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Appendix 1: References of the 114 Reports Included in the Analysis

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Appendix 2: Details of Statistical Analysis

Preliminary Analysis

We prepared descriptive statistics for all PRMs (SST score, ASES score, Constant score) and covariates prior to analysis using frequencies and percentages for binary variables (preoperative CT, stemless humerus, short stem humerus, standard humerus, all-poly glenoid, hybrid glenoid, metal backed glenoid, augmented glenoid, 3D planning); and mean, standard deviation, median, quartiles, and range for continuous variables (preoperative and postoperative PRM, age, follow-up duration, percent male, and year of publication). We analyzed the effect of each of these covariates for each of the three postoperative PRMs separately.

Deriving and Estimating Standard Deviations

If a study reported the mean postoperative PRM but did not report a standard deviation, we used available information such as the standard error of the mean or 95% confidence interval to derive the standard deviation arithmetically. Otherwise, if a range was available, we estimated the standard deviation using Hozo et al.'s rule of thumb,[51, 52] substituting the mean for the median. We checked the distribution of these derived and estimated standard deviations against the reported standard deviations using scatterplots of the postoperative score versus the standard deviation. No unusual derived or estimated standard deviations were noted.

Meta-Analysis

For each postoperative PRM we first conducted a random effects meta-analysis to determine the percentage of the total variability attributable to between-study variability (I^2).[53] We visualized the meta-analysis using a forest plot. We chose a random effects meta-analysis because we expected the true mean postoperative outcome could vary from study to study given the complexity of surgical interventions, while a fixed-effects meta-analysis would assume one true mean postoperative outcome. The random effects meta-analysis used inverse variance weighting, simultaneously accounting for the sample size and variability of the studies.

Meta-Regression

Following the meta-analysis, we conducted a random effects meta-regression including only the corresponding preoperative outcome to determine the percentage of between-study variability explained by the preoperative score (R^2). Next, we considered each covariate one at time with the preoperative score in a random effects meta-regression to determine the reduction in between-study variability explained by adding the covariate (change in R^2). Covariates were specified prior to undertaking any analysis. If there was no variation in the covariate (e.g., a binary variable with only studies reporting "No"), no meta-regression was undertaken. We summarized the results of the meta-analyses and meta-regressions using the estimate and 95% confidence interval, change in R^2, and associated p-value for each covariate.

Clinical and Statistical Significance

We interpreted the 95% confidence interval with respect to the reported MCID in assigning clinical significance. The covariate was clinically significant if the 95% confidence interval lay above the MCID; we could not rule out the clinical significance of the covariate if the 95% confidence interval for the estimate included the MCID; and the covariate was not clinically significant if the 95% confidence

interval lay below the MCID. We considered changes in R^2 greater than 10% to be important, corresponding to at least a weak correlation with the postoperative outcome. We set the statistical significance level at 0.10, which is often used to screen covariates in univariate analyses prior to any multivariable analysis.

Software

All statistical analyses were performed using R (R Foundation for Statistical Computing, Vienna, Austria). We used the metafor package to conduct the meta-analyses and meta-regression with the rma() command. The anova() command was used to calculate the change in R^2 when adding a covariate.

Appendix 3: Descriptive Statistics of all 114 Studies

Continuous covariates	**Min**	**1st quartile**	**Median**	**3rd quartile**	**Max**	**Mean**	**SD**	**Missing**
Age (years)	48.4	64	66.5	68.2	78.6	65.3	5.2	2
Follow-up (years)	2	2.4	3.5	5	15	4.4	2.7	0
% male	4	37.5	49	59.5	97	48.3	18.1	7
Preop SST	1.4	3.16	3.6	4.1	5.7	3.6	0.9	79
Preop ASES	15.6	31.9	36.3	39.6	57.2	35.3	7.3	46
Preop Constant	14	25.2	30	38.3	48.7	31.4	7.9	53
Year of publication	2000	2013	2016	2018	2020	2015	4.4	0
Binary covariates	**Not used**	**Used**						
CT scan	77 (68%)	37 (32%)						
Stemless humerus	107 (94%)	7 (6%)						
Short stem humerus	108 (95%)	6 (5%)						
Standard humerus	16 (14%)	98 (86%)						
All-poly glenoid	20 (18%)	94 (82%)						
Hybrid glenoid	108 (95%)	6 (5%)						

Metal backed glenoid	104 (91%)	10 (9%)						
Augmented glenoid	110 (96%)	4 (4%)						
SST studies with data on variance of mean (n=22)								
Continuous covariates	**Min**	**1st quartile**	**Median**	**3rd quartile**	**Max**	**Mean**	**SD**	**Missing**
Age (years)	56	64.9	66.3	67.6	71	65.9	3.2	0
Follow-up (years)	2	2.5	3.6	4.2	4.8	3.4	1	0
% male	31.5	48.8	55.5	65	97	59.4	16.7	1
Preop SST	2.6	3.3	3.7	4.2	5.7	3.8	0.7	0
Preop ASES	29.4	33.6	35.5	38.6	57.2	37.3	6.3	5
Preop Constant	36.2	37.5	38.6	41.4	44.3	39.6	3.1	15
Year of publication	2002	2015	2017	2019	2020	2015	5.2	0
Binary covariates	**Not used**	**Used**						
CT scan	18 (82%)	4 (18%)						
Stemless humerus	21 (95%)	1 (5%)						

Short stem humerus	22 (100%)	0 (0%)						
Standard humerus	3 (14%)	19 (86%)						
All-poly glenoid	3 (14%)	19 (86%)						
Hybrid glenoid	21 (95%)	1 (5%)						
Metal backed glenoid	22 (100%)	0 (0%)						
Augmented glenoid	21 (95%)	1 (5%)						
ASES studies with data on variance of mean (n=43)								
Continuous covariates	**Min**	**1st quartile**	**Median**	**3rd quartile**	**Max**	**Mean**	**SD**	**Missing**
Age (years)	48.4	65.1	66.7	68.4	78.6	66.4	4.6	1
Follow-up (years)	2	2.4	3.5	4.2	10.6	3.8	1.8	0
% male	4	43.4	50	60.2	93	51	15.6	3
Preop SST	2.9	3.3	3.6	4	5.7	3.8	0.7	26
Preop ASES	15.6	30.8	35.5	39.6	57.2	34.8	8.6	0
Preop Constant	18	25	35.1	38.6	44.3	32.5	8	26

Year of publication	2000	2014	2017	2019	2020	2015	4.75	0
Binary covariates	**Not used**	**Used**						
CT scan	33 (77%)	10 (23%)						
Stemless humerus	41 (95%)	2 (5%)						
Short stem humerus	40 (93%)	3 (7%)						
Standard humerus	8 (19%)	35 (81%)						
All-poly glenoid	10 (23%)	33 (77%)						
Hybrid glenoid	41 (95%)	2 (5%)						
Metal backed glenoid	39 (91%)	4 (9%)						
Augmented glenoid	42 (98%)	1 (2%)						

Constant studies with data on variance of mean (n=49)								
Continuous covariates	**Min**	**1st quartile**	**Median**	**3rd quartile**	**Max**	**Mean**	**SD**	**Missing**
Age (years)	50.5	64.3	66.7	68.5	78.6	65.6	4.87	0
Follow-up (years)	2	2.6	4	7	15	5.2	3.3	0
% male	4	27.3	43	54.5	78.8	42.1	17.3	0
Preop SST	3.3	3.6	4	4.6	5.7	4.2	0.9	42
Preop ASES	18.1	30.7	36.9	40.2	46.4	34.5	8.5	32
Preop Constant	14	25.2	29.1	38.3	48.7	31.2	8.1	0
Year of publication	2002	2011	2014	2017	2020	2013	4.2	0
Binary covariates	0	1						
CT scan	28 (57%)	21 (43%)						
Stemless humerus	43 (88%)	6 (12%)						
Short stem humerus	46 (94%)	3 (6%)						

Standard humerus	7 (14%)	42 (86%)						
All-poly glenoid	6 (12%)	43 (88%)						
Hybrid glenoid	49 (100%)	0 (0%)						
Metal backed glenoid	43 (88%)	6 (12%)						
Augmented glenoid	48 (98%)	1 (2%)						