Humeral Head Reconstruction with Talus Osteochondral Allograft: Bone Plug Optimization for Hill-Sachs Lesions

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INTRODUCTION: Engaging, or off-track, Hill-Sachs lesions (HSLs) pose a significant risk for failure of surgical repair of recurrent anterior shoulder instability. Reconstruction of the HSL has been proposed as a treatment for large HSLs. Fresh talus osteochondral allograft (OCA) has been postulated as an effective treatment option as it allows for anatomic reconstruction of HSLs. This study aims to determine the optimal characteristics and locations of talus OCA bone plugs in a simulated HSL model.

METHODS:

Three-dimensional (3-D) models of proximal humeri computed-tomography (CT) scans were constructed. HSLs were modeled by matching the contour of the lesion's rim to the articular surface of the ipsilateral humeral head. A custom optimization algorithm was generated to maximize bone plug surface area at the superior margin of the HSL (superiorization) and minimize its position relative to the medial margin of the HSL (medialization). Optimal number, diameter, medialization, and superiorization of the bone plug(s) were reported for each HSL. Percentage of restored glenoid track width and conversion from off- to on-track HSLs after bone plug optimization were calculated. A cluster analysis was performed to identify the optimal bone plug sizes that maximized surface area coverage of HSLs.

RESULTS:

A total of 86 patients who presented with recurrent anterior shoulder instability and identifiable HSLs (mean age: 27.2 years, range 18 – 43 years) were included in the final analysis. There were 19.7% (17 patients) off-track and of these, in order to convert to on-track, the mean bone plug size was 9.9 mm ± 1.4 mm, at 2.2 mm ± 1.7 mm of medialization, and 3.3 mm ± 2.9 mm of superiorization. The optimization identified 21% (18 patients) of HSLs requiring one bone plug, 65% (56 patients) requiring two bone plugs, and 14% (12 patients) requiring three bone plugs. Percentage of bone plug to HSL surface area was at least 49% for all specimens with a mean bone plug overall coverage of 60%. Mean restored glenoid track width was 68%, while all off-track HSLs (n=17) were restored to on-track. The k means cluster analysis calculated three ideal bone plug diameters of 8 mm (small), 10.4 mm (medium), and 12 mm (large), in order to convert HSLs to on-track.

DISCUSSION AND CONCLUSION:

The optimal talus OCA bone plug diameters to reconstruct HSLs are small (8 mm), medium (10.4 mm) and large (12 mm), and can successfully restore HSL track and, on average, 60% of HSL surface area and 68% of the glenoid track width. Talus OCA bone plug optimization is a promising tool that can be used to guide treatment of HSLs.