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Intraarticular Biomechanical Environment after Bristow and Latarjet Procedures in Shoulders with Large Glenoid Defects: Relationship to Postoperative Complications

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Summary:
A new stress concentration was seen in the humeral head cartilage in both Bristow and Latarjet models, which might contribute to develop glenohumeral osteoarthritis. Stress shielding observed in the proximal half of the coracoid graft in Latarjet models might be responsible for osteolysis. Surgeons should be aware of the risk of the breakage or loosening of inserted screw after Bristow procedure.

Abstract:

Introduction

Coracoid transfers, including Bristow and Latarjet procedures, are widely used to treat traumatic anterior shoulder instability in patients with a large anterior glenoid bone defect. Although the stabilization mechanisms of these two procedures appear similar, studies of their biomechanical differences are sparse. The purposes of the present study were to investigate intraarticular stress and strain distributions after Bristow and Latarjet procedures using a 3-dimensional finite element (FE) method and to clarify their roles in the pathophysiology of postoperative complications.

Methods

The software, Mechanical Finder (version 9.0, RCCM, Japan), was used in the present study. We developed three-dimensional FE models of the glenohumeral joint using CT-DICOM data of the contralateral healthy shoulder in six males with unilateral anterior shoulder instability (age: 17–47). A 25% bony defect was created in the anterior glenoid rim (Defect model), where the coracoid process was transferred, either in the standing (Bristow model) or lying (Latarjet model) position. Care was taken to place the coracoid graft flush with the glenoid cartilage; arm position was determined as 0° or 90° abduction. A compressive load (50 N) was applied to the greater tuberosity, toward the center of the glenoid, and a tensile load (20 N) was also applied to the tip of the coracoid in the direction of the conjoint tendon. We then completed an elastic analysis to determine patterns of equivalent stress distribution and maximum principal strain.

Results

Both the Bristow and Latarjet procedures significantly reduced the mean equivalent stress within the glenoid cartilage ($p = 0.031$). However, in both models, a new stress distribution appeared in the humeral head cartilage,

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specifically within the area facing the grafted coracoid. For the coracoid grafts, all the Latarjet models demonstrated lower mean equivalent stress in the proximal half, compared with the distal half, for 0° abduction ($p = 0.031$). Although the difference of the mean equivalent stress in the abducted position did not reach the level of statistical significance, five out of six models showed a lower mean equivalent stress for the proximal half, compared with the distal half ($p = 0.063$). On the other hand, the proximal half showed a higher equivalent stress than the distal half in all six Bristow models ($p = 0.031$). For the Bristow models, a high stress concentration was seen at the midportion of the inserted screw, with circumferential increases in the maximum principal strain.

Discussion And Conclusion

In both procedures, enlargement of the glenoid surface by the grafted coracoid effectively reduced the biomechanical stress on the glenoid cartilage. However, we observed a new stress concentration within the humeral head cartilage due to contact with the grafted coracoid, after both procedures. This stress might contribute to the development of glenohumeral osteoarthritis. During the Latarjet procedure, stress shielding was seen in the proximal part of the coracoid graft, which might be responsible for osteolysis. During the Bristow procedure, surgeons should be aware of the risk of postoperative breakage and loosening of inserted screws.