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Resident participation does not affect outcomes or complications after arthroscopic Bankart repair surgery

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Abstract

Purpose: We performed a retrospective cohort study to assess the impact of resident participation on Bankart repair surgical outcomes over a 2-year mean follow-up period, by comparing clinical and patient-reported outcomes (PROs) between surgeries primarily performed by residents in training and those primarily performed by fellowship-trained attending shoulder surgeons. We hypothesised that there would be no difference in outcomes between the two groups.

Methods: All consecutive patients who underwent primary arthroscopic Bankart repair surgery for shoulder instability over a 4-year window in our institution were included. They were divided into two cohorts depending on whether they were performed primarily (>75% of the cases) by residents or attending surgeons. Standard preoperative, intraoperative and post-operative follow-up clinical (rates of recurrent instability and revision surgery) and PRO (Constant–Murley Score, American Shoulder and Elbow Surgeons, Short Form Health Survey-36 and visual analogue scale) data were collected. Data were collected manually and analysed using logistic regression and linear mixed model analysis.

Results: Three hundred twenty patients met the inclusion criteria and were enroled into the present study. The mean age was 25.08 ± 8.43, with 290 males (90.6%). One hundred fifty-three cases (47%) were performed primarily by residents. Operative times were similar with no significant difference ($p = 0.08$). Both cohorts demonstrated significant improvements in both shoulder-specific and global outcomes post-operatively. The stability sub-score of the ASES score was lower in the residents group by a mean of 0.31 points ($p = 0.027$). All the other PROs were not significantly different between the two cohorts. The rate of recurrence was also low, with no significant difference between the two cohorts (5.9% vs 4.8%, $p = 0.903$).

Conclusion: We found that resident involvement in arthroscopic Bankart repair as primary surgeons did not adversely affect recurrence and revision surgery rates as well as PRO measures at 2 years post-operatively, provided they were adequately supervised by attending surgeons.

Abbreviations: ASES, American Shoulder and Elbow Surgeons; MRI, magnetic resonance imaging; PRO, patient-reported outcome; SF-36, short form 36; VAS, visual analogue scale.

Level of Evidence: Level III.

KEYWORDS
arthroscopy, Bankart, residency, shoulder, Trainee

INTRODUCTION

Surgical training has traditionally followed an apprenticeship model, with trainee surgeons learning by observing and then eventually replicating the skills of their attending surgeons over a period of time. Ultimately, trainees will have to reach that final end point of independently operating on patients, which may at first impression appear be at odds with our obligation to patient safety and to provide the best for them. The onus thus lies on the attending surgeons of today to walk that fine line of training while providing a safe service.

Resident participation in surgery is often viewed negatively by the public [4]. A significant proportion of patients in various countries would decline resident participation, let alone allow them to perform the whole surgery [7, 8, 25]. This may arise from concerns that outcomes may be inferior when surgery is performed by doctors in training. A meta-analysis by Singh et al. found no difference in patient outcomes following total hip arthroplasty performed by consultants or residents [22]. A similar conclusion was drawn when residents performed hip fracture surgery [17] or were involved in more complex spine surgery [16]. Specifically with shoulder arthroscopy, resident involvement has been shown not to be associated with short-term risks to patients [3, 9].

The aim of the present study is to allay the concerns of the general public and expand on current literature by conducting a comprehensive analysis of the impact of resident participation in arthroscopic shoulder surgery—in particular Bankart repair surgery—on surgical outcomes at a longer 2-year follow-up period. We hypothesised that arthroscopic Bankart surgeries performed by residents would achieve clinical outcomes comparable to those performed by attending surgeons.

MATERIALS AND METHODS

Study population

This was a retrospective cohort study of prospectively collected data over a 4-year period. Ethical approval was obtained from our local institutional review board prior to the commencement of this study. We looked at all consecutive adult patients (>18 years) who underwent primary arthroscopic Bankart repair surgery for shoulder instability over a 4-year period within a tertiary referral centre teaching hospital. All patients who underwent surgery had persistently symptomatic shoulder instability (more than one dislocation) from soft-tissue or bony Bankart lesions confirmed on magnetic resonance imaging (MRI) despite at least 6 weeks of physiotherapy. Those who were found to have bony lesions underwent additional computed tomography scans to determine their suitability for arthroscopic Bankart repairs. The 'circle of best fit' method was used to determine the extent of glenoid bone loss, and those with glenoid bone loss of more than 17% [21] were deemed to require additional bony reconstructive procedures (e.g., Latarjet–Bristow); these patients were excluded from the study. Patients who underwent revision surgery or required concomitant rotator cuff or biceps tendon surgery were also excluded.

All patients were under the care of fellowship-trained specialist shoulder surgeons who were scrubbed in for all cases. In some cases, surgeons were assisted by orthopaedic surgery trainees (residents), who may assume the role of primary surgeon once the surgeon-in-charge assesses them to be ready for that role. These trainees are at a minimum in their third year of a 6-year training programme. All trainees have had dedicated exposure to the surgical and arthroscopic anatomy of the shoulder through focused teaching, and have attended basic cadaveric shoulder arthroscopy courses. Patients were divided into two cohorts based on whether the primary surgeon was a specialist surgeon (attending) or a trainee (resident). To be considered the primary surgeon (i.e., all cases in the 'resident' group) the trainees had to have performed 75% or more of the procedure, that is, at the minimum the resident must have established the arthroscopic portals, completed the diagnostic arthroscopy including assessment of the extent of the labral tear, mobilised and prepared the labrum and glenoid for repair, as well as inserted at least one of the suture anchors. If any of the above steps needed to be revised or repeated by the attending surgeon, then the case was no longer considered a 'resident' case. The decision to allow the trainee to proceed through the various stages of the procedure, from insertion of the arthroscope, was at the discretion of the supervising attending surgeon in each case and was not predetermined. All surgical decisions in all cases were made by the attending surgeon.

Surgical technique

All surgeries involved a single working portal arthroscopic Bankart repair technique [14] under general anaesthesia in the beach chair position. Arthrex Pushlock knotless

2.9 mm suture anchors (Arthrex) with fibrewire sutures were used for repair. The repair was performed using three or more knotless suture anchors depending on the extent of the tear. An additional Remplissage procedure was performed as previously described using a double-pulley technique with two Arthrex SutureTak 2.4 mm suture anchors (Arthrex) for off-track Hill–Sachs lesions [23]. Off-track Hill–Sachs lesions were assessed on pre-operative MRI scans [10], and the decision for this additional Remplissage was made by the attending surgeon pre-operatively.

Post-operatively, a simple arm sling was applied keeping the affected shoulder in internal rotation. Patients were advised to wear it for 3 weeks before the commencement of physiotherapy for range of motion and strengthening exercises. Sports were permitted after the normal range of motion and strength were achieved.

Data collection

The data collected for our study included basic patient demographics and relevant information related to the surgeries performed, including surgical duration. Post-operative complications, including nerve injury or infection, were recorded. The incidence of recurrent instability was assessed clinically during the post-operative follow-up visits in addition to the need for revision surgery. Patient-reported outcome (PRO) measures were collected pre-operatively, and at 6 months, 1 and 2 years post-operatively by independent assessors who were blinded to the primary surgeon. These PROs include the Constant–Murley Score, the American Shoulder and Elbow Surgeons (ASES) score, the Short Form Health Survey-36 (SF-36) and the visual analogue scale (VAS).

Statistical analysis

All analyses were performed using SPSS for Windows version 29.0 (SPSS Inc.). Continuous variables were presented as means with standard deviations, while categorical variables were presented as frequencies and percentages. Differences in numerical variables were assessed using a two-sample *t* test when normality and homogeneity assumptions were satisfied; otherwise, the Mann–Whitney *U* test was used. Chi-square or Fisher's exact test was used for categorical variables. The primary outcome measure for this study was the rate of recurrent instability. Secondary outcome measures were post-operative PRO scores. Rates of recurrent instability after arthroscopic Bankart repair in the current literature range from 13.7% [1] to 31.2% [13]. Assuming the above difference in rates of recurrent instability between the two groups, we calculated a required sample size of 88 patients per cohort. Logistic regression was performed on recurrence rate, while linear mixed model analysis was performed on each repeated measure of the PRO scores, adjusting for demographics and relevant covariates. Statistical significance was set at two-sided $p < 0.05$.

RESULTS

Three hundred and twenty patients met the inclusion criteria and were enrolled in our present study. At the time of surgery, the mean age was 29.4 ± 8.45. There were 290 males (90.6%) and 30 females (9.4%). Further epidemiological data are collated in Table 1. Both patient cohorts were similar in terms of baseline characteristics.

One hundred and fifty-three cases (47.8%) were performed primarily by residents, while 167 cases were

TABLE 1 Baseline characteristics of the patient cohort.

	Total	Resident	Attending	*p*
Gender (male/female)	290/30	142/11	148/19	0.20
Age, years (mean ± SD)	29.4 ± 8.5	28.6 ± 7.5	30.1 ± 9.3	0.23
Height, cm (mean ± SD)	172.2 ± 7.9	172.1 ± 7.6	172.2 ± 8.2	0.80
Weight, kg (mean ± SD)	73.6 ± 15.4	73.7 ± 15.2	74.3 ± 15.5	0.32
BMI, kg/m^2 (mean ± SD)	25.01 ± 4.76	24.79 ± 4.55	25.20 ± 4.94	0.55
Smoker (*n* (%))	50 (15.6)	23 (15)	27 (16.2)	0.78
Injured side (right/left)	212/108	97/56	115/52	0.40
Dominant arm injury (*n* (%))	176 (55)	87 (56.9)	89 (53.3)	0.58
Hill–Sachs lesions	258	126	132	0.61

Abbreviations: BMI, body mass index; SD, standard deviation.

TABLE 2 Operative details of the patient cohort.

	Total	Resident	Attending	*p*
Hill–Sachs remplissage procedures	15	4	11	0.09
Operative time, min (mean ± SD)	52.8 ± 19.9	52.6 ± 19.4	51.1 ± 18.9	0.08
Follow-up duration, months (mean ± SD)	26.6 ± 19.6	24.8 ± 4.6	28.9 ± 19.4	*0.03*

Note: Italicized values indicate statistical significance at $p < 0.05$.
Abbreviation: SD, standard deviation.

TABLE 3 Post-operative complications.

	Total	Resident	Attending	*p*
Recurrences (*n* (%))	17 (5.3)	9 (5.9)	8 (4.8)	0.44
–Mean time to recurrence, days (mean ± SD)	822.3 ± 485.6	863.5 ± 441.0	781.0 ± 554.1	0.75
–Cause (traumatic/atraumatic)	9/8	4/5	5/3	0.36
Revision surgeries	3	0	3	0.25

Abbreviation: SD, standard deviation.

TABLE 4 Repeated measures analysis for the Constant–Murley Shoulder Score.

Variables	Mean difference (95% CI)[a]	*p*[a]
Group		
Resident	−0.24 (−3.22 to 2.74)	0.876
Attending	-	-
Time point		
6 months	2.28 (−0.94 to 5.50)	0.165
1 year	5.76 (2.23–9.30)	*0.001*
2 years	6.33 (0.45–12.20)	*0.035*
Preop	-	-

Note: Italicized values indicate statistical significance at $p < 0.05$.
Abbreviation: CI, confidence interval.
[a]Adjusted for hand dominance, smoking status, gender, race and age.

TABLE 5 Repeated measures analysis for the total functional component of the Association of Shoulder and Elbow Surgeons Score.

Variables	Mean difference (95% CI)[a]	*p*[a]
Group		
Resident	−0.37 (−2.23 to 1.49)	0.698
Attending	-	-
Time point		
6 months	6.32 (4.43–8.22)	*<0.001*
1 year	10.71 (8.61–12.80)	*<0.001*
2 years	11.97 (8.46–15.47)	*<0.001*
Preop	-	-

Note: Italicized values indicate statistical significance at $p < 0.05$.
Abbreviation: CI, confidence interval.
[a]Adjusted for hand dominance, smoking status, gender, race and age.

performed by the senior surgeons (50.2%). The injured shoulder was more commonly the right shoulder (66.3%).

The Remplissage procedure for an off-track Hill–Sachs lesion was carried out more frequently by the attendings, although the difference was not significant likely due to the small numbers. The operative times were also similar (Table 2).

No post-operative nerve injuries or infections occurred in this cohort of patients. The early post-operative stiffness that was noted in all cases resolved within 4 months. Overall, the recurrent dislocation rate was statistically similar in both cohorts (5.9% vs. 4.8%, $p = 0.903$) and was low overall at 5.3%. Of these, 44.4% and 62.5% of the recurrent dislocations in the residents and attendings cohorts were from traumatic events, respectively. Three of the 17 recurrent dislocations required revision surgery (Table 3). The mean time to recurrence was also not statistically different in both groups (28.4 vs. 25.7 months, $p = 0.75$).

Patients in both cohorts demonstrated significant improvements in both shoulder-specific and global outcomes post-operatively (Tables 4–12). VAS scores improved significantly post-operatively at 6 months compared to pre-operatively in both the resident and the attending groups. The attendings cohort had a significantly higher ASES total stability score than the residents cohort post-operatively (Table 7). There were no statistically significant differences between the two cohorts for all the other PROs (Tables 4–6 and 8–12).

TABLE 6 Repeated measures analysis for the total strength component of the Association of Shoulder and Elbow Surgeons Score.

Variables	Mean difference (95% CI)[a]	p[a]
Group		
Resident	0.08 (−0.38 to 0.53)	0.742
Attending	-	-
Time point		
6 months	0.45 (−0.06 to 0.95)	0.082
1 year	0.80 (0.23–1.36)	*0.006*
2 years	1.26 (0.34–2.17)	*0.007*
Preop	-	-

Note: Italicized values indicate statistical significance at $p < 0.05$.
Abbreviation: CI, confidence interval.
[a]Adjusted for hand dominance, smoking status, gender, race and age.

TABLE 7 Repeated measures analysis for the total stability component of the Association of Shoulder and Elbow Surgeons Score.

Variables	Mean difference (95% CI)[a]	p[a]
Group		
Resident	−0.31 (−0.58 to −0.035)	*0.027*
Attending	-	-
Time point		
6 months	1.32 (1.01–1.62)	*<0.001*
1 year	1.16 (0.82–1.49)	*<0.001*
2 years	1.34 (0.80–1.89)	*<0.001*
Preop	-	-

Note: Italicized values indicate statistical significance at $p < 0.05$.
Abbreviation: CI, confidence interval.
[a]Adjusted for hand dominance, smoking status, gender, race and age.

TABLE 8 Repeated measures analysis for the Total Association of Shoulder and Elbow Surgeons Score.

Variables	Mean difference (95% CI)[a]	p[a]
Group		
Resident	0.73 (−2.08 to 3.53)	0.611
Attending	-	-
Time point		
6 months	9.17 (6.26–12.07)	*<0.001*
1 year	13.13 (9.93–16.34)	*<0.001*
2 years	15.44 (10.10–20.78)	*<0.001*
Preop	-	-

Note: Italicized values indicate statistical significance at $p < 0.05$.
Abbreviation: CI, confidence interval.
[a]Adjusted for hand dominance, smoking status, gender, race and age.

TABLE 9 Repeated measures analysis for the Short-Form 36 Physical Component Summary score.

Variables	Mean difference (95% CI)[a]	p[a]
Group		
Resident	−0.39 (−1.68 to 0.90)	0.548
Attending	-	-
Time point		
6 months	4.59 (3.26–5.91)	*<0.001*
1 year	7.24 (5.77–8.70)	*<0.001*
2 years	6.69 (4.26–9.13)	*<0.001*
Preop	-	-

Note: Italicized values indicate statistical significance at $p < 0.05$.
Abbreviation: CI, confidence interval.
[a]Adjusted for hand dominance, smoking status, gender, race and age.

TABLE 10 Repeated measures analysis for the Short-Form 36 Mental Component Summary score.

Variables	Mean difference (95% CI)[a]	p[a]
Group		
Resident	−0.41 (−2.00 to 1.19)	0.617
Attending	-	-
Time point		
6 months	2.22 (0.51–3.93)	*0.011*
1 year	2.84 (0.96–4.72)	*0.003*
2 years	3.90 (0.78–7.02)	*0.015*
Preop	-	-

Note: Italicized values indicate statistical significance at $p < 0.05$.
Abbreviation: CI, confidence interval.
[a]Adjusted for hand dominance, smoking status, gender, race and age.

TABLE 11 Repeated measures analysis for the visual analogue scale for pain.

Variables	Mean difference (95% CI)[a]	p[a]
Group		
Resident	−2.10 (−6.76 to 2.57)	0.378
Attending	-	-
Time point		
6 months	−11.10 (−16.84 to −5.36)	*<0.001*
1 year	−10.11 (−15.27 to −4.94)	*<0.001*
2 years	−2.89 (−10.86 to 5.09)	0.477
Preop	-	-

Note: Italicized values indicate statistical significance at $p < 0.05$.
Abbreviation: CI, confidence interval.
[a]Adjusted for hand dominance, smoking status, gender, race and age.

TABLE 12 Logistic regression analysis for recurrence rates.

Variables	No recurrence	Recurrence	OR (95% CI)[a]	p[a]
Group				
Resident	144 (94.1%)	9 (5.9%)	1.1 (0.4–3.0)	0.903
Attending	159 (95.2%)	8 (4.8%)	1.0	

Abbreviations: CI, confidence interval; OR, odds ratio.

[a]Adjusted for hand dominance, smoking status, gender, race and age.

Revision rates were also similar between the two cohorts ($p = 0.25$). No significant interaction effect was found for all the reported outcomes, indicating that any group effect did not vary over time.

DISCUSSION

Our study found that resident participation in arthroscopic Bankart repair surgery as primary surgeons did not adversely affect clinical outcomes at a mean follow-up period of 2 years, with the caveat that they were adequately supervised by an attending surgeon. There were no nerve injuries or infections in either group. There was no significant difference in the rates of recurrent instability or rates of revision surgery when trainees performed the surgery supervised by their attendings compared to those performed by the attendings themselves. Our overall recurrence rate was 5.3% at a mean follow-up duration of 27 months, with only 2.5% of the entire cohort suffering atraumatic redislocations—these may thus be considered true failures of the first surgery. This is slightly lower than the current rate in the literature, which is at least 15% [26]. This may be attributable to an insufficient follow-up duration, with a recent study recommending a minimum of 4 years follow-up in order to more accurately ascertain the true recurrence rate—the patients in that study were followed for 10.5 years [18]. We found such a follow-up protocol impractical and not likely to be useful for the majority of our patients who were casual sportsmen. An alternative potential explanation is differing levels of resident participation in our cohort, although this is hard to qualify given the arbitrary 75% employed in our study. In the same vein, even if the attending surgeons performed the minority of the surgeries in the residents group, this may still be sufficient to mask any potential differences in outcomes if these were the 'critical' components of the surgery.

The career of any given surgeon is finite, and the training of subsequent generations of surgeons is an inherently crucial part of keeping any healthcare system sustainable [19]. For surgeons in training, hands-on experience is particularly important, and can only partially be substituted by simulation training [18]. Attending surgeons must thus maintain a delicate balance of allowing resident participation in surgeries while ensuring it does not affect patient outcomes.

Interestingly, there were also no statistically significant differences in the surgical time taken to perform the surgery in both groups, suggesting that the presence of an attending ensures the timely progress of the surgery. Other studies have also come to the same conclusion [3, 9]. The current literature studying the effect of resident involvement on operative times is mixed [2, 5, 24], with many studies finding at most a modest increase in surgical times when residents were involved [2]. This latter study looked at non-arthroscopic surgical procedures, which may not be directly applicable to specific procedures like arthroscopic shoulder surgery. All the revisions occurred in patients in the attending group, although this did not reach statistical significance. There may be several explanations for the above two findings. The first may be the possible increased complexity of cases in the attending group—it is likely for attending surgeons to take over when the resident encounters insurmountable difficulty or assesses the case to be beyond the capacity of the resident. These nuanced differences in complexity are difficult to quantify objectively. They are thus not reflected in our data collection. However, there is some evidence for this in the increased numbers of arthroscopic Remplissage procedures in the attending group, which may account for the similar operative times. Additionally, even patients in whom residents were listed as assistants are still afforded a variable degree of hands-on opportunities—the time spent allowing the residents these opportunities in these cases would also increase the operative time for patients in the attending group. A more accurate comparison would require residents not to participate in the attending surgeon cohort and vice versa—this is, in practice, logistically impractical to achieve, given that most surgeons at our centre operate with residents as assistants.

The literature surrounding the impact of resident participation in surgery is largely supportive, with many papers finding in favour of the current apprenticeship model of surgical training [3, 9]. There is a possibility of some publication bias in this regard, but large-scale studies have not found any significant detrimental effect with resident participation in surgery, both overall [5, 12] and specifically with orthopaedic surgery procedures [6, 20]. Even with shoulder arthroscopy specifically, studies have shown that resident participation has no adverse effect on patient outcomes at least in the short term [3, 9, 11]. In their reviews of a national registry of over 15,000 patients, Basques et al. [3] and Gulbrandsen et al. [9] independently found that resident participation in arthroscopic shoulder surgery was not associated with an increased risk of medical complications or wound infections. Readmission rates within 30 days also did not increase. Jovan et al. [11] also looked at their national database specifically for shoulder stabilisation procedures, again finding that in nearly 4000 patients, resident involvement in surgery was not associated with an increased risk of 30-day post-operative complications. These studies, however, are limited to the first 30 days following surgery, where revision surgery following Bankart surgery is highly unlikely.

Our study, with a mean follow-up duration of over 2 years, further lends support to the body of evidence for resident participation in surgeries. It is the first to report on their effect on clinical outcomes. We found that patient outcomes after arthroscopic Bankart repairs generally do not worsen with resident involvement in surgery. The constant shoulder score, overall ASES and SF-36 scores showed no major differences between the two groups over the 2-year period. The total stability component of the ASES score in the residents group was 0.31 lower than in the attendings group ($p = 0.027$). To our knowledge, there has not been any report of the minimal clinically important difference (MCID) for the ASES stability sub-score, so it remains uncertain whether this difference is clinically significant. The total ASES scores met the published MCID post-operatively [15].

LIMITATIONS

Our study is not without its limitations. The overall mean follow-up duration for the cohort of just over 2 years is slightly short, as previously discussed; despite a significant proportion of recurrences occurring within the first 2 years, longer-term follow-up would help further solidify our conclusion. The slightly longer rates of follow-up in the attending surgeon group may impact direct comparisons of recurrence rates. Our determination of recurrent instability was based upon the history presented to us by patients, correlated with physical examination. MRI confirmation of a recurrent labral tear was only obtained if significant instability persisted, requiring revision surgery, which fortunately occurred in only three patients in our cohort during the study period. Finally, despite our attempts to further delineate the impact of resident participation by including only cases in which residents were listed as primary surgeons, this classification of resident involvement remains a subjective one, and there is no way to standardise the exact degree of involvement in each surgery. We have considered cases to be performed by residents only if they performed the majority of the procedure, but further clarity would be gained by comparing cases performed exclusively by residents against those performed exclusively by attendings. We did not collect data on the number of cases previously performed by the trainees prior to performing them as primary surgeons, and were thus unable to correlate these to clinical outcomes.

CONCLUSIONS

We conclude that orthopaedic surgery resident involvement in arthroscopic Bankart repair surgery as the primary surgeon did not adversely affect recurrence and revision surgery rates as well as PRO measures at 2 years post-operatively, provided they were adequately supervised by attendings.

AUTHOR CONTRIBUTIONS

Alex Quok An Teo, Hoi Pong Nicholas Wong, Sherlyn Yen Yu Tham, Zavier Yongxuan Lim, Fucai Han and Veerasingam Prem Kumar were involved in the conceptualization, methodology and design of the study protocol. Alex Quok An Teo and Sherlyn Yen Yu Tham performed the data collection. Hoi Pong Nicholas Wong, Zavier Yongxuan Lim and Qai Ven Yap performed the data analysis. Hoi Pong Nicholas Wong wrote the initial draft. Senior authors Alex Quok An Teo, Fucai Han and Veerasingam Prem Kumar critically reviewed the different versions of the draft and suggested improvements. All authors approved the submitted and final version of the manuscript.

CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

All relevant data generated or analysed during the study are included in the published paper. The data sets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

ETHICS STATEMENT

Ethics approval was obtained from our institution's institutional review board (IRB).

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