Comparing Fusion Rates Between Fresh-Frozen and Freeze-Dried Allografts in Anterior Cervical Discectomy and Fusion (ACDF)

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Introduction

- ACDF is used to treat a variety of cervical pathologies (degenerative disease, myelopathy, etc.)[1]
- Post-operative pseudarthrosis, nonunion, is defined as a failure of fusion between cervical levels.
- Pseudarthrosis is a leading cause of pain post-operatively resulting in 45%-56% of revision surgeries.[1]
- The “gold standard” graft for ACDFs is an autograft from the patients iliac crest.[2]
- Autografts lead to a higher level of fusion rates, however, can cause a number of donor site morbidities. [2-7]
- To reduce these morbidities, allografts are frequently used as an alternative.
- Allografts usually are freeze-dried or fresh-frozen.
- Freeze-dried allografts have gone through more processing which leads to a more sterile option, but can lead to a weaker bone graft. [3,8-11]
- Fresh-frozen allografts go through less processing, leading to preserved structural integrity but increased chances on immune response. [3,8-11]

Hypothesis

- We hypothesize that fresh-frozen allografts, given their persevered structural integrity, will reduce the rate of pseudarthrosis in patients.

Methodology

- Retrospective consisting of 79 patients that underwent ACDF in a span of 6 years
- Freeze-dried allografts and fresh-frozen allografts were given to patients on physician’s preferences and suggestions
- Co-morbidities and patient history such as smoking, osteoporosis, obesity, and diabetes were recorded. These factors are shown to affect fusion rates. [1,10, 11]
- Freeze-dried and fresh-frozen allografts were processed and preserved through standard protocol.
- 50 patients received the Freeze-dried allograft.
- 28 patients received Fresh-frozen allograft
- Fusion was observed through post-op AP/Lat radiographs by observing trabecular bridging on the superior and inferior borders.[12](Table. 2 Fig. 3)
- Three independent observers graded fusion for each radiograph. An average of fusion percentages was used to determine fusion grade

Fusion Grade	Criteria
Union	Complete bridging (over 50% on sup and inferior borders) <26 weeks
Delayed Union	Complete bridging (over 50% on sup and inferior borders) 26-52 weeks
Fibrous Union	Lack of bridging on one or more surfaces >52 weeks

Table 2: Criteria and guidelines to determine fusion at each cervical spine level. [12]

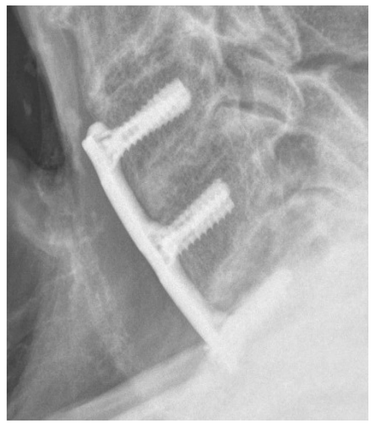


Figure 3: Cervical levels that show complete trabecular bridging on superior and inferior levels.

Results

-Our results show that there were no incident of Fibrous union/non-union in the freeze-dried and fresh-frozen allografts.
-Fresh-frozen allografts (80%) did have a higher rate of union (complete bridging by 26 weeks) than freeze-dried allografts (77%) (p=0.85). (table 1)
-Patient factors also did not impact Union rates for each specific allograft. (table 1.)
-There was also no significant differences in time-to-fusion between either allografts. (Figure 2.)
-Freeze-dried allografts did show a significant different in NDI score reduction at the 6 month follow-up, however at 1 year follow-up, NDI score improvements were comparable between allografts. (Figure 1.)

Risk Factor	Unadjusted OR	p-value	Interaction p-value
Graft type (FD vs FF)	0.89 (0.25, 3.13)	0.85	--
Male Sex	0.41 (0.12, 1.4)	0.15	0.95
Hx Smoking	1.3 (0.40, 4.3)	0.67	0.26
Curr Smoking	1.3 (0.15, 11.1)	0.82	0.95
NSAIDs	1.6 (0.24, 10.6)	0.63	0.75
Diabetes	0.95 (0.23, 4.0)	0.95	Did not converge

Table 1: Odds ratios for Union by Risk Factor
The table shows the odds ratio of union (adequate fusion in 6 months) in patient factors that may contribute to rate of union. Patient factors examined were allograft types (Freeze-dried (FD) vs Fresh-frozen (FF)), patient sex, history of smoking, current smoking, NSAID use, and history of diabetes. P-values are also listed and mostly show no significant changes in odds of union in various patient factors. Interaction p-value shows whether the effect of patient factors (sex, smoking, NSAID, and diabetes) on union differed between patients receiving FD or FF allografts.

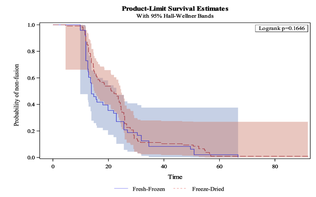
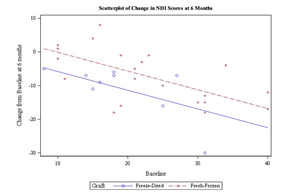
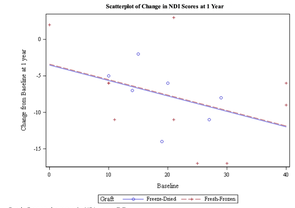


Figure 2: Kaplan Meier Curve Analysis of Time to Fusion
Each patient’s time to fusion (adequate trabecular bridging on superior and inferior borders) were analyzed to observe whether freeze-dried or fresh-frozen allografts reached fusion sooner. Freeze-dried allografts (red dotted line) nor fresh-frozen allografts (solid blue line) did not show a significant difference in their time to fusion (Logrank p=0.1646).



Fresh-Frozen decrease in NDI score: 6.588
Freeze-dried decrease in NDI score: 12.292
P=0.03
Figure 1a: Scatterplot with regression lines of NDI score at 6 month Post-op
NDI (Neck Disability Index) scores were recorded from patients at 6 month post-op. Baseline (pre-op) NDI scores were also recorded and controlled for. Patients with freeze-dried allografts are shown in blue circles with a solid blue line. Fresh-frozen allografts are shown through red crossed with dotted red lines. Patients with freeze-dried bone grafts showed a statistically greater decrease in NDI scores in any given baseline score when compared to patients with fresh-frozen bone grafts (p=0.03).



Fresh-Frozen decrease in NDI score: 7.7
Freeze-dried decrease in NDI score: 7.8
P=0.9647
Figure 1b: Scatterplot with regression lines of NDI score at 1 year Post-op
NDI (Neck Disability Index) scores were recorded from patients at 1 year post-op. Baseline (pre-op) NDI scores were also recorded and controlled for. Patients with freeze-dried allografts are shown in blue circles with a solid blue line. Fresh-frozen allografts are shown through red crossed with dotted red lines. There were no statistical difference in changes of NDI scores between patients that received freeze-dried or fresh-frozen bone grafts for any given baseline score (p=0.9647).

Conclusion

-Due to no statistical significance in fusion rates between fresh-frozen and freeze-dried allografts, physicians can choose between either grafts for ACDFs on availability and cost efficiency for the hospital.

Abstract and References.

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