

Effectiveness of Lavage Techniques in Removing Immunogenic Elements from Osteochondral Allografts

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Purpose: The purpose of this study is to assess the effectiveness of standard saline lavage compared to combination lavage with saline and high-pressure carbon-dioxide gas on removing immunogenic marrow elements from osteochondral allografts.

Methods: Six fresh hemi-condyles were obtained. Three osteochondral allograft plugs (15 mm diameter, 6 mm depth) were harvested from each hemi-condyle and randomly assigned to one of three treatment arms: A, no lavage; B, 1L standard saline lavage; C, simultaneous saline lavage (1L) and 1-minute high-pressure CO₂ lavage. After staining with hematoxylin & eosin, a “percentage fill” of remaining marrow elements residing in the trabecular space was calculated using ImageJ software. This was then repeated in three distinct compartments for each sample based on depth from surface: 1, deepest third, adjacent to cartilage; 2, middle third; and 3, most superficial third. Trial arms B and C were compared with one-tailed t-tests with significance set at $p < 0.05$.

Results: Control samples had an overall percentage fill of $51.2 \pm 8.8\%$. While both lavage techniques decreased overall remaining marrow elements, Group C yielded significantly lower percentages of remaining marrow elements than Group B ($14.6 \pm 8.7\%$, $28.6 \pm 16.5\%$, $p=0.045$) (Fig. 1). On depth analysis, control samples exhibited homogenous filling of trabecular space ($63.0 \pm 15.5\%$, $67.6 \pm 13.7\%$, and $55.2 \pm 10.1\%$ in Zones 1, 2, and 3, respectively). Both lavage arms equally removed marrow elements from superficial Zone 3 (B, $17.4 \pm 9.2\%$; C, $15.6 \pm 12.4\%$, $p=0.41$) and middle Zone 2 (B, $30.2 \pm 17.7\%$; C, $21.4 \pm 15.5\%$, $p=0.18$). However, Group C lavage removed significantly more marrow elements in deep Zone 1 than Group B ($29.7 \pm 10.9\%$, $58.5 \pm 25.2\%$, $p=0.01$) (Fig. 2).

Conclusion: Combination saline and high-pressure carbon dioxide lavage more effectively clears marrow debris from trabecular space in osteochondral allografts than saline lavage alone. This effect is most pronounced in the deepest third of the graft.

Keywords: knee; articular cartilage; osteochondral allograft

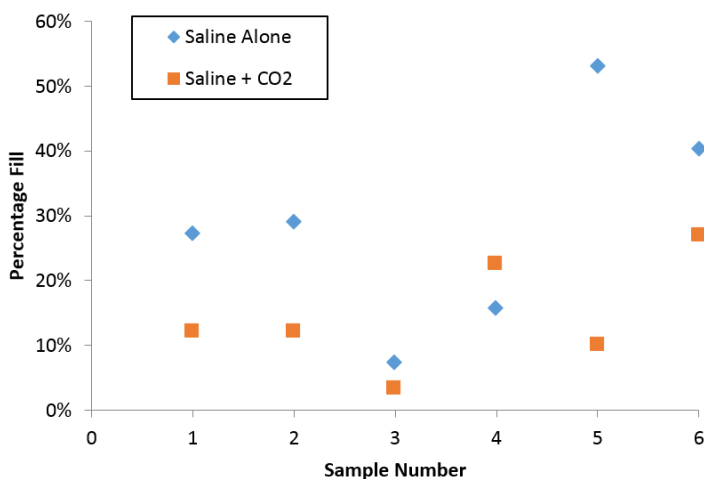


Fig. 1. Overall “% fill” of remaining marrow elements after treatment ($p=0.045$).

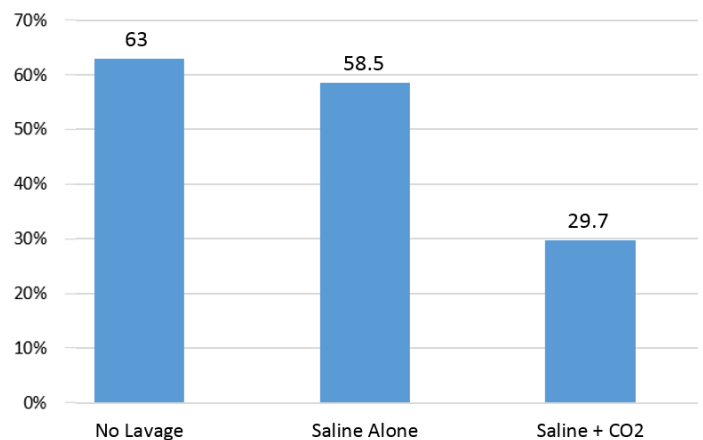


Fig. 2. Marrow elements remaining (% fill) after lavage in Zone 1 (Deep Zone).