The Biomechanical Effectiveness of Classic and Congruent Arc Latarjet Procedures

INTRODUCTION:
The Latarjet procedure is commonly used to treat glenoid bone loss due to recurrent instability and dislocation. In this procedure, the coracoid process is osteotomized from its native position and fixed to the anterior glenoid at the site of bone loss. As a result, the coracoid acts as an extension of the glenoid face, thus restoring the glenoid articulating surface and increasing stability of the glenohumeral joint. There are two methods of performing this procedure, the originally described technique, termed the "Classic Latarjet" and the "Congruent Arc" modification of the original technique. These methods differ in their orientation of the coracoid bone graft with respect to the glenoid. The Classic method affixes the coracoid so that its lateral edge becomes part of the glenoid face, while the Congruent method uses the inferior coracoid surface as part of the glenoid face. The objective of this study was to evaluate and compare the strength of these two Latarjet constructs by quantifying load transfer and graft displacement.

METHODS:
Eight fresh-frozen cadaveric shoulders (four pairs) were subjected to a compressive loading protocol using a testing machine (Instron, MA) (Figure 1). Specimens were tested in their intact condition and following Latarjet reconstruction of a simulated anterior glenoid defect measuring 25% of the glenoid width. The Classic Latarjet and Congruent Arc Latarjet were randomized for each shoulder pair. With the humerus in a static position of 30° abduction, the glenoid was subjected to a cyclic compressive load of 100 cycles at a frequency of 1 Hz, directed 30° anterior and applied on the glenoid rim. Cyclic loading followed a staircase pattern with magnitudes of 50, 100, 150 and 200N. Following sub-failure testing, the load was increased until the graft displaced 10 mm, which was recognized as failure.

RESULTS:
The Congruent Arc Latarjet caused a significant change in humeral displacement in comparison to the shoulder in its intact state. After a load of 150N was applied, the mean difference in displacement increased to 3.803 ± 2.287 mm (p = 0.045) and continued to increase at 200N (4.922 ± 2.365 mm, p = 0.025) (Figure 2). In contrast, there were no significant changes in displacement at any loading level after the Classic Latarjet repair, suggesting that load transfer was only evident when comparing intact and Congruent Arc Latarjet reconstructions at one loading level. This difference was not consistent enough throughout loading to indicate a difference in graft strength but does suggest that the change in coracoid graft geometry produced a slightly different loading distribution. This is reasonable, since the inferior coracoid surface is wider than the lateral and is thus able to restore a greater anterior-posterior diameter of glenoid bone; however, in the case of a 25% defect, the Congruent Arc may in fact create an articular surface greater than the intact anatomy. This discrepancy in glenoid width may lead to abnormal kinematics and increased loads.

DISCUSSION:
We investigated whether a difference in strength existed between the Classic and Congruent Arc Latarjet constructs. An insignificant change in humeral displacement at all loading levels indicated that displacement of the Classic Latarjet construct closely resembled that of the intact bone. Differences in mean displacement between the Classic and Congruent bone grafts occurred at loads above 150N suggesting that the behavior of the grafts may be considered comparable at lower loads but begin to diverge as the load is increased. This was further reinforced by the significant difference in load magnitude required to fail either construct.

There were no significant changes in strain levels before and after completing the Classic Latarjet repair, suggesting that load transfer was effectively reestablished. A significant difference in glenoid strain was only evident when comparing intact and Congruent Arc Latarjet reconstructions at one loading level. This difference was not consistent enough throughout loading to indicate a difference in graft strength but does suggest that the change in coracoid graft geometry produced a slightly different loading distribution. This is reasonable, since the inferior coracoid surface is wider than the lateral and is thus able to restore a greater anterior-posterior diameter of glenoid bone; however, in the case of a 25% defect, the Congruent Arc may in fact create an articular surface greater than the intact anatomy. This discrepancy in glenoid width may lead to abnormal kinematics and increased loads.

The differences in graft displacement and glenoid strain suggest a variance in strength among the Classic and Congruent Arc Latarjet constructs. Strain data is of specific interest as it identifies a change in load transfer from the intact state. This is critical in evaluating the behavior of each construct and their ability to ensure joint stabilization.

SIGNIFICANCE:
There are currently no studies that have quantitatively compared the mechanical characteristics of the two Latarjet techniques. The results of this study indicate there are substantial differences in strength and load transfer between the two most commonly used techniques.

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REFERENCES: