Objective
- Determine the effect of Demineralized bone matrix (DBM) on the mechanical properties of the calcium phosphate cement.
- Find the optimal amount of DBM material to add to SKaffold to optimize the mechanical properties.

Materials and Methods
- Both SKaffold™ (Skeletal Kinetics, Cupertino, CA) and DBM material (Osteotech, Eatontown, NJ) were obtained from manufacturers.
- DBM was characterized by Fourier Transform Infrared Spectroscopy (FTIR) to determine whether demineralization was complete.
- Particle size distribution analysis (Micromeritics, Norcross, GA) was also completed on the DBM to confirm manufacturer’s specifications.
- Tensile, compressive, injectability, and setting tests were performed on the mixed SKaffold and DBM.
- We evaluated the effects of adding 0.5%, 1%, 2%, 2.5%, 3%, 5%, and 10% DBM (by weight of SKaffold powder) on the mechanical properties of the bone cement.
- Fractographic analysis was performed by Scanning Electron Microscopy (SEM).

Results
- It was found that DBM absorbed water to approximately twice its weight. As such, the liquid to solid ratio was adjusted accordingly.
- DBM was best mixed if added to SKaffold powder prior to addition of the liquid component.

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Results
- FTIR analysis showed remnants of bone mineral still present (Fig. 1). With the majority of the sample composed of protein (strong amide I, II, and III bands present)
- Particle size distribution analysis results showed that the size of the procured DBM particles were distributed around two peaks of 247 and 500 μm with a small percentage of particles above 570 μm.

Conclusion
- The setting time test was performed for nine samples of DBM concentrations: 0.5%, 1%, 2%, 2.5%, and 3%. For all concentrations of DBM added, setting loads increased with time. Setting loads were higher at 0.5% and 1% DBM additions, but then decreased with increasing DBM concentrations (Fig. 3).
- The results from the injectability test showed that there was almost no injectability when more than 3% DBM was added.
- Fractographic analysis of failed specimens revealed a direct relationship between DBM augmentation and greater plastic deformation of SKaffold specimen. The sample with low DBM concentration (Fig. 4B) illustrates a smoother and more linear crack than the sample with high DBM concentration.
- Mechanical testing indicated that the optimal value of DBM that can be added to this calcium phosphate cement is 2.5% (by weight) without significantly decreasing its functional properties.
- When DBM was added to SKaffold material, samples showed plastic yielding behavior under load. This greater plastic deformation may be the result of collagen fibrils bridging SKaffold particles and acting to deflect crack propagation.

Tensile test results
- Tensile testing was performed (n=9) for each DBM concentration. The results (Fig. 2) showed that the addition of DBM in the range of 0.5% to 3% did not significantly reduce the tensile strength of SKaffold while the addition of 5% and 10% DBM reduced tensile strength by more than 50%.

Compressive test results
- Compressive test results showed a similar decrease in strength with increasing percentage of DBM material added.

Conclusion
- Our results indicated that the DBM can be successfully incorporated with calcium phosphate cement with good functional results. This incorporation may enhance the cement’s biological properties.
- Additions of DBM above 3% resulted in unacceptably low tensile injection and compressive values. Setting strengths were acceptable up to 2.5%.