

**ABSTRACT – ORAL****Cold Sintering Process Framework for Bone Biomaterials Consolidation:  
Mechanistic Insights and Microstructural Evolution**

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Biomaterials are essential for treating bone defects, particularly when used as structural grafts in cases of non-union bone defects. Although a broad range of biomaterial options, including ceramics, polymers, and composites, has been investigated, challenges still exist in developing these into synthetic grafts with optimal biological and mechanical properties comparable to natural bone. The Cold Sintering Process (CSP) is an innovative, low-temperature, non-conventional sintering technique that allows for ceramic consolidation at temperatures below 300°C by utilizing pressure ( $\leq 600$  MPa) and a transient liquid phase. This method addresses the challenges associated with high-temperature sintering of ceramics and opens new possibilities for co-sintering ceramics with polymers. This study highlights the essential framework of CSP for consolidating biomaterials commonly used in bone regenerative applications. In particular, the CSP mechanism, process parameters, and properties of hydroxyapatite, bioglass, and hydroxyapatite-poly lactide composite materials will be discussed based on ex-situ and in-situ experimental results.

**Keywords:** cold sintering process, sintering mechanism, nano-hydroxyapatite, bioglass, composites