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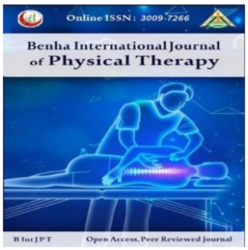

Original research

Relation between Shoulder Lateral Rotators Strength and Hand Grip Strength after Arthroscopic Bankart Repair.

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Abstract

Background: Anterior shoulder instability is common in young, active individuals, with arthroscopic Bankart repair frequently performed to restore stability. Full upper limb function relies on coordinated kinetic chain activity, with hand grip strength (HGS) serving as a simple indicator of overall upper limb strength. Lateral rotators strength (LRS), primarily from the infraspinatus and teres minor, is key for glenohumeral stability. While HGS correlates with shoulder function in various groups, its specific relationship with LRS post-Bankart repair remains unclear. **Purpose:** To investigate the correlation between shoulder LRS and HGS at different shoulder abduction angles after arthroscopic Bankart repair surgery. **Methods:** A cross-sectional study was conducted on 15 patients (mean age 27.67 ± 6.72 years) at least six months post-arthroscopic Bankart repair. Isometric LRS and HGS were measured on both surgical and non-surgical sides at 0°, 90°, and 90° abduction with 70° external rotation using handheld and Jamar dynamometers. Pearson correlation analysis was used ($P < 0.05$). **Results:** Significant differences were observed between surgical and non-surgical limbs in HGS and LRS at 90° abduction and 90° abduction with 70° external rotation ($P < 0.05$), but not at 0°. A significant positive correlation between HGS and LRS was found across all positions on the surgical side ($r = 0.573$–0.677, $P < 0.05$). **Conclusion:** A strong positive correlation exists between HGS and LRS post-Bankart repair, supporting their functional linkage. HGS may serve as a practical tool for monitoring shoulder rehabilitation.

Keywords: Arthroscopic Bankart repair, Correlation, Hand grip strength, Lateral rotators strength.

INTRODUCTION:

Anterior shoulder instability represents a clinically significant challenge, particularly among athletic populations where its prevalence is disproportionately high [1]. It commonly arises from a posteriorly directed force applied to a shoulder positioned in flexion, abduction, and external rotation. This injury mechanism compromises key stabilizing structures, including the subscapularis muscle, the long head of the biceps tendon, and the glenohumeral (GH) ligaments—most prominently the anterior band of the inferior GH ligament [2].

This structural compromise frequently manifests as Bankart lesions, involving the anterior-inferior glenoid labrum and joint capsule, which are commonly observed in cases of traumatic anterior instability [3]. Arthroscopic Bankart repair is the prevailing surgical technique for restoring joint congruency and structural integrity [4]. Despite its efficacy in reducing recurrence and improving functional outcomes, postsurgical recovery entails multidimensional changes in neuromuscular function and control [5].

Postoperative rehabilitation focuses on regaining joint mobility, muscular strength, and proprioceptive acuity [6]. Among the rotator cuff muscles, the external rotators (ER) play a pivotal role in maintaining dynamic shoulder stability and functional integrity following Bankart repair. However, deficits in ER strength are frequently observed after surgery and may compromise optimal shoulder performance [7].

Emerging evidence points to a kinetic chain relationship between rotator cuff activity and upper limb function, particularly hand grip strength (HGS) [8]. Studies suggest that rotator cuff activation may influence HGS through shared neuromuscular pathways or biomechanical linkages within the kinetic chain [9,10]. Nevertheless, the direct association between shoulder lateral rotator strength (LRS) and HGS in individuals post–arthroscopic Bankart repair remains unexplored in current literature.

Understanding this relationship holds valuable clinical implications .If a correlation is established, simple HGS assessments could serve as surrogate markers of rotator cuff integrity and recovery following surgery. This may contribute to the development of more individualized and effective rehabilitation strategies.

Therefore, the primary objective of this study was to investigate the correlation between the isometric shoulder LRS —assessed across varying degrees of shoulder abduction and external rotation— and the isometric HGS in individuals following arthroscopic Bankart repair.

We hypothesized that there would be a significant positive correlation between LRS and HGS measurements on the surgically repaired side.

METHODS

Study design:

This study employed a cross-sectional correlational design.

Subjects:

Patients were recruited postoperatively from Mansoura International Hospital (MIH). The current study was conducted at the outpatient physiotherapy unit of the hospital between September 2024 and April 2025. Sample size was calculated using G*Power software (version 3.1), which indicated that a minimum of 15 participants was required to achieve sufficient power to detect medium effect size correlations. Inclusion criteria were: (1) history of traumatic anterior shoulder dislocation treated with arthroscopic Bankart repair, (2) male patients aged between 18 and 40 years [11], (3) completion of a post-operative rehabilitation program for at least 6 months[12], (4) full passive shoulder range of motion [8], and (5) ability to understand and follow instructions. While exclusion criteria were: (1) history of neurological disorders affecting the upper limb, (2) previous surgery on the same or contralateral upper limb, (3) rotator cuff tears or other significant shoulder pathologies, (4) bilateral shoulder instability, and (5) inability to complete measurement due to pain [8] (reported as >3/10 on a Numerical Pain Rating Scale during testing). Ethical approval was obtained from the Institutional Review Board (IRB) of the faculty of physical therapy, Cairo University (Approval Number: PT.REC/012/005367). The study was also registered at the ClinicalTrials.gov (Registration Number: NCT07099781).

Instrumentation

- Lateral Rotator Strength (LRS): Isometric LRS was measured using a Lafayette® manual muscle test system hand-held dynamometer (HHD) (Model 01165, Lafayette Instrument Company™, USA), calibrated according to manufacturer guidelines. HHDs have demonstrated reliability in measuring shoulder strength [13].
- Hand Grip Strength (HGS): Isometric HGS was measured using a Jamar® Hydraulic

Hand Dynamometer (Model 5030J1, Patterson Medical™, USA), set to the second handle position as recommended. This device is considered the gold standard for HGS measurement [14].

Procedures

Demographic data including age, sex, body mass index (BMI), dominant hand, surgical side, and time since surgery were collected.

Strength testing was performed bilaterally, starting with the non-surgical side. Shoulder lateral rotator strength (LRS) and hand grip strength (HGS) were assessed isometrically in three standardized shoulder positions:

- **Position 1:** Shoulder in 0° abduction, elbow flexed to 90°, with neutral forearm rotation [8].
- **Position 2:** Shoulder abducted to 90°, elbow flexed to 90°, neutral forearm rotation [8].
- **Position 3:** Shoulder abducted to 90°, externally rotated to 70°, and elbow flexed to 90° [10].

Although the same shoulder angles were used for both tests, patient positioning differed. LRS was measured in the supine position using a hand-held dynamometer (HHD) facilitating optimal scapular stabilization and reducing compensatory movement [13]. HGS was assessed in the seated position using a Jamar hand grip dynamometer (HGD). This procedure adhered to the standardized protocol recommended by American Society of Hand Therapists (ASHT) guidelines ensuring reduced compensatory movements [10].

For each measurement, participants maintained a maximal isometric contraction for 5 seconds. Three trials were conducted in each position, and the mean of the three trials was recorded. A 60-second rest was provided between repetitions to prevent fatigue [8]. Testing order of positions was randomized for each participant to minimize bias. Standardized verbal instructions and encouragement were provided throughout.

Figures 1 illustrates HGS testing positions using the HGD, and **Figures 2** shows LRS testing with the HHD in the same shoulder positions.

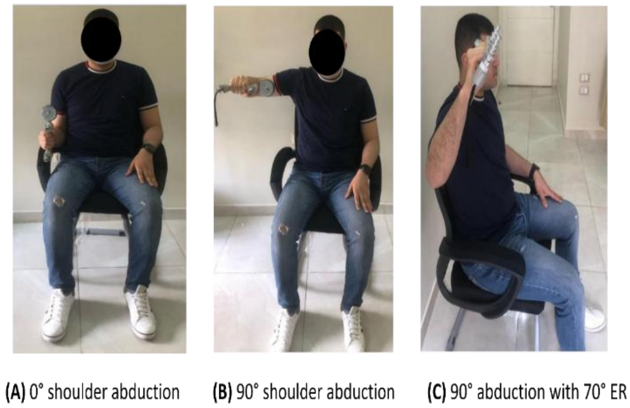

Figure 1: HGS testing positions using hand grip dynamometer

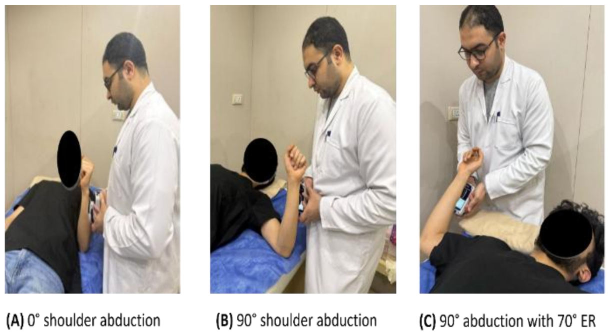

Figure 2: LRS testing positions using handheld dynamometer

Statistical analysis

Statistical analysis was conducted using SPSS for Windows, version 26 (SPSS, Inc., Chicago, IL). Before final analysis, data were screened for normality assumption using Shapiro-Wilk test and Kolmogorov-Smirnov test, homogeneity of variance, and presence of extreme scores. This analysis was done as a pre-requisite for parametric testing of the analysis of differences with p-value > 0.05. Descriptive statistics are expressed as mean ± SD for the general demographic data of the participants (age and BMI) in addition to all dependent variables. A normality test was performed by Shapiro-Wilk and Kolmogorov-Smirnova. Pearson rank correlation test was used to correlate between shoulder external rotator strength and hand grip strength in post-surgical Bankart repair patients. Values of (r) ranged from 0 (no correlation), 0~0.2 (very low and probably meaningless), 0.2~0.4 (a low correlation that might warrant further investigation), 0.4~0.6 (a reasonable correlation), 0.6-0.8 (a high correlation) and 0.8-1 (a very high correlation). A paired sample t-test was used to compare HGS and ERS between surgical and non-surgical sides.

RESULTS

The sample size of this research was 15 participants. age and BMI were 27.67±6.72 years, and 26.46±4.5Kg/m2 respectively. The time since surgery was 9.07±2.4. The dominant distribution revealed that there were 12 Rt side with a reported percentage of 80% while the Lt side was 3 with a reported percentage of 20%. The surgical side distribution revealed that there were 6 Rt side with a reported percentage of 40% while the Lt side was 9 with a reported percentage of 60%.

Correlation between HGS (0° Abd) and ERS Surgical

The Pearson correlation test revealed that there was a significant high correlation between the HGS (0° Abd) and the ERS (0° Abd) Surgical side (r = 0.627, p = 0.012). Also, there was a significantly high correlation between the HGS (0° Abd) and the ERS (90° Abd) Surgical side (r = 0.674, p = 0.006). Moreover, there was a significantly high correlation between the HGS (0° Abd) and the ERS (90° Abd, 70° ER) Surgical side (r = 0.606, p = 0.017) as shown in **(Table 1).**

Correlation between HGS (90° Abd) and ERS Surgical

The Pearson correlation test revealed that there was a significant high correlation between the HGS (90° Abd) and the ERS (0° Abd) Surgical side (r = 0.622, p = 0.013). Also, there was a significantly high correlation between the HGS (90° Abd) and the ERS (90° Abd) Surgical side (r = 0.657, p = 0.008). Moreover, there was a significantly high correlation between the HGS (90° Abd) and the ERS (90° Abd, 70° ER) Surgical side (r = 0.645, p = 0.009) as shown in **(Table 1).**

Correlation between HGS (90° Abd, 70° ER) and ERS Surgical

The Pearson correlation test revealed that there was a significant reasonable correlation between the HGS (90° Abd, 70° ER) and the ERS (0° Abd) Surgical side (r = 0.573, p = 0.026). Also, there was a significantly high correlation between the HGS (90° Abd, 70° ER) and the ERS (90° Abd) Surgical side (r = 0.677, p = 0.006). Moreover, there was a significantly high correlation between the HGS (90° Abd, 70° ER) and the ERS (90° Abd, 70° ER) Surgical side (r = 0.613, p = 0.015) as shown in **(Table 1).**

Table 1: Correlations between HGS and ERS at Different Shoulder Positions on the Surgical Side

HGS Position	ERS Position	Pearson r	p-value
0° Abd	0° Abd Surgical	0.627	0.012
0° Abd	90° Abd Surgical	0.674	0.006
0° Abd	90° Abd, 70° ER Surgical	0.606	0.017
90° Abd	0° Abd Surgical	0.622	0.013
90° Abd	90° Abd Surgical	0.657	0.008
90° Abd	90° Abd, 70° ER Surgical	0.645	0.009
90° Abd, 70° ER	0° Abd Surgical	0.573	0.026
90° Abd, 70° ER	90° Abd Surgical	0.677	0.006
90° Abd, 70° ER	90° Abd, 70° ER Surgical	0.613	0.015

The Comparison Between Surgical Sides for All Dependent Variables

A paired sample t-test was performed to test the significant differences between the surgical and non-surgical sides for HGS and ERS. The results revealed significant differences between both sides for HGS and ERS at both 90° Abd and 90° Abd, 70° ER ($p < 0.05$). On the other hand, no significant differences were observed between both sides for HGS and ERS at 0° Abd as shown in **(Table 2).**

Table 2: The comparison between surgical and non-surgical sides for HGS and ERS

Paired Samples Test								
	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
HGS (0° Abd)	-1.58	4.24	1.09	-3.92	0.77	-1.440	14	0.172
HGS (90° Abd)	-2.58	4.16	1.07	-4.88	-0.27	-2.398	14	0.031*
HGS (90° Abd, 70° ER)	-1.87	3.21	0.82	-3.64	-0.09	-2.256	14	0.041*
ERS (0° Abd)	-0.79	1.86	0.48	-1.82	0.24	-1.641	14	0.123
ERS (90° Abd)	-1.64	1.92	0.49	-2.70	-0.57	-3.301	14	0.005*
ERS (90° Abd, 70° ER)	-1.34	2.13	0.54	-2.51	-0.16	-2.438	14	0.029*

DISCUSSION

The present study aimed to explore the association between HGS and shoulder LRS in individuals after at least six months post-arthroscopic Bankart repair. The principal finding revealed a significant positive correlation between isometric LRS and isometric HGS across multiple shoulder positions on the surgically treated side. Notably, this association persisted irrespective of whether the measurements were obtained in identical or differing shoulder configurations.

The present findings are consistent with emerging evidence suggesting a functional interdependence between rotator cuff activation and distal limb strength [9,10]. The observed correlations imply that neuromuscular pathways contributing to shoulder external rotation may also influence hand grip force, even beyond six months of surgical stabilization for anterior shoulder instability. Several mechanisms may underlie this relationship, including neural irradiation and co-contraction phenomena [15], shared central motor drive [16], or biomechanical coupling through the kinetic chain — whereby proximal stabilization from the rotator cuff enhances distal force output.[17].

Consistent with current findings, earlier research has identified a link between rotator cuff strength and HGS in both asymptomatic individuals and those with atraumatic shoulder instability [8,10]. The present study specifically focuses on individuals following arthroscopic Bankart repair, who often experience neuromuscular impairments despite successful anatomical correction [5]. The persistence of the LRS-HGS correlation across multiple shoulder positions, particularly those imposing higher stabilization demands, highlights the integrative coordination between proximal shoulder musculature and distal hand function during dynamic tasks.

These findings carry important clinical relevance, particularly given that HGS assessment is a rapid, reliable, and straightforward procedure using standardized dynamometry [18]. If a consistent correlation with LRS is established post–Bankart repair, HGS could function as a practical surrogate marker of rotator cuff neuromuscular status during rehabilitation [8]. While HGS cannot replace direct LRS measurement for diagnostic purposes or specific strength training prescription, it could potentially supplement clinical assessment by providing a broader indication of upper limb neuromuscular recovery and functional readiness [19].

The current study has few limitations; Firstly, the cross-sectional design precludes establishing causality. Secondly, the small sample size might limit generalizability. We measured isometric strength in specific static positions, which may not fully reflect dynamic functional activities. Furthermore, factors like specific surgical technique variations, rehabilitation protocol details beyond basic completion, and individual neuromuscular adaptations could influence the observed relationship.

Future research should recognize this relationship longitudinally to follow changes during rehabilitation and determine if HGS changes parallel with LRS recovery. Investigating the underlying mechanisms through electromyography (EMG) studies could clarify the nature of the neuromuscular integration. Additionally, examining these correlations in different patient populations and during dynamic activities would enhance understanding of underlying mechanism and pathology.

CONCLUSION

In conclusion, this study demonstrates a significant positive correlation between shoulder lateral rotator strength and hand grip strength in individuals following arthroscopic Bankart repair. This finding highlights the functional interdependence within the upper limb kinetic chain and suggest that HGS assessment may offer supplementary clinical insight into neuromuscular recovery status during rehabilitation.

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Conflict of interest:

There is no conflict of interest.

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