Impact of Vertebral Bone Density on Expansion Stiffness of Expandable Interbody Fusion Cages

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Background

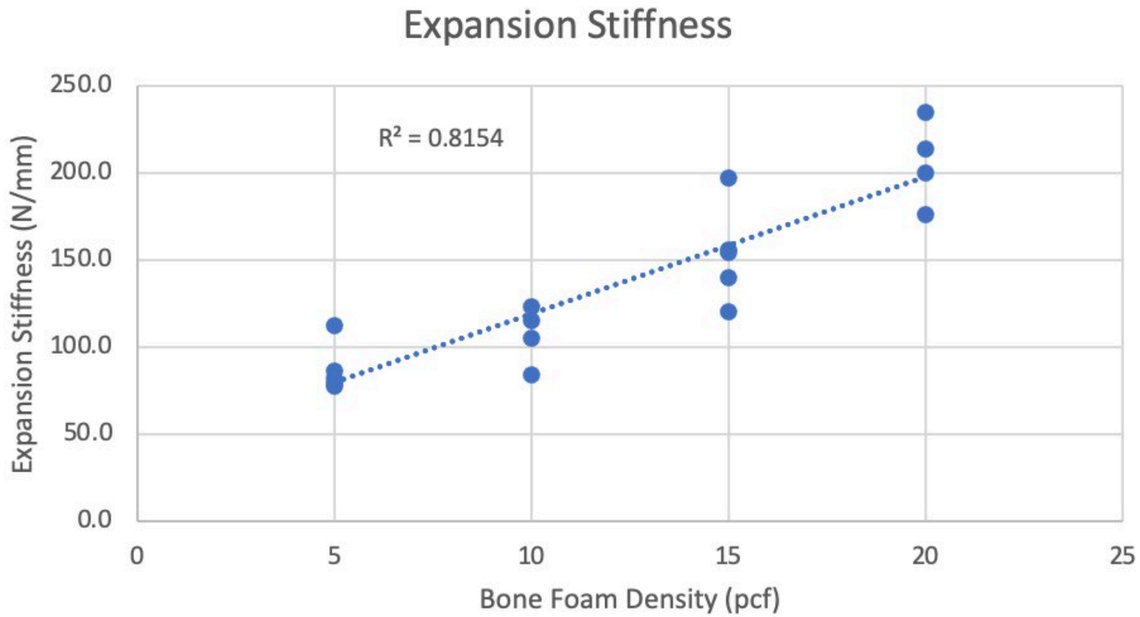
- Various parameters related to expandable interbody cages have been suggested as indicators of spinal stability.
- Expansion stiffness is a metric with utility in both biomechanical and clinical settings that offers a direct-controlled correlation to stability.
- Exceedingly high expansion stiffness may increase the risk of subsidence and reduce graft loading.
- However, variables influencing expansion stiffness have not been well-studied.
- Therefore, the current study aimed to evaluate the impact of bone density on expansion stiffness of expandable interbody fusion cages.

Methods

- The Mojave PL 3D Expandable Interbody System (Stryker, Leesburg, VA, USA) was utilized for the experiment.
- Expansion stiffness was measured throughout the 100-200 N output force range for 4 different bone foam densities, including 5, 10, 15, and 20 pounds per cubic foot (PCF).
- 5 experimental trials were conducted for each PCF material, and the mean expansion stiffness was calculated for each PCF material.
- Trials in which 200 N output force was not reached were considered outliers and were excluded from the analysis.

Results

- Expansion stiffness was found to increase linearly with increasing bone foam density.
- The expansion stiffness (mean ± standard deviation) for various PCF materials were:
  - 87.4±12.9 N/mm for 5 PCF
  - 107.1±14.8 N/mm for 10 PCF
  - 153.7±25.2 N/mm for 15 PCF
  - 206.4±21.3 N/mm for 20 PCF



Conclusions

- Our findings provide a better understanding of the biomechanics of expandable interbody fusion cages by demonstrating that expansion stiffness linearly increases as vertebral bone density increases.
- These findings highlight the relationship between the propensity for subsidence and excess force on end plates during peak torque while expanding.
- They also underscore an important relationship between location of cage and vertebral bone density closer to cortical regions of the bone, which may also be able to better withstand cyclic loading and unloading stresses.
- This can impact future cage design to capitalize upon stronger areas of bone.