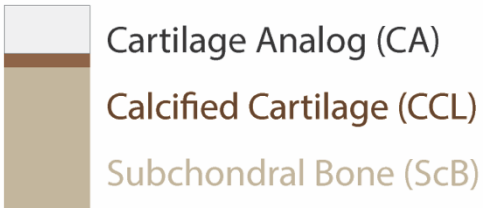
A One-Step, Off-the-Shelf Construct for the Repair of Focal Osteochondral Defects



LEFT: Image of the OCP construct
MIDDLE: Image of the OCP cartilage analog surface
RIGHT: Schematic illustrating the 3-layered OCP construct.

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Background: Focal osteochondral defects occur due to wear and tear, traumatic injury, or metabolic disorders and result in persistent joint pain as well as limitations in daily activities.[1] Osteoarticular transplantation (OATS), the current gold standard for defect repair, has shown limited clinical success due to donor site morbidity, limited graft availability, potential graft rejection, and insufficient osseous support.[2] Off-the-shelf products offer the potential to overcome these limitations. However, current products suffer from drawbacks including limited shelf life, high cost, insufficient osseous support, failure to promote tissue remodeling, and lack of biomimetic structure.[3] We have developed a novel osteochondral plug construct (OCP) that addresses the limitations of currently available clinical and commercial approaches.

Product/Technology Description: The OCP has a biomimetic, three-layer structure coinciding with the cartilage, calcified cartilage, subchondral bone layers of native osteochondral tissue. Each layer is made using scalable manufacturing techniques at a low-cost (COGS analysis estimates $52.64 per construct). The subchondral bone layer (ScB) combines poly(lactic-co-glycolic) acid, hydroxyapatite, and Bioglass to provide mechanical strength and facilitate boney regeneration. The cartilage layer (CA) is an aggrecan/type II collagen rich xenograft matrix similar in composition to native cartilage. The intermediate calcified cartilage layer (CCL) provides secure attachment of the CA to the ScB. This construct is designed to be implanted using a simple, one-step procedure similar to that used in the gold standard OATS approach.

Market Opportunity: The total global market for knee cartilage repair was valued at $1.6B in 2014.[4] With a CAGR of 5.95%, this market is expected to reach $2.7B worldwide by 2023.[4] Valued at $651.2M in 2014, the North American segment accounts for 40.7% of the global market and is projected to reach $1.1B by 2023.[4] Further segmentation reveals that cartilage repair allografts account for 5% of the knee cartilage repair market, valued at $32.6M in 2014 and projected to reach $55M by 2023 in North America.[4] In addition to knee cartilage repair, this construct could be used in the shoulder cartilage repair, talus cartilage repair, and as an OATS backfill.

Stage of Development: The OCP construct has undergone preclinical verification testing for degradation mechanics (short- and long-term mass loss, impact on tissue pH), physical characterization (polymer/mineral phase distribution), mechanical characterization (ScB compressive mechanical properties, CA viscoelastic mechanical properties, CA attachment strength), bioactivity, cytotoxicity, and cellular attachment. Together, the testing of OCP constructs demonstrated compatibility with human progenitor cells, bioactive potential to promote boney integration, and superior mechanical properties when compared to other osteochondral constructs currently available.

Intellectual Property: The subchondral bone phase is covered by U.S Provisional Pat. Ser. No. 62/638,422 filed March 5, 2018 and the OCP as a whole is covered by U.S. Provisional Pat. Ser. No. 62/638,530 filed March 5, 2018.

Future Development: This OCP offers a one-step, off-the-shelf approach for focal defect treatment that can be produced at a low cost via scalable manufacturing techniques. On-going studies are being conducted to evaluate the potential of OCPs to support regeneration in *ex vivo* models as well as an *in vivo* rabbit cartilage defect model.

References: [1] Falah *et al.*, *Int. Orthop*. 2010. [2] Camp *et al.*, *Sports Health*. 2014. [3] McCormick *et al. Arthroscopy*. 2014. [4] Transparency Market Research, 2017.