for revision in the <55 year (15.9%) and 55–64 years age group (20.9%) and was the primary cause of late failure in both groups (Figures 3 and 4).

For RTSA, instability/dislocation was the most common reason for revision in both the <55 and 55–64 years age groups (50% and 34.6%, respectively). This was noted to occur frequently in the early post-operative period (Figures 3 and 4). Infection was the second most common reason for revision in both RTSA age groups (12.5 and 26.2% of revisions, respectively).

Discussion

Demographics, arthroplasty class and primary diagnosis

Overall, patients undergoing HRA were younger (53.9 years) compared to HA (55.1 years), TSA (58.4 years) and RTSA (59.3 years).

This may reflect the desire of surgeons to utilise resurfacing in younger patients to attempt to minimalize glenoid bone loss, the low prevalence of periprosthetic fractures and ease of revision to a conventional TSA.[19]

Osteoarthritis was the main indication for HRA, TSA and RTSA in young patients. In HA, fracture was the primary indication. This is in contrast to previous smaller studies that indicated reasons other than osteoarthritis to

Table 1. Age, gender and follow-up of primary shoulder replacement in patients aged <65 years.

		Hemi stemmed	Hemi resurfacing	Total stemmed	Total reverse	Total
Male	Number	663	542	2055	1276	
	Percent	44.2	69.5	54.6	47.3	
	Minimum age	14	19	21	17	
	Maximum age	64	64	64	64	
	Median age	55	55	60	61	
	Mean age	53.0	53.1	57.9	59.4	
	Std. dev.	9.4	8.5	6.2	5.5	
Female	Number	836	238	1712	1420	
	Percent	55.8	30.5	45.4	52.7	
	Minimum age	13	27	21	13	
	Maximum age	64	64	64	64	
	Median age	59	58	60	61	
	Mean age	56.8	55.8	58.9	59.3	
	Std. dev.	7.5	8.0	5.4	5.7	
Total	Number	1499	780	3767	2696	
	Percent	100	100	100	100	
	Minimum age	13	19	21	13	
	Maximum age	64	64	64	64	
	Median age	58	56	60	61	
	Mean age	55.1	53.9	58.4	59.3	
	Std. dev.	8.6	8.4	5.9	5.6	
Follow-Up	Number	1499	780	3767	2696	8742
	Minimum follow-up	0.01	0.03	0.01	0.00	0.00
	Maximum follow-up	13.1	12.8	13.7	12.4	13.7
	Median follow-up	5.24	6.12	4.61	2.14	3.87
	Mean follow-up	5.34	5.80	5.00	3.00	4.51
	Std. dev.	3.46	3.50	3.20	2.74	3.30

account for a higher percentage of joint replacements in the younger age group.[9,16,20] Saltzman in 2010 reported on 172 patients aged <50 years and found 79% had a diagnosis other than primary degenerative joint disease compared to 34% of patients aged >50 years.[9]

Revision rate and survivorship in young patients

All classes of shoulder replacement had comparable CPR in patients aged <55 years. HRA had the lowest early revision rate of the group compared to RTSA which had the highest early revision rate (Figure 1). However, RTSA had a lower

Table 2. Yearly cumulative percent revision of primary shoulder replacement by age and type of primary (all diagnoses).

Age	Type of primary	N revised	N total	Obs. years	Revisions/100 obs. years (95% CI)
<55	Hemi resurfacing	44	347	1901	2.31 (1.68, 3.11)
	Hemi stemmed	70	525	2550	2.75 (2.14, 3.47)
	Total stemmed	88	708	3448	2.55 (2.05, 3.14)
	Total reverse	24	356	1077	2.23 (1.43, 3.32)
55–64	Hemi resurfacing	72	433	2624	2.74 (2.15, 3.46)
	Hemi stemmed	123	974	5458	2.25 (1.87, 2.69)
	Total stemmed	297	3059	15,375	1.93 (1.72, 2.16)
	Total reverse	130	2340	7019	1.85 (1.55, 2.20)

revision rate compared to HRA and HA but not TSA in patients aged <55 years at mid-term follow-up. CPR data for RTSA was only available out to 6 years so long-term outcome and analysis in this age group remains unknown. RTSA had the lowest CPR rate in patients aged 55–64 years when compared to all other classes of shoulder replacement however, once again showed higher early revision rates (Figure 2). To our knowledge, this is the first large scale registry based study that reports on the midterm outcomes of young arthroplasty that includes data on RTSA. In 2018, Rasmussen reported on the 10 year outcomes of TSA, HRSA and HRA from the Nordic arthroplasty registry but did not include RTSA. They found that TSA had the highest implant survival rate at 10 years for all groups including young patients under 55.[21] A separate study from the same registry evaluated the survival of 1904 RTSA at 10 years follow-up and found a low (.91) cumulative percent revision. Patient age was not associated with risk of revision.[22]

Glenoid erosion in resurfacing and stemmed hemiarthroplasty

Resurfacing humeral hemiarthroplasty is often considered in young active patients to treat arthritic conditions of the shoulder where loosening or wear of the glenoid component is a concern.[23,24] Our cohort included prosthesis utilising metal, pyrocarbon or ceramic as the bearing surface.

Table 3. Primary diagnosis of primary shoulder replacement in patients aged <55 years by type of primary.

	Hemi resurfacing		Hemi stemmed		Total stemmed		Total reverse	
Primary diagnosis	N	Col%	N	Col%	N	Col%	N	Col%
Osteoarthritis	291	83.9	124	23.6	578	81.6	126	35.4
Fracture	5	1.4	246	46.9	17	2.4	46	12.9
Osteonecrosis	14	4.0	75	14.3	45	6.4	14	3.9
Rheumatoid arthritis	8	2.3	19	3.6	44	6.2	38	10.7
Tumour	.	.	46	8.8	3	0.4	48	13.5
Rotator cuff arthropathy	12	3.5	3	0.6	3	0.4	70	19.7
Instability	14	4.0	10	1.9	8	1.1	9	2.5
Other inflammatory arthritis	3	0.9	2	0.4	9	1.3	5	1.4
Other					1	0.1		
Total	347	100.0	525	100.0	708	100.0	356	100.0

Table 4. Primary diagnosis of primary shoulder replacement in patients aged 55–64 years by type of primary.

	Hemi resurfacing		Hemi stemmed		Total stemmed		Total reverse	
Primary diagnosis	N	Col%	N	Col%	N	Col%	N	Col%
Osteoarthritis	384	88.7	256	26.3	2836	92.7	976	41.7
Fracture	2	0.5	593	60.9	31	1.0	390	16.7
Rotator cuff arthropathy	17	3.9	20	2.1	16	0.5	737	31.5
Rheumatoid arthritis	10	2.3	26	2.7	76	2.5	98	4.2
Osteonecrosis	15	3.5	36	3.7	57	1.9	57	2.4
Tumour	.	.	29	3.0	4	0.1	32	1.4
Instability	3	0.7	10	1.0	14	0.5	35	1.5
Other inflammatory arthritis	2	0.5	4	0.4	23	0.8	13	0.6
Other					2	0.1	2	0.1
Total	433	100.0	974	100.0	3059	100.0	2340	100.0

Overall, glenoid erosion and pain were the most common reasons for revision in both patient age groups. Glenoid erosion was also shown to be the second most common cause of revision for HA (17.1%) in patients aged <55 years. These findings are consistent with previous studies. A multicentered cohort study of 33 shoulders treated with the Copeland shoulder resurfacing showed that 45% of patients had glenoid erosion on x-ray at 7 year follow-up.[20] Similarly, a multicentered study of 419 patients with mean age of 49 years, treated with HA using a metal head demonstrated that painful glenoid erosions accounted for 9.5% of the 11% of revisions at 10 years.[25] The cause of glenoid erosion in HRA and HA is not fully understood. Baile reviewed the outcomes of 36 patients who underwent cementless HRA for osteoarthritis and despite high satisfaction levels at two years, noted concerns over progressive glenoid erosion given that many of their younger patients chose to return to higher activity levels rather than adhere to recommended activity restriction.[26] Al-Hadithy et al. demonstrated a correlation between an

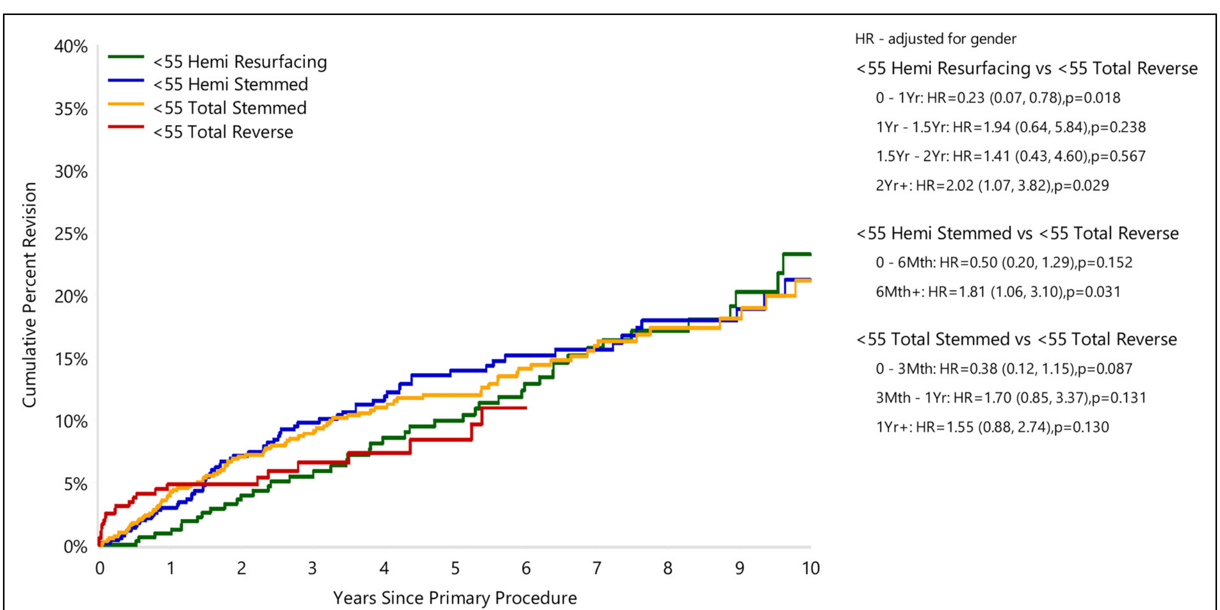

Figure 1. Cumulative percent revision of primary shoulder replacement in patients aged <55 years by type of primary (all diagnoses).

oversized implant and degree of glenoid erosion in a series of 53 patients at 4.2 years follow-up for shoulder resurfacing.[27] Oversizing is thought to increase tension on the rotator cuff leading to the compressive forces that cause glenoid erosion.[20]

Infection in shoulder hemiarthroplasty

Infection was the main reason for revision in HA in patients aged <55 years with an overall rate of 2.9% (Figure 3) at mean 5.2 years follow-up. The primary indication for HA was fracture as opposed to osteoarthritis for the other classes of arthroplasty in this age group. Patients that sustain proximal numerus fractures secondary to osteoporosis are more likely to have modifiable risks factors including smoking, excessive alcohol intact and poor nutrition that are known to increase the risk of infection and may contribute to the high rate of revision for infection for this subset of patients.[28,29] The rate of infection in this cohort was similar to that reported in previous studies. In a meta-analysis of 810 hemiarthroplasties performed for fracture, the rate of infection was reported at 2.2% at mean follow-up of 3.7 years.[30]

Instability in total shoulder arthroplasty

Instability was the main reason for revision for TSA for patients aged <55 years. The reported incidence of instability following anatomic TSA ranges from 1 to 2%.[31–33]

Table 5. Revision rates of primary shoulder replacement by Age and type of primary (all diagnoses).

Age	Type of primary	1 year	2 years	3 years	4 years	5 years	
<55	Hemi resurfacing	0.9 (0.3, 2.8)	4.0 (2.3, 6.9)	5.5 (3.4, 8.8)	8.6 (5.8, 12.7)	10.0 (6.9, 14.3)	
	Hemi stemmed	3.0 (1.8, 4.9)	7.2 (5.1, 9.9)	9.8 (7.3, 13.0)	11.6 (8.8, 15.1)	13.9 (10.8, 17.8)	
	Total stemmed	4.2 (2.9, 6.1)	7.1 (5.3, 9.3)	8.9 (6.9, 11.5)	11.0 (8.7, 13.9)	12.0 (9.6, 15.0)	
	Total reverse	4.8 (3.0, 7.8)	4.8 (3.0, 7.8)	6.6 (4.2, 10.4)	7.4 (4.7, 11.6)	8.4 (5.3, 13.3)	
55–64	Hemi resurfacing	2.4 (1.3, 4.4)	6.1 (4.2, 8.9)	10.4 (7.8, 13.9)	12.5 (9.6, 16.3)	15.6 (12.3, 19.8)	
	Hemi stemmed	4.9 (3.7, 6.5)	8.6 (6.9, 10.6)	10.9 (9.0, 13.2)	11.6 (9.6, 13.9)	12.5 (10.5, 14.9)	
	Total stemmed	3.5 (2.9, 4.3)	5.8 (5.0, 6.8)	7.2 (6.3, 8.3)	8.1 (7.1, 9.2)	9.5 (8.4, 10.7)	
	Total reverse	3.8 (3.0, 4.6)	5.2 (4.3, 6.3)	6.0 (5.0, 7.2)	6.8 (5.6, 8.1)	7.1 (5.9, 8.5)	
Age	Type of primary	6 Yrs	7 Yrs	8 Yrs	9 Yrs	10 Yrs	11 Yrs
<55	Hemi resurfacing	12.9 (9.2, 17.9)	15.8 (11.6, 21.3)	17.1 (12.7, 22.9)	20.2 (15.0, 27.0)	23.2 (17.0, 31.2)	
	Hemi stemmed	15.1 (11.8, 19.2)	15.6 (12.2, 19.8)	17.9 (14.1, 22.7)	18.9 (14.7, 24.0)	21.2 (16.3, 27.3)	
	Total stemmed	14.1 (11.3, 17.5)	15.9 (12.8, 19.7)	17.4 (14.0, 21.4)	18.1 (14.5, 22.5)	21.1 (16.5, 26.8)	
	Total reverse	11.0 (6.8, 17.4)					
55–64	Hemi resurfacing	17.3 (13.8, 21.7)	18.5 (14.8, 23.0)	20.0 (16.0, 24.8)	20.0 (16.0, 24.8)	20.9 (16.7, 26.1)	
	Hemi stemmed	13.4 (11.2, 15.9)	13.8 (11.6, 16.4)	14.5 (12.2, 17.3)	14.9 (12.5, 17.7)	16.5 (13.6, 19.8)	
	Total stemmed	10.7 (9.5, 12.0)	11.4 (10.1, 12.9)	12.4 (11.0, 14.0)	14.0 (12.3, 15.8)	15.9 (13.9, 18.3)	16.6 (14.2, 19.4)
	Total reverse	7.3 (6.0, 8.9)	8.0 (6.5, 9.8)	8.4 (6.7, 10.6)	9.7 (7.4, 12.6)	9.7 (7.4, 12.6)	

Anterior instability can be associated with subscapularis insufficiency, axillary nerve injury, component malpositioning or oversizing the humeral head.[31] To reduce the incidence of subscapularis rupture, the recommendations of several studies have advocated lesser tuberosity osteotomy over a subscapularis tenotomy due to lower failure rates of repair, improved shoulder external rotation, higher load to failure in vivo, improved strength with lift off testing and improved functional outcomes.[34–36] Other studies reported no difference in strength and outcome between tenotomy, osteotomy and subscapularis peel.[37–43]

Regardless, the risk of subscapularis failure can be minimised by avoiding oversizing the humeral head, meticulous repair of the subscapularis and avoidance of excessive external rotation in the postoperative period.[31] Posterior shoulder instability is less common than anterior shoulder instability.[33] Excessive humeral or glenoid retroversion along with posterior capsular laxity have been implicated as the main causes.[32]

Loosening in total shoulder arthroplasty

Loosening of the glenoid component was the second most common cause of revision for TSA and the most common cause of failure after 9 years in both age groups.

This is consistent with previous studies. A retrospective multicentre study with long term follow-up of patients aged <60 years who underwent stemmed total shoulder arthroplasty demonstrated that of the shoulders that underwent revision surgery, 80% were attributed to glenoid component loosening.[15] In this cohort, survivorship of TSA dropped precipitously after 10 years of follow-up, likely representing glenoid component loosening and failure.[15]

Rotator cuff failure in hemiarthroplasty and total shoulder arthroplasty

Rotator cuff failure was the main reason for revision for both hemi and total stemmed shoulder replacement in patients aged 55–64 years. This highlights the importance of patient selection, ensuring rotator cuff integrity prior to proceeding with shoulder HA or TSA and the importance of intraoperative reconstruction of the subscapularis on closure. Assessment of the rotator cuff preoperatively involves both clinical examination and imaging assessment. Integrity of the rotator cuff can be inferred from plain radiography on the grashey view utilizing the Hamada-Fukuda classification.[44] MRI remains the gold standard in assessing for tears within the tendons of the cuff muscles and assessing the integrity of the cuff musculature.[45] The Goutallier grading system on CT scan has been modified by Fuchs to assess fatty infiltration of the cuff and has been shown to have good intra and interobserver reliability.[46,47]

Despite good patient selection, rotator cuff failure has been shown to increase over time in both this age cohort and older age cohorts as shown by the AOANJRR (7). Furthermore, previous imaging based studies have also shown that rotator cuff tearing and degeneration increases with age even in asymptomatic individuals.[48] Whilst careful patient selection remains paramount to avoid rotator cuff failure in total shoulder arthroplasty, the

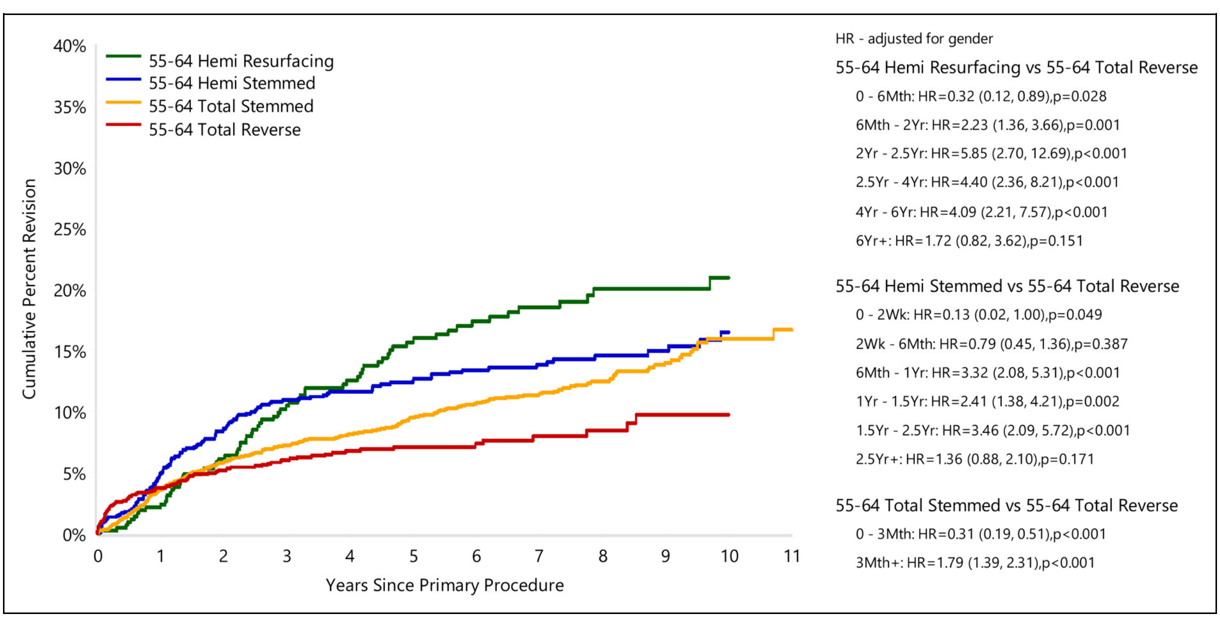

Figure 2. Cumulative percent revision of primary shoulder replacement in patients aged 55–64 years by type of primary (all diagnoses).

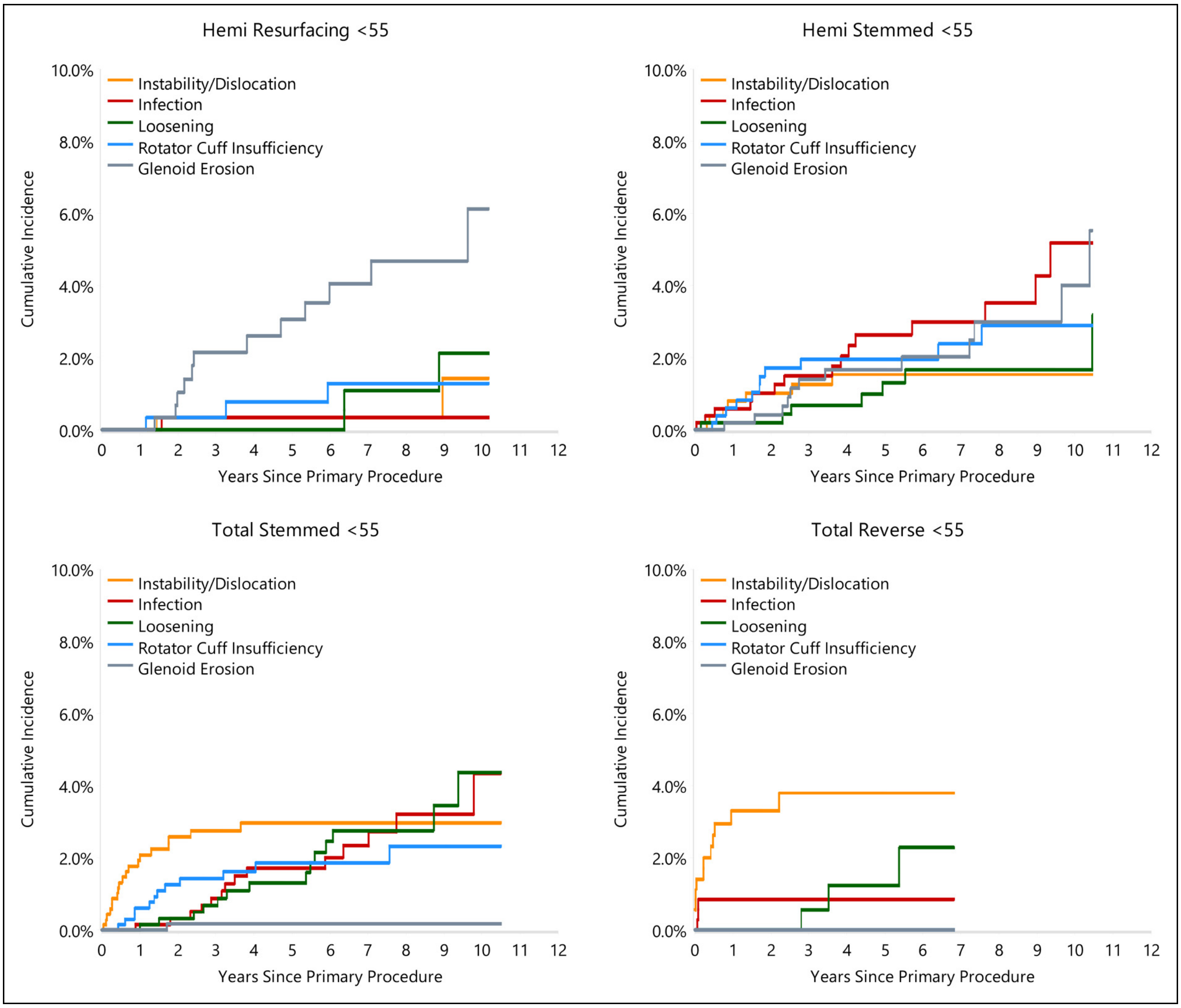

Figure 3. Cumulative incidence revision diagnosis of primary shoulder replacement by type of primary and age (all diagnoses).

natural history of degenerative cuff tears with age will likely remain a contributor to revision in total shoulder arthroplasty in the future.

Instability in reverse total shoulder arthroplasty

Shoulder instability was the major reason for revision in patients aged <55 years with rates approaching 4% at three years. It was also a key reason for revision in patients aged 55–64 years. Revision for instability in RTSA can be a simpler procedure than revision of RTSA for other reasons. This may be a factor in the higher rates of revision for instability in this cohort and lower rates of revision for other causes in RTSA. The rates of dislocation for RTSA range widely in the literature from 1.5–31%.[49–52] Most studies report that component malposition, inadequate tensioning of the soft tissue envelope and insufficient subscapularis for repair are contributing factors to instability post RTSA.[53–56] Chalmers identified additional patient factors including a BMI >30 kg/m^2, male gender, and previous surgery increased the risk of dislocation in the first 3 months post procedure.[49]

Despite the higher prevalence of instability, RTSA had comparable long-term outcomes in patients aged <55 years, and patients aged 55–64 years had a lower revision rate than the other classes of joint replacements. The reason for the lower revision rates in the longer term for RTSA is not fully understood. It may reflect the design construct of a reverse prosthesis being less dependent on a functioning rotator cuff as patients age or could be confounded by the limited revision options of these prostheses.

This study has a number of limitations. Firstly, all cause revision as the primary outcome in any form of arthroplasty has bias as it does not include data on radiographic or functional outcome measures and does not capture information of the poorly performing prosthesis that is not revised. The data collection method also does not allow for multiple reasons for revision to be recorded in a hierarchical

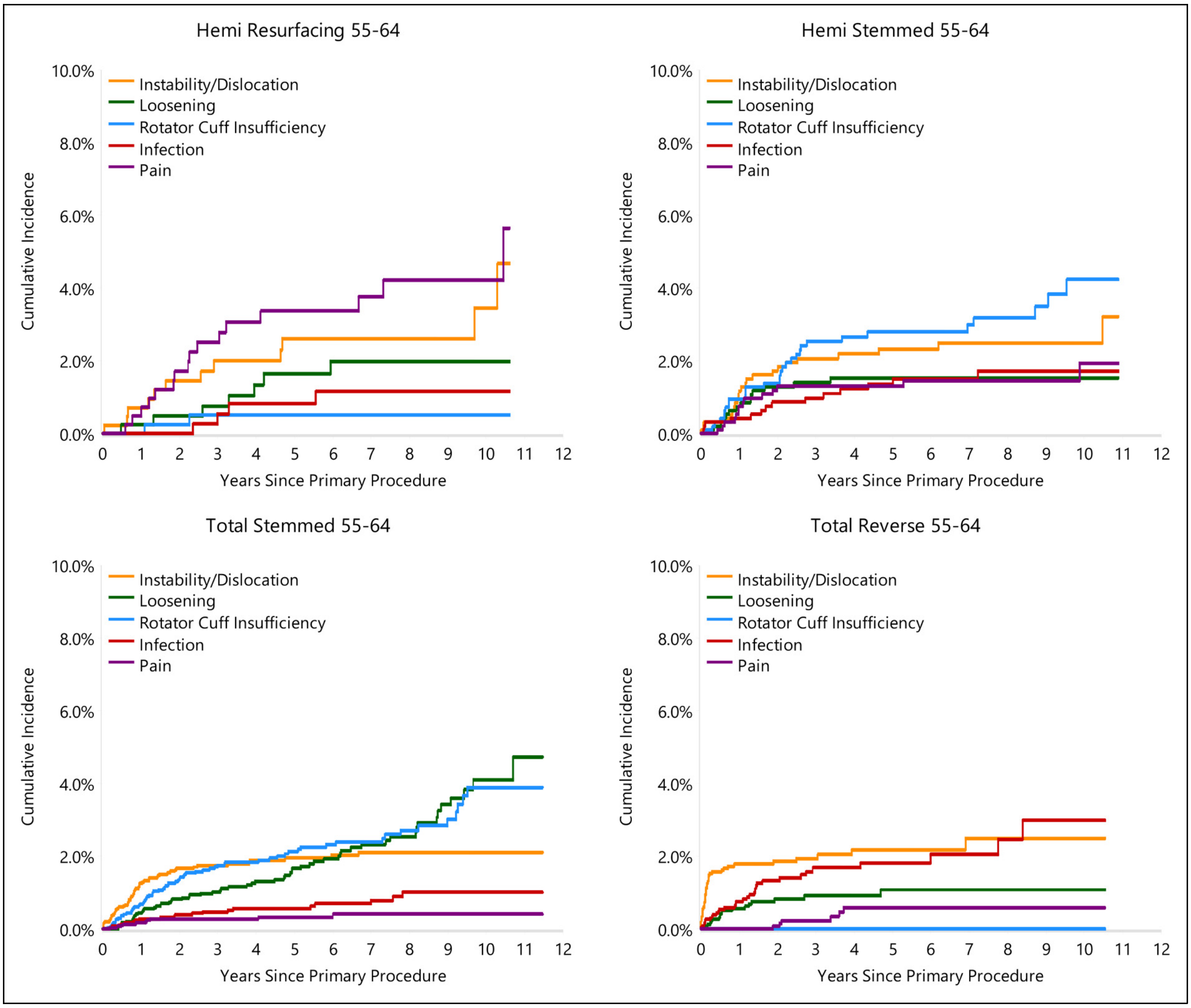

Figure 4. Cumulative incidence revision diagnosis of primary shoulder replacement by type of primary and age (all diagnoses).

fashion. Secondly, care needs to be taken comparing revision rates as outcomes, as the revision of a HA, HRA and TSA can be an easier option than RTSA. Many surgeons view RTSA as a final surgical procedure and may be more inclined to revise an anatomic TSA to a RTSA. This may lead to bias. Furthermore, the follow-up is mid-term. In particular, despite the maximum follow for reverse total shoulder replacement being 12.4 years, the mean follow-up for this group was only 3 years. Information regarding longer term follow is not currently available for this younger age cohort. The national joint registry does, however, have a 99% capture rate and therefore almost all cases of arthroplasty have been included in this analysis.

Conclusion

This is the first large scale study that has compared the outcomes of the differing classes of shoulder arthroplasty in patients aged <65 years. Our study showed that for patients aged <55 years, all classes of shoulder replacement had similar rates of revision. In patients aged 55 to 64, reverse total shoulder replacement had higher revision rates within the first three months, however overall had the lowest rates of revision. The modes of failure of shoulder arthroplasty differed in young patients. In younger patients, glenoid erosion and pain were more frequent causes for revision for shoulder resurfacing and hemiarthroplasty. Instability accounted for a higher percentage of revision for both total shoulder arthroplasty and reverse total arthroplasty, especially in the short to medium term. Given the limitations of using revision as a primary endpoint for outcome, the results from this study should be considered carefully and with caution in clinical practice. Understanding the reasons for revision of shoulder arthroplasty in young patients will help surgeons with patient selection, prosthetic choice, refine surgical technique and lead to the development of newer materials and improved prosthetic designs.

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ORCID iDs

Andrew Phillip McBride https://orcid.org/0000-0002-8425-6219

Greg Hoy https://orcid.org/0000-0002-3142-5891

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