Biomechanical Analysis of Latarjet Screw Fixation: Comparison of Screw Types and Fixation Methods

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Purpose: To compare the initial fixation stability, failure strength, and mode of failure of 5 different screw types and fixation methods commonly used for the classic Latarjet procedure. **Methods:** Thirty-five fresh-frozen cadaveric shoulder specimens were allocated into 5 groups. A 25% anteroinferior glenoid defect was created, and a classic Latarjet coracoid transfer procedure was performed. All grafts were fixed with 2 screws, differing by screw type and/or fixation method. The groups included partially threaded solid 4.0-mm cancellous screws with bicortical fixation, partially threaded solid 4.0-mm cancellous screws with unicortical fixation, fully threaded solid 3.5-mm cortical screws with bicortical fixation, partially threaded cannulated 4.0-mm cancellous screws with bicortical fixation, and partially threaded cannulated 4.0-mm captured screws with bicortical fixation. All screws were stainless steel. Outcomes included cyclic creep and secant stiffness during cyclic loading, as well as load and work to failure during the failure test. Intergroup comparisons were made by a 1-way analysis of variance. **Results:** There were no significant differences among different screw types or fixation methods in cyclic creep or secant stiffness after cyclic loading or in load to failure or work to failure during the failure test.

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This study was performed during the course of 3 fellowship-training years and resulted in the extensive list of authors.

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Post-failure radiographs showed evidence of screw bending in only 1 specimen that underwent the Latarjet procedure with partially threaded solid cancellous screws with bicortical fixation. The mode of failure for all specimens analyzed was screw cutout. **Conclusions:** In this biomechanical study, screw type and fixation method did not significantly influence biomechanical performance in a classic Latarjet procedure. When performing this procedure, surgeons may continue to select the screw type and method of fixation (unicortical or bicortical) based on preference; however, further studies are required to determine the optimal method of treatment. **Clinical Relevance:** Surgeons may choose the screw type and fixation method based on preference when performing the Latarjet procedure.

In the setting of recurrent shoulder instability, glenoid bone deficiency should be evaluated because the osseous structure of the anterior glenoid is a critical factor that influences surgical outcomes.[1,2] Recurrent anterior shoulder instability with significant glenoid bone loss has high recurrence rates when managed with capsulolabral repair alone.[3-6] The Latarjet procedure has become the gold standard of treatment in the management of anterior glenohumeral instability with significant bone loss.[7-11] The principles of the Latarjet procedure are to transfer the post-osteotomy coracoid process through a split in the subscapularis tendon to the anterior-inferior glenoid neck and to internally fix the graft flush, or slightly recessed, to the glenoid articular surface.[12]

Although the Latarjet coracoid transfer procedure has undergone multiple modifications during the past 50 years, the principles have largely remained unchanged. Several fixation devices using various techniques have been proposed: 1 or 2 metallic screws,[13] interference screws,[14] and plating.[15] Reports of fixation of the coracoid transfer to the glenoid with screws have shown good long-term outcomes and high healing rates.[11,14] However, nonunion and hardware failure have been reported, and revision surgery in this setting is extremely challenging.[16] The more common screw fixation constructs used in the Latarjet procedure include 2 bicortical screws of the following types: fully threaded solid cortical screws, partially threaded solid cancellous screws, and cannulated partially threaded cancellous screws. Solid cortical screws are thought to be the strongest constructs biomechanically. However, partially threaded screws are used to achieve maximum compression, and cannulated screws provide accurate screw placement and prevent migration of bone blocks during screw insertion. Screw selection in the Latarjet procedure has largely been based on surgeon preference, and to our knowledge, there are very few biomechanical studies that have compared the fixation strength of different screw types. Cadaveric studies have shown the risk of suprascapular nerve injury at the posterior exit point during screw insertion in the Latarjet procedure as a result of bicortical fixation.[17,18] Therefore, we also sought to compare the biomechanical strength of unicortical and bicortical fixation to identify a possible alternative to bicortical fixation to minimize this risk of iatrogenic neurologic injury through unicortical screw placement.

The purpose of this cadaveric biomechanical study was to compare the initial fixation stability, failure strength, and mode of failure of 5 different screw types and fixation methods commonly used for the classic Latarjet procedure. The null hypothesis was that there would be no statistically significant differences in construct biomechanical performance among the 5 screw fixation groups.

Methods

An institutional review board—approved exemption was obtained prior to initiation of the study (12020704-IRB01). Thirty-five fresh-frozen cadaveric shoulders were obtained from commercial vendors and approved for use. These included 30 male and 5 female specimens, with 20 right- and 15 left-sided shoulders. The mean age was 54.3 years (range, 35-70 years). The exclusion criteria for the cadaveric specimens included a history of shoulder trauma or shoulder surgery and any radiographic evidence of trauma or degenerative changes in the glenoid based on computed tomography. The demographic characteristics of the cadaveric shoulder specimens are listed in Table 1.

Before specimen preparation, computed tomography scans (BrightSpeed; GE Medical Systems, Fairfield, CT) were obtained and reviewed to ensure specimen quality was satisfactory for testing. Local bone density (BD) of the glenoid was determined with the multiplanar reconstruction tool in a picture archiving and communication system (Opal-RAD PACS; Viztek, Garner, NC), in which the elliptical regions of interest were captured in the subchondral layer of the glenoid by use of the en face sagittal view. The mean Hounsfield units of the regions of interest were calculated and reported (Table 1). Specimens were allocated to 1 of 5 groups based on BD measurements by ensuring the mean BD of each group was not significantly different (confirmed by 1-way analysis of variance [ANOVA] testing) in an attempt to control for BD as a confounding variable influencing biomechanical performance of screws. The groups were also controlled for age. The shoulders were thawed at room temperature overnight before dissection and testing.

Table 1. Demographic Characteristics of Cadaveric Specimens

	Latarjet Screw Group*					
	1	2	3	4	5	*P* Value
Age, yr	55.3 ± 11.3	55.3 ± 11.8	54.6 ± 12.2	49.7 ± 7.5	56.7 ± 9.0	.77
Bone density, HU	247.9 ± 68.6	251.9 ± 33.0	288.3 ± 69.2	296.7 ± 70.1	285.1 ± 72.3	.51
Side						
Right	4	3	4	3	6	
Left	3	4	3	4	1	
Sex						
Male	6	5	7	5	7	
Female	1	2	0	2	0	

NOTE. Data are presented as number of specimens or mean ± standard deviation.

HU, Hounsfield unit.

*Group 1 received partially threaded solid 4.0-mm cancellous screws with bicortical fixation; group 2, fully threaded solid 3.5-mm cortical screws with bicortical fixation; group 3, partially threaded cannulated 4.0-mm cancellous screws with bicortical fixation; group 4, partially threaded solid 4.0-mm cancellous screws with unicortical fixation; and group 5, partially threaded cannulated 4.0-mm captured screws with bicortical fixation.

Surgical Technique

The scapula underwent skeletonization by removing all skin and surrounding soft tissue. All soft tissue was released from the coracoid process, including the conjoined tendon. The coracoid underwent osteotomy at 25 mm from the tip of the coracoid process of each specimen with a 10 × 0.5—mm sagittal saw (Smith & Nephew, Memphis, TN). The concave inferior surface of the coracoid graft was decorticated and flattened with a saw and rasp to create a more flush surface to match the glenoid bone loss site as would be performed during intraoperative graft preparation. Care was taken to maintain each graft thickness at a minimum of 7 mm. Two transverse holes were drilled 10 mm apart with a 2.7-mm drill, centered in the coracoid graft.

Attention was then directed to preparing the glenoid. The labrum was sharply excised from the anterior-inferior aspect of the glenoid. The 10 × 0.5—mm sagittal saw was used to perform the glenoid osteotomy based on preliminary work by Bhatia et al.[19] By use of the percentage of glenoid width bone loss based on a best-fit circle,[20] a defect simulating 25% bone loss was created in the anteroinferior quadrant through a transverse line osteotomy at a 45° inclination to the long axis of the glenoid (Fig 1).

With the classically described Latarjet technique, each coracoid graft was carefully positioned onto the anterior-inferior glenoid defect so that the lateral edge of the graft was flush or slightly recessed (<1 mm) to the anterior-inferior glenoid articular cartilage with the concave side of the coracoid graft against the glenoid bone surface.[9] All screws used in the study were stainless steel. For group 1, partially threaded solid 4.0-mm cancellous screws (Smith & Nephew) were used after drilling bicortically with a 2.7-mm drill. For group 2, fully threaded solid 3.5-mm Peri-Loc self-tapping cortical screws (Smith & Nephew) were placed under interfragmentary compression by the standard lag screw technique by overdrilling the coracoid proximal cortex with a 3.5-mm drill and the distal glenoid cortex with a 2.7-mm drill. For group 3, partially threaded cannulated 4.0-mm cancellous screws (Smith & Nephew) were used after drilling bicortically with a 2.7-mm drill over a 1.3-mm guide pin. For group 4, partially threaded solid 4.0-mm cancellous screws (Smith & Nephew) were used after drilling unicortically with a 2.7-mm drill. A depth gauge was inserted into the drill hole to measure down to the distal cortex for appropriate screw sizing for unicortical placement. The screw was then inserted with care taken not to breach the distal cortex. For group 5, partially threaded cannulated 4.0-mm captured screws (Smith & Nephew) were used after drilling bicortically with a 2.7-mm drill.

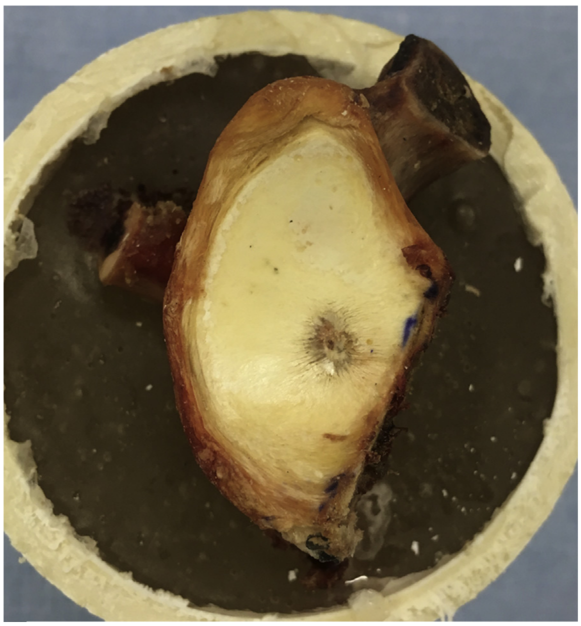

Fig 1. Anteroinferior glenoid defect created in a right-sided glenoid specimen prior to graft fixation.

The name "captured screw" has been inserted to assist readers if they want to look into using this specific type of screw in clinical practice. The captured screw has a locking mechanism between the head of the screw and the screwdriver, which helps to ease screw insertion. This does not influence the overall stability of the construct or strength of the screw. All screws were inserted with a handheld screwdriver until maximum manual compression was achieved. To maximize compression, parallel drill guides were used to keep the screw trajectories parallel to each other, perpendicular to the orientation of the glenoid bone loss, with approximately 15° of angulation compared with the glenoid articular surface, and fixed bicortically or unicortically (group 4 only). The screw placement technique used in this study was similar to that used during graft fixation in the clinical setting.

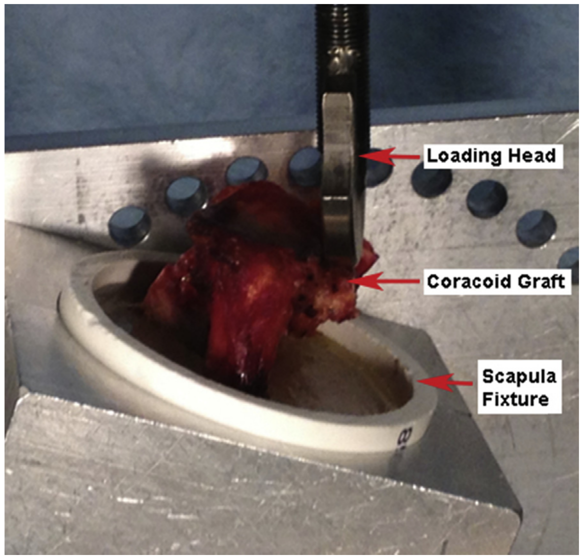

Fig 2. Testing apparatus (MTS Insight 5) and position of the curved loading head during eccentric rim loading in a right-sided specimen with graft fixation.

Testing Conditions

The fixed glenoid specimens were sized for potting by performing an osteotomy on the scapular spine and the superior and inferior aspects of the scapula with care taken not to disrupt the graft fixation. The specimens were then secured in polyvinyl chloride pipes with dental acrylic (Isocryl; Lang Dental, Wheeling, IL) such that the glenoid face was parallel to the potting surface. Biomechanical tests were conducted with a materials testing system (MTS Insight 5; MTS Systems, Eden Prairie, MN). Specimens were placed in 30° of version, with neutral tilt and rotation, and a load was applied directly to the coracoid graft with a custom, stainless steel, 7-mm-wide, rounded loading head (Fig 2). This direction was chosen to replicate anterior-inferior loading as would be expected clinically. The loading head was fabricated such that it mimicked the average radius of curvature of a humeral head (24 ± 1.5 mm) but with a width of only 7 mm so that only the graft was loaded, representing a worst-case scenario. After an initial 1-N preload was applied, the corresponding crosshead position and load were set to zero. Grafts were then cyclically loaded with cantilever bending from 5 to 150 N at a rate of 0.05 mm/s for 100 cycles. After completion of cyclic loading, the crosshead was returned to its position at the onset of cyclic testing. The graft was then monotonically loaded at 0.5 mm/s from the zero position until the crosshead advanced 7 mm, although macroscopic failure was defined as 5 mm of displacement of the graft interface.

For data analysis, the average secant stiffness from the first 5 and final 5 cycles was computed, as was the percentage increase in secant stiffness between the initial and final 5 cycles. Secant stiffness was defined as the slope of the line joining the minimum and maximum points of the loading phase of the force-deformation curve. Creep was defined as the net increase in the valley displacement of cycle 100 relative to the zero position. Maximum cyclic displacement was defined as the peak crosshead displacement at cycle 100. On the basis of previous work by Giles et al.,[21] we chose to predefine failure as occurring when displacement of the graft, at its interface with the glenoid, reached 5 mm relative to its initial position. Therefore, from the monotonic loading portion of the protocol, load at 5 mm of graft interface displacement (relative to the crosshead position at the onset of cyclic loading) was recorded as the primary outcome, whereas work to 5 mm was computed as the area under the load-displacement curve. Linear stiffness was determined as the slope of the line tangent to the load-displacement curve within its linear region. Post-failure radiographs (en face view of glenoid, anteroposterior view, axillary view) of each specimen were obtained after mechanical testing to determine the mode of failure including screw bending, breakage, pullout, or bone deformation.

Outcome Variables and Statistical Analysis

Statistical analysis of the testing results was performed with SPSS Statistics (version 21.0; IBM, Armonk, NY). Shapiro-Wilk testing validated the normality of all outcome variables, and 1-way ANOVA was performed with the Tukey post hoc test for multiple comparisons when applicable. The Pearson correlation test was used to determine the relation between biomechanical outcome variables and BD. Statistical significance was set at $P < .05$. A post hoc power analysis was performed on the primary outcome (load at 5 mm of displacement).

Results

After the completion of biomechanical cyclic and load-to-failure testing, 3 total specimens were excluded from data analysis because of technical difficulties. Two specimens (one each from group 4 and group 5) resulted in large first-cycle displacements (4.7 mm and 2.3 mm, respectively) with screw cutout. This may have been a result of multiple screw tracts placed during preparation. One additional specimen (from group 5) was excluded because of glenoid fracture at the bone-pot interface during failure testing.

Cyclic Loading Test

None of the specimens failed (i.e., displaced >5 mm) during cyclic loading. ANOVA showed that comparison of mean creep during cyclic loading did not show any significant differences among the 5 groups (Table 2). The graft-host construct remained well fixed, and the mean maximum displacement was minimal during cyclic loading. There was no statistically significant difference in maximum displacement with cyclic loading among groups. When we compared the mean secant stiffness increase during the first 5 cycles and last 5 cycles, no statistically significant differences were noted among the 5 groups with regard to initial, final, or percentage increase in secant stiffness during cyclic loading.

Failure Test

All specimens completed the entire cyclic loading protocol and underwent load-to-failure testing. The load to failure at 5 mm of displacement did not show any significant differences among the 5 groups. Work to failure also did not show any significant differences among the 5 groups, and there were no statistical differences among the groups in linear stiffness (Table 3). A post hoc power analysis on the primary outcome (load at 5 mm of displacement) showed that a total sample size of 540 specimens (108 per group) would be needed to achieve 80% power. On the basis of the primary outcome, the statistical power of this study was low (8.6%).

Mode of Failure

Post-failure radiographs showed evidence of screw bending in only 1 specimen, from group 1. In the remaining 31 specimens included in the analysis, the mode of failure was screw cutout without signs of screw deformation.

Correlation Between BD and Biomechanical Variables

When we considered data from all 32 specimens used in the analysis, a statistically significant negative correlation was observed between BD and maximum cyclic displacement, as well as cyclic creep (Table 4). This finding suggested that with higher bone quality based on BD, less displacement of the graft was observed. In addition, significant positive correlations were observed between BD and load to 5 mm, linear stiffness, and work to 5 mm.

Discussion

The principal findings of this biomechanical study suggest that screw type or fixation method does not significantly influence the biomechanical properties of fixation in the classic Latarjet procedure. These findings suggest that surgeons may continue to select screws and fixation methods based on preference without significantly compromising the biomechanical properties of the construct.

Although patient satisfaction rates are high after the Latarjet procedure, complications have been reported.[16] A recent systematic review of 30 studies including 1,658 open Latarjet procedures found a reoperation rate of 5%, recurrent instability rate of 6%, hardware complications in 6.5%, and graft nonunion or migration in 10%.[22] Proper coracoid graft fixation is necessary to accommodate the axial and shear forces present in the glenohumeral joint and avoid fixation failure, which can lead to graft nonunion, migration, hardware complication, or recurrent instability.[5]

Choosing an optimal coracoid transfer fixation construct (screw type and fixation method) may avoid fixation failure and, secondarily, improve clinical outcomes. A recent study by Weppe et al.[14] examined the initial fixation strength after the Latarjet procedure in a

Table 2. Cyclic Biomechanical Testing Results

	Latarjet Screw Group*					
	1	2	3	4	5	*P* Value
Maximum cyclic displacement, mm	2.21 ± 1.56	1.10 ± 0.31	1.55 ± 0.74	1.72 ± 0.65	1.23 ± 0.37	.19
Cyclic creep, mm	1.80 ± 1.46	0.83 ± 0.33	1.24 ± 0.64	1.20 ± 0.51	0.83 ± 0.29	.20
Secant stiffness, N/mm						
First 5 cycles	357.0 ± 178.0	461.2 ± 122.2	455.3 ± 158.2	288.1 ± 117.0	336.1 ± 110.2	.15
Last 5 cycles	421.5 ± 206.1	571.2 ± 149.7	529.1 ± 171.7	321.0 ± 146.8	386.6 ± 99.7	.06
Δ Secant stiffness, %	19.3 ± 10.9	24.7 ± 22.0	17.0 ± 10.3	10.1 ± 11.2	17.4 ± 11.9	.49

NOTE. Data are presented as mean ± standard deviation.

*Group 1 received partially threaded solid 4.0-mm cancellous screws with bicortical fixation; group 2, fully threaded solid 3.5-mm cortical screws with bicortical fixation; group 3, partially threaded cannulated 4.0-mm cancellous screws with bicortical fixation; group 4, partially threaded solid 4.0-mm cancellous screws with unicortical fixation; and group 5, partially threaded cannulated 4.0-mm captured screws with bicortical fixation.

Table 3. Load-to-Failure Biomechanical Testing Results

	Latarjet Screw Group*					
	1	2	3	4	5	*P* Value
Load to 5 mm of displacement, N	498.8 ± 266.5	554.1 ± 163.3	561.9 ± 236.4	513.1 ± 154.8	495.1 ± 114.2	.96
Linear stiffness, N/mm	309.9 ± 169.4	399.9 ± 99.0	387.0 ± 129.6	269.3 ± 129.2	311.5 ± 74.8	.31
Work to 5 mm of displacement, N mm	1,322.2 ± 954.7	1,745.8 ± 476.3	1,589.3 ± 699.8	1,447.0 ± 596.7	1,556.3 ± 382.8	.82

NOTE. Data are presented as mean ± standard deviation.

*Group 1 received partially threaded solid 4.0-mm cancellous screws with bicortical fixation; group 2, fully threaded solid 3.5-mm cortical screws with bicortical fixation; group 3, partially threaded cannulated 4.0-mm cancellous screws with bicortical fixation; group 4, partially threaded solid 4.0-mm cancellous screws with unicortical fixation; and group 5, partially threaded cannulated 4.0-mm captured screws with bicortical fixation.

cadaveric model by comparing fixation of the transferred coracoid using 2 bicortical metal screws versus a bioabsorbable interference screw. They showed that metal screws provided stronger biomechanical fixation than an absorbable interference screw, and we used this rationale for testing different metal screws in our study. The median ultimate failure load of the bicortical metal screw fixation was 202 N (range, 95-300 N),[14] which is less than the results of our study. The differences observed might be attributed to the different biomechanical testing scenario, in which the force required to pull the conjoined tendon off of the glenoid was reported. In addition, the age of the cadavers used was greater (mean, 87 years) than that in our study (mean, 54.3 years). In our study the testing conditions were adapted from a study by Giles et al.[21] in which cadaveric glenoid specimens, after creation of a defect and subsequent repair by the Latarjet technique, were tested for 100 cycles at each of 4 different load magnitudes (50, 100, 150, and 200 N). Pilot studies in the laboratory concluded that a 150-N load applied to the construct fell below the yield point at which plastic deformation would occur in a monotonic test. In addition, 150 N is considered within the high range of force over the glenohumeral joint during activities of daily living.[23] Giles et al.[21] compared fixation stability, strength, and joint contact between 2 different techniques of graft positioning on the glenoid: classic Latarjet coracoid transfer compared with congruent-arc technique. Biomechanical testing showed improved fixation stability with the classic Latarjet technique. The authors found that the classic Latarjet technique had a load at failure of 557 ± 135 N and gross graft displacement of approximately 1.00 mm with standard deviations ranging from 0.10 to 0.33 mm for similar applied loads; both of these findings are within the range of the results of our study.

Table 4. Pearson Correlations for Biomechanical Indices and Bone Density for All Specimens Analyzed

	r	*P* Value
Maximum cyclic displacement	−0.490	.004
Cyclic creep	−0.500	.004
Load to 5 mm of displacement	0.626	<.001
Linear stiffness	0.395	.025
Work to 5 mm of displacement	0.561	.001

Few biomechanical studies have investigated differences between cannulated and solid screws. In a recent biomechanical study, Alvi et al.[24] showed no differences in energy or cycles to failure when comparing metal cortical screws and partially threaded cannulated screws for the congruent-arc Latarjet fixation technique. As noted earlier, the biomechanical study by Giles et al.[21] showed that the classic technique had superior fixation stability compared with the congruent-arc technique; therefore, in our study we chose to perform biomechanical testing using the classic technique, whereas Alvi et al. performed testing with the more inferior construct. Also of note, our study was more exhaustive than that of Alvi et al., given that we compared differences in biomechanical performance for different fixation methods (unicortical and bicortical) and 5 different screw types and fixation methods (as opposed to 2).

A recent biomechanical study by Chen et al.[25] showed that, in a severely osteoporotic spine model, solid screws were superior to cannulated screws in initial fixation strength. However, severe osteoporosis is not a clinically relevant issue in most patients undergoing shoulder instability treatment because of their younger age. Although none of the specimens in our study were considered severely osteoporotic, a range of BD values among specimens was observed. In this study we made a conscious effort to acquire the youngest cadaveric specimens available with the highest BD. To determine whether BD influenced the results of biomechanical testing, Pearson correlation coefficients were determined. The results of the analysis suggest that lower BD was associated with poorer mechanical integrity of the fixation, as we expected. This finding reiterates the importance of ensuring that quality cadaveric specimens are used in biomechanical studies that reflect the patient population to which the results are being generalized. Given the high correlation found between BD and outcome variables, the standard deviations observed in our study may have been better controlled if specimens of more similar BD had been tested.

Using fracture models, studies from the orthopaedic trauma literature[26] have reported advantages and disadvantages of various screw fixation techniques that are applicable to the Latarjet procedure. Cannulated screws allow ideal screw positioning by using guidewires; the guidewire trajectory can be easily repositioned if the original path is not ideal.[27] In addition, the guidewires prevent migration of the bone block during screw insertion. Cannulated screws would be especially useful when performing mini-open or all-arthroscopic Latarjet procedures, which are considered technically demanding procedures that are associated with steep learning curves. These procedures have several advantages including decreased skin complications, improved disabilities (especially in obese and muscular patients), decreased postoperative pain, less scarring, and accelerated rehabilitation.[14,28] Moreover, a clinical study by Castricini et al.[29] showed good results using 2 cannulated screws in an arthroscopic procedure in 30 patients at a mean of 13 months' follow-up. Cannulated screw fixation of the coracoid may facilitate arthroscopic performance of the coracoid transfer. On the other hand, a major disadvantage of cannulated screws is increased implant cost. Complications such as guidewire breakage and screw thread unraveling have also been reported.[30]

Limitations

Methodologic limitations of the study must be considered. The biomechanical testing setup as conducted may not mirror in vivo mechanics; therefore, a weakness of the study is the nonanatomic testing model, given that the effects of the conjoined tendon and subscapularis are not accounted for. This study was conducted as a time-zero analysis without healing effects, thereby examining initial fixation strength. The mean age of the cadaveric specimens used in this study was 54.3 years, which is older than the usual patient population undergoing the Latarjet procedure for glenohumeral instability.[31] These older specimens may have lower BD; therefore, we would expect improved biomechanical performance in all tested screw groups in a younger, more clinically relevant population with higher BD. Furthermore, although there were no statistical differences in mean BD among the 5 groups, 2 specimens from group 1 had the lowest BD values. BD values and age may have influenced the various biomechanical outcomes in a way that may not accurately represent the coracoid fixation in a young, athletic patient with higher BD. This is perhaps why a large standard deviation was seen in measured outcome variables among specimens within each group. In addition, inherent to any cadaveric study, sample size can be a limitation, as was evident in this study. A post hoc power analysis on the primary outcome showed that a total of 540 specimens would be needed to achieve 80% power, which would not be feasible in a cadaveric study, especially given our study's inclusion criteria. Therefore, the results are subject to the potential for a type II error.

Another limitation of this study is the lack of consideration of soft-tissue structures and their contribution to coracoid transfer strength. Our study only examined the bony contribution to Latarjet fixation and did not consider the effect of the soft tissues (conjoined tendon sleeve, capsular repair) on load transfer. Furthermore, we simulated isolated humeral head loading of the graft with cantilever bending, which may not accurately represent in vivo graft loading after Latarjet reconstruction. However, the loading head approximated the worst-case scenario and allowed us to better standardize the magnitude of force acting on the graft without having force distributed over a greater glenoid surface area. Moreover, although the biomechanical testing setup used 100 cycles between 5 and 150 N, in vivo forces acting on the graft are not known, especially during the early rehabilitation stage prior to bony union. Finally, although every attempt was made to keep all screw trajectories parallel and identical to one another, there were small variations in screw trajectories. These differences were not quantitatively evaluated; however, this scenario likely represented typical clinical use.

Conclusions

In this biomechanical study, screw type and fixation method did not significantly influence biomechanical performance in a classic Latarjet procedure. When performing this procedure, surgeons may continue to select the screw type and method of fixation (unicortical or bicortical) based on preference; however, further studies are required to determine the optimal method of treatment.

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