COREBONE

CoreTlage™

One Step Solution for Complete
Articular Cartilage Regeneration

White Paper

Highlights: CoreTlage™ is a sustainably cultivated coral scaffold engineered with vertical micro-channels to support simultaneous subchondral bone and cartilage regeneration. In preclinical sheep studies, CoreTlage™ implants were highly biocompatible and integrated seamlessly: no chronic inflammation or foreign-body reaction was observed. Treated defects filled with extensive new bone (micro-CT showed trabeculae bridging implant and host) and were covered by a continuous, proteoglycan-rich hyaline-like cartilage layer. Repair outcomes were achieved with a single surgery and *no added cells or growth factors*, offering a scalable one-step solution. These data underscore CoreTlage' s clinical potential and competitive advantage in the large osteochondral repair market.

Clinical Need: Osteochondral Defects in the Knee

Osteochondral lesions—a common yet challenging condition in orthopedics—involve full-thickness damage to cartilage that may extends into the underlying bone. Because articular cartilage is avascular and contains few cells, small defects show little ability to heal on their own, often resulting in repair with weaker fibrocartilage. Without treatment, even minor lesions can grow in size to more substantial lesions and may progress to widespread joint degeneration and osteoarthritis. Current treatments (microfracture, chondroplasty, autograft/allograft transplantation, ACI, etc.) are often staged, require cell harvesting/expansion, or yield mechanically inferior repair tissue. There is a clear unmet need for a *single-stage* implant that can reliably restore the osteochondral unit to its native structure and function. CoreTlage™ addresses this need by harnessing a proven osteoconductive biomaterial (coral) in a novel design to regenerate bone and cartilage in one step.

CoreTlage™ Scaffold & Advantages

CoreTlage™ is a cylinder milled from *cultivated* coralline aragonite at different dimensions with diameters ranging 6-15 mm and length of 10 mm. Advantages include:

- **Sustainably cultivated coral.** Unlike reef-harvested coral, CoreTlage™ is grown under fully controlled conditions to ensure consistent quality and supply. This eco-friendly source not only avoids depleting natural reefs but also guarantees high product quality and uniformity.
- **Osteoconductive matrix.** Natural coral has a trabecular structure similar to cancellous bone, providing a scaffold for new bone in-growth.
- **Vertical micro-channels.** Proprietary perforations run along the cylinder's axis to promote fluid/nutrient transport and cell migration between the bone and cartilage regions. This design accelerates simultaneous repair of subchondral bone and overlying cartilage (figure1).

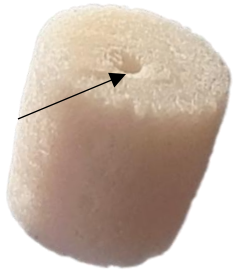

Figure 1 Coral plug with through vertical channel (arrow) for cells migrations

- **One-step procedure.** CoreTlage™ is designed for press-fit implantation: surgeons drill a defect and immediately implant the scaffold flush with the subchondral bone. No second surgery or exogenous cells/growth factors are needed (figure 2).

Together, these features make CoreTlage™ an *off-the-shelf* device that can be used in a single arthroscopic/open procedure to restore the osteochondral unit.

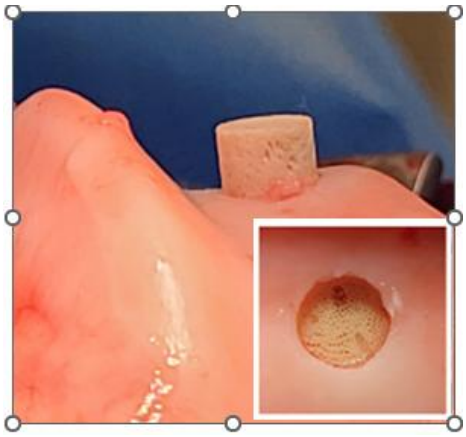

Figure 2. scaffold flush with the subchondral bone

Preclinical Study Overview

An ovine (sheep) study was conducted to evaluate the safety and effectiveness of the CoreTlage™ implant in repairing critical-size osteochondral defects.
In each sheep knee, cylindrical defects (6 mm × 8 mm) were surgically drilled into the load-bearing medial femoral condyle. Each defect was immediately treated in a single-stage procedure by press-fitting a CoreTlage™ implant flush with the surrounding cartilage.

The study consisted of eight animals in total:

- Two animals were followed for 4.5 months post-operatively for preliminary evaluation.
- Six animals were followed for 6 months post-operatively,

Postoperative care and monitoring were conducted according to standard protocols for large-animal cartilage studies, including unrestricted weight-bearing, analgesia, and daily welfare observations. At the designated endpoints, animals were humanely sacrificed and the knees harvested for gross, micro–CT, and histological analyses.
Outcomes included clinical monitoring, gross/macro scoring (e.g. ICRS criteria), high-resolution micro–computed tomography (micro-CT) of the explanted joints, and comprehensive histology (Hematoxylin–Eosin, Masson's Trichrome and Safranin-O/Fast Green staining) of the repair sites. Histological slides were semi-quantitatively graded for tissue reaction (0=normal to 4=severe) and cartilage morphology by board-certified pathologists.

Safety & Biocompatibility Results

Excellent biocompatibility. Throughout the study, animals showed normal recovery with no adverse reactions. At explant, no signs of joint irritation. Most importantly, no chronic inflammation or foreign-body response was observed in any CoreTlage™-treated joint. Histopathology consistently noted "very clean" tissue fields: bone and cartilage around the implants were free of inflammatory infiltrates or necrosis.

No implant encapsulation or toxicity. Natural bone was observed growing directly onto and into the coral-based material. No signs of thick fibrous encapsulation or giant cells were seen around any implant. In all samples, no residual coral fragments were found. These findings suggest that the coral matrix is well tolerated in the joint environment.

Macroscopic & Imaging Outcomes

Gross morphology. At the post-procedure analysis, all CoreTlage™-treated defects appeared well-healed. The repair sites were flat or slightly convex, blending with surrounding cartilage. According to blinded gross scoring, all implants evaluated at 6 months achieved Grade I–II (nearly normal) in texture, color, and defect fill (figure 3). In plain view the cartilage covering the implant looked continuous and smooth. As noted in the study report, the treated defects were described as "smoothly contoured, well-filled, and flush with the adjacent cartilage," which we see as encouraging preliminary outcomes.

Micro-CT analysis. High-resolution micro-CT scans performed at 4.5 months post implantation (figure 4). The coral scaffold was completely encased by new bone, restoring an anatomically normal subchondral bone structure. In cross-section images the implant (light gray) was interspersed with dark gray newly formed trabeculae, yielding a uniform appearance. Importantly, no lucencies or implant displacements were observed, underscoring excellent osseointegration.

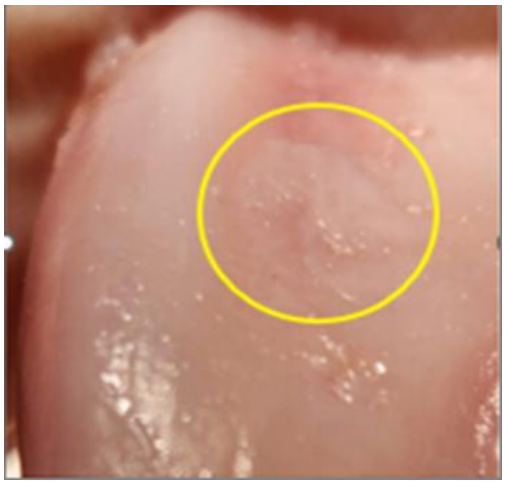

Figure 3. Gross appearance of a treated osteochondral defect at 18 weeks post-implantation. The yellow circle highlights the defect region, which is completely filled with cartilage-like repair tissue that is smooth and level with the surrounding native cartilage.

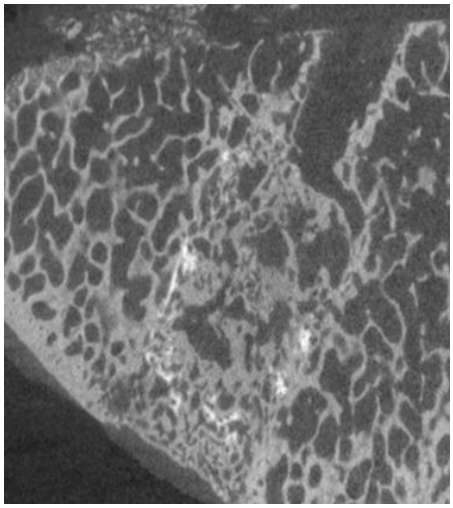

Figure 4. Micro-CT cross-sectional image of an explanted femoral condyle treated with a CoreTlage™ implant (center of image). The coral scaffold (lighter gray) is fully integrated with the surrounding host bone. New trabecular bone formation is evident within and around the implanted scaffold, restoring the subchondral bone

Bone Regeneration Efficacy

Robust new subchondral bone. Micro-CT at sacrifice demonstrated that all defects had become densely filled with new trabecular bone, seamlessly integrating the implant. In cross-section, the coral (high X-ray attenuation) was indistinguishable from host bone, with continuous bony trabeculae spanning the former defect boundary. No gaps were observed between implant and host. By 6 months the repaired subchondral region was essentially remodeled into normal-appearing bone.

Histological analysis revealed that new bone tissue had filled nearly the entire defect area beneath the joint surface. Masson's Trichrome staining showed thick, mineralized bone trabeculae (red) interdigitating with the coral matrix as shown in figure 5. As the evaluating pathologist noted: "the area of implantation is filled with new bone trabeculae that are wide and massive including mineralization".

Anatomical restoration. Across samples, the subchondral plate and trabecular architecture were rebuilt to near-normal geometry. Bone bridges often thickened across the defect. Histology noted a thickened trabecular network underlying the new cartilage. Grossly, the articular surface was supported by a solid bony foundation: all CoreTlage™ defects were described as "well-filled" and flush with the native subchondral plate. In sum, CoreTlage™ proved highly osteoconductive, guiding new bone formation to reestablish the subchondral bone stock.

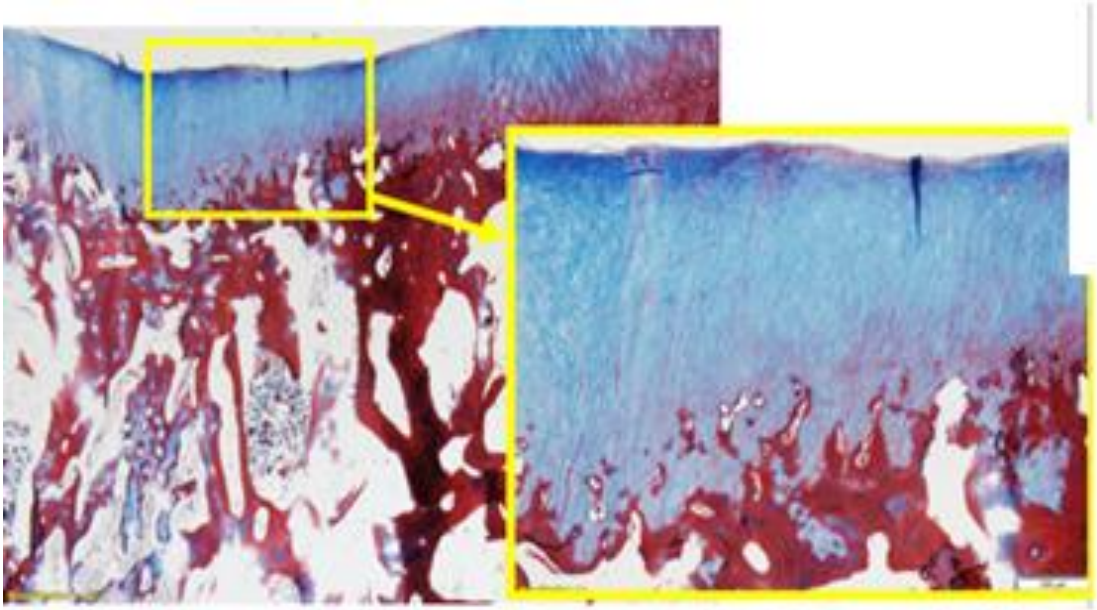

Figure 5. Histological section of a CoreTlage™-treated defect ~4.5 months post-surgery (Masson's Trichrome stain). The defect space is being filled with regenerated tissues: new bone (red-stained trabeculae, bottom) is present within the coral scaffold, and a layer of nascent cartilaginous matrix (blue staining) is extending over the surface of the new bone (see inset). This indicates progressive osteochondral healing, with cartilage formation emerging from the underlying bone.

Cartilage Regeneration Efficacy

Hyaline-like cartilage formation. A hallmark finding was the regeneration of cartilage at the defect surface. By 6 months, histology consistently revealed a continuous cartilage layer covering the CoreTlage™. Staining with Safranin-O/Fast Green revealed rich proteoglycan content within the new matrix—shown by bright red staining—suggesting the presence of glycosaminoglycans similar to those found in healthy natural cartilage (figure 6). The superficial cartilage surface was smooth and unbroken, and chondrocytes were organized in columns similar to native tissue in the deeper zones. In top-performing implants the tidemark (interface) between new cartilage and underlying bone was clear, mimicking a normal osteochondral junction. It was also encouraging to see that cartilage formation was localized to the defect area, with seamless integration into surrounding host tissue and no signs of osteophytes or ectopic cartilage formation.

Matrix quality. Overall, the repair cartilage tended toward hyaline character. Immunostains showed predominantly type II collagen, and the semi-quantitative scores for proteoglycan staining were high. However, pathologists did note that the new cartilage was not always perfectly hyaline. In some cases, the matrix was somewhat more fibrous than native cartilage. Overall, CoreTlage™ supported the formation of hyaline-like cartilage that was structurally and functionally superior to untreated healing, and no adverse degeneration of adjacent cartilage was seen in any sample.

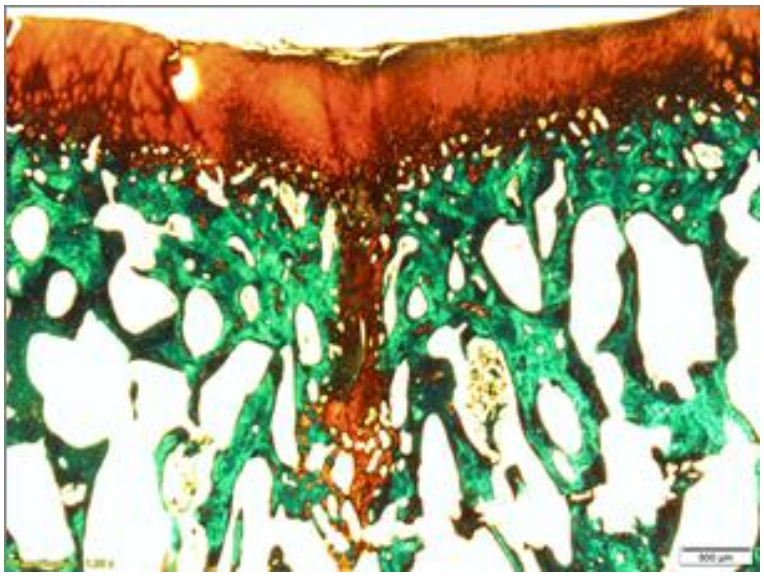

Figure 6. Safranin-O/Fast Green–stained section of a treated defect at 6 months post-implantation. A layer of hyaline-like cartilage (red staining at top) has regenerated over the defect, with proteoglycan-rich matrix and a smooth articular surface. Underneath, the Fast Green stain highlights the regenerated subchondral bone (green), demonstrating reconstitution of the bone-cartilage interface. No notable gaps or inflammatory tissue are present at the implant site.

Conclusions and Key Takeaways

The preclinical data demonstrates that CoreTlage™ is a safe and effective platform for one-step osteochondral repair offering:

- **Complete osteochondral repair:** In all animals, the CoreTlage™ implant guided full-thickness healing. New bone fully filled the defect and supported a continuous layer of hyaline-like cartilage (rich in proteoglycans) by 4.5–6 months.
- **High repair quality:** Histology confirmed that the regenerated cartilage had a smooth surface, robust matrix staining, and a clear tidemark to bone. Blinded scoring showed minimal pathology (mean score ~1.5 of 4).
- **Excellent safety:** No inflammation or foreign-body reaction was observed. The implant material was fully remodeled into native bone, and surrounding tissues remained healthy.
- **Methodological clarity:** The preclinical model used clinically relevant defects in sheep knees, with standard surgical techniques and validated outcome measures (gross scoring, micro-CT, histology). This lends confidence to the translatability of the findings.
- **Commercial impact:** These promising results (n=6) – achieved without added cells or growth factors – suggest that CoreTlage™ can meet a critical market need for effective one-step osteochondral repair. Its sustainable manufacturing and single-surgery use may offer regulatory and competitive advantages over complex biologics.

In conclusion, CoreTlage™ implants support robust bone regeneration and the formation of high-quality cartilage over small to medium defects, without eliciting any adverse tissue reaction. In contrast with conventional repair methods, CoreTlage™ combines sustainable materials with advanced design to achieve outcomes at least on par with grafting and cell-based therapies, but in a simpler format. CoreTlage™ implants consistently demonstrated osteochondral regenerative efficacy and safety in these studies. The regenerated tissue closely resembled native osteochondral anatomy, with complete defect filling and restoration of joint surface integrity. These findings support further development of CoreTlage™ toward First in Man Study.

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