

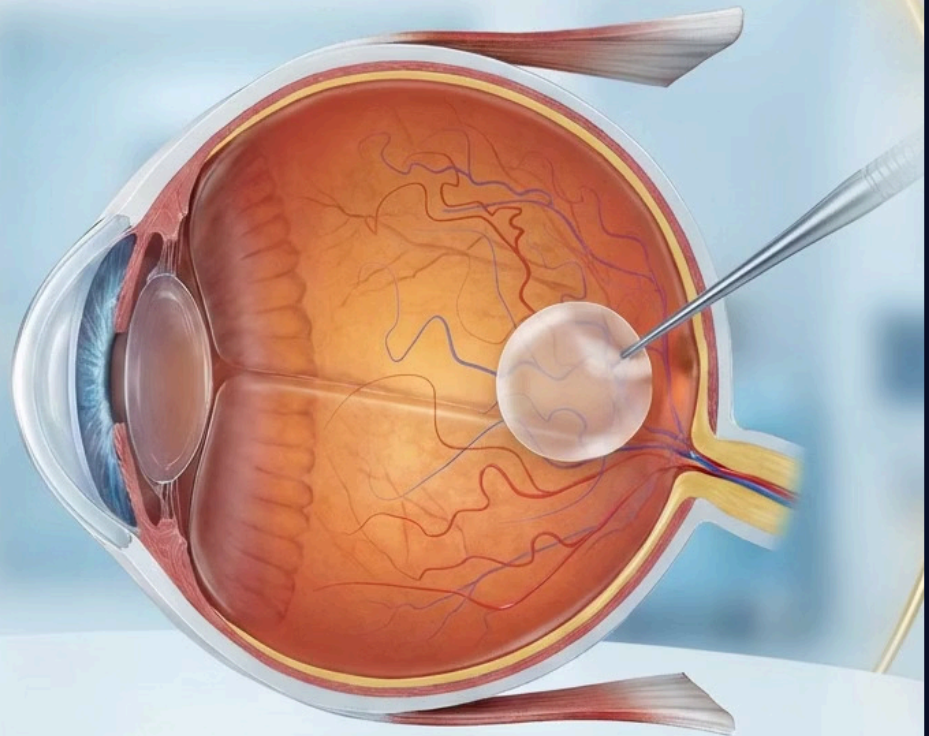
Natarajan MacuSeal™

Dehydrated Human Amniotic Membrane Allograft for Retinal Surface Coverage

Natarajan MacuSeal™ is a dehydrated human amniotic membrane (AM) allograft engineered to provide **temporary coverage and structural support** to retinal and macular tissue during vitreoretinal surgery. By preserving native membrane architecture through a controlled dehydration process, it enables room-temperature storage and seamless intraoperative deployment – bringing biological precision to the posterior segment.

Akriti®
Simplifying Eye Care

EXPLORE INNOVATION NATARAJAN MACUSEAL™



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Homologous Use

Structural scaffold mirroring the amniotic membrane's native protective function

Minimal Manipulation

Devitalised, dehydrated – no living cells, no combined articles

Section 361 Compliant

Regulated under 21 CFR 1271 and PHS Act Section 361

Room-Temperature Stable

Terminally sterilised to SAL 10⁻⁶; no cold-chain requirement

Intended Use & Homologous Function

REGULATORY FOUNDATION

Stated Intended Use

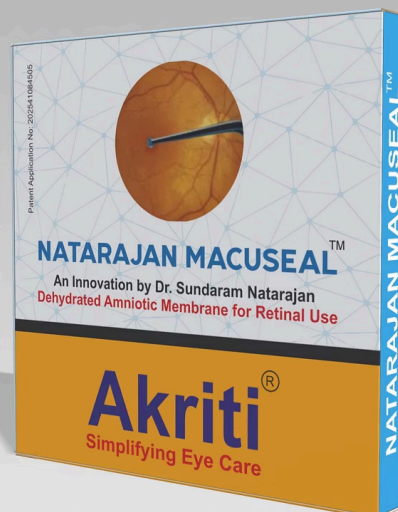
Natarajan MacuSeal™ is intended to serve as a **temporary physical covering and structural scaffold** for retinal tissue during surgical repair procedures. The allograft is applied directly to the retinal surface – functioning as an intraoperative tissue interface that conforms to posterior segment anatomy and supports the underlying tissue while natural healing processes are initiated.

This intended use is **homologous** to the natural, established function of the human amniotic membrane. In its native anatomical environment, the amniotic membrane provides protective, structural, and scaffolding support to the developing foetus. Applying it as a covering and scaffold in retinal surgery therefore represents a direct functional parallel, not a novel or repurposed application.

Why Homologous Use Matters

Homologous use is one of the four criteria that must be satisfied for a human cellular or tissue-based product (HCT/P) to qualify for regulation solely under Section 361 of the Public Health Service Act. Meeting this criterion confirms that the product is performing the **same basic function** in the recipient as the donor tissue performs in its native context.

For Natarajan MacuSeal™, the parallel is clear: amniotic membrane natively provides **structural coverage and physical protection**. Its intraoperative role as a retinal surface covering replicates this function precisely, satisfying the homologous use standard under 21 CFR 1271.3(c).



Description of the Allograft

PRODUCT COMPOSITION

Natarajan MacuSeal™ is a **single-use, devitalised, dehydrated amniotic membrane** derived from human birth tissue obtained following full-term, live births by consenting donors. The tissue is processed under rigorously controlled aseptic conditions designed to preserve the native extracellular matrix architecture – including collagen, fibronectin, laminin, and proteoglycan components – that underpin its structural and mechanical properties.

Terminal sterilisation is achieved through **gamma irradiation to a Sterility Assurance Level (SAL) of 10^{-6}** , ensuring the highest tier of sterility assurance for single-use surgical allografts. The dehydration process eliminates cellular viability while maintaining the three-dimensional scaffold integrity of the membrane, enabling room-temperature storage without specialised cold-chain logistics.

1

Human Birth Tissue Origin

Derived from full-term, live-birth placentas; donor eligibility confirmed under 21 CFR 1271 Subpart C

2

Aseptic Processing

Controlled dehydration under aseptic conditions preserves native extracellular matrix architecture

3

Terminal Sterilisation

Gamma irradiation to SAL 10^{-6} – the highest sterility assurance standard for surgical allografts

4

Multiple Sizes Available

Multiple thicknesses and dimensions to accommodate the full range of posterior segment defect geometries

"Dehydrated... room-temperature stable... terminally sterilised to SAL 10^{-6} ... individually packaged for single-use intraoperative deployment."

Processing, Preservation & Minimal Manipulation

REGULATORY CLASSIFICATION

The processing methodology applied to Natarajan MacuSeal™ is specifically designed to **preserve the relevant biological and structural characteristics** of the amniotic membrane without introducing alterations that would constitute more-than-minimal manipulation under 21 CFR 1271.10(a)(1). The FDA's definition of minimal manipulation for structural tissue requires that processing not alter the original relevant characteristics of the tissue relating to its utility for reconstruction, repair, or replacement.

Controlled dehydration removes moisture to enable stable storage, but does not alter the collagen architecture, laminar structure, or mechanical properties that define the membrane's structural utility. The ECM scaffold remains intact and fully functional upon rehydration intraoperatively, demonstrating that the relevant characteristics have been **preserved, not altered**.

Not Combined with Other Articles

The allograft contains no drugs, biologics, or device components – it is tissue only

Devitalised — No Living Cells

Cellular viability is eliminated during processing; the product relies entirely on structural ECM properties

Local, Temporary Application

Intended for direct, localised placement on retinal tissue – no systemic distribution or metabolic activity

☐ Minimal Manipulation — Regulatory Basis

Under 21 CFR 1271.10(a)(1), structural tissues are minimally manipulated when processing does not alter the original relevant characteristics relating to the tissue's utility for reconstruction, repair, or replacement. Natarajan MacuSeal™'s dehydration process satisfies this standard by preserving the structural ECM scaffold that constitutes its primary functional attribute.

Application Instructions

Natarajan MacuSeal™ is designed for intuitive intraoperative use, accommodating both inlay and overlay placement configurations depending on macular hole dimensions, retinal architecture, and surgeon preference. The dehydrated format allows brief hydration for enhanced pliability if required, and the graft can be precisely trimmed to match the target defect geometry prior to placement.

1 Preparation

Open the sterile packaging using strict aseptic technique. Hydrate the membrane briefly if required for pliability. Trim to the desired size based on macular hole dimensions using intraoperative forceps or scissors as needed.

2 Placement — Inlay (Plug Technique)

The membrane is gently inserted **within** the macular hole to act as an internal scaffold. Carefully position using end-gripping forceps under direct visualisation to ensure full defect coverage and membrane stability.

3 Placement — Overlay (Cover Technique)

The membrane is placed **over** the macular hole, covering the defect as a biological patch. Lay flat against the retinal surface, ensuring even contact across the defect margins and surrounding retina.

4 Stabilisation

The membrane naturally conforms to the retinal surface following placement. Fluid-air exchange may be performed as per surgeon preference to further stabilise the graft position and initiate the integration process.

5 Post-Procedure

The membrane integrates gradually into the retinal tissue, supporting remodelling, cellular migration, and eventual macular hole closure. Standard postoperative positioning instructions apply per surgeon protocol.

Functional Characteristics in Vitreoretinal Surgery

When applied during vitreoretinal surgery, Natarajan MacuSeal™ leverages the inherent structural properties of the amniotic membrane ECM to deliver several clinically relevant intraoperative functions. These characteristics align directly with the demands of posterior segment surgery, where tissue fragility, precise anatomical coverage, and intraoperative stability are paramount considerations.

The membrane's conformability to retinal contours allows it to be placed with precision over irregular defect geometries – including macular holes, retinal tears, and areas of focal degeneration – without creating edge lift or mechanical tension on the surrounding retinal tissue. Its ability to remain stable during fluid-air exchange and other standard vitreoretinal maneuvers makes it a reliable intraoperative adjunct in complex surgical scenarios.



Temporary Physical Covering

Provides direct surface coverage over retinal defects, protecting the underlying tissue from mechanical disruption during intraoperative manipulation



Structural Scaffold

Supports retinal tissue architecture during the acute phase of surgical repair, providing a biological matrix that interfaces with the host tissue surface



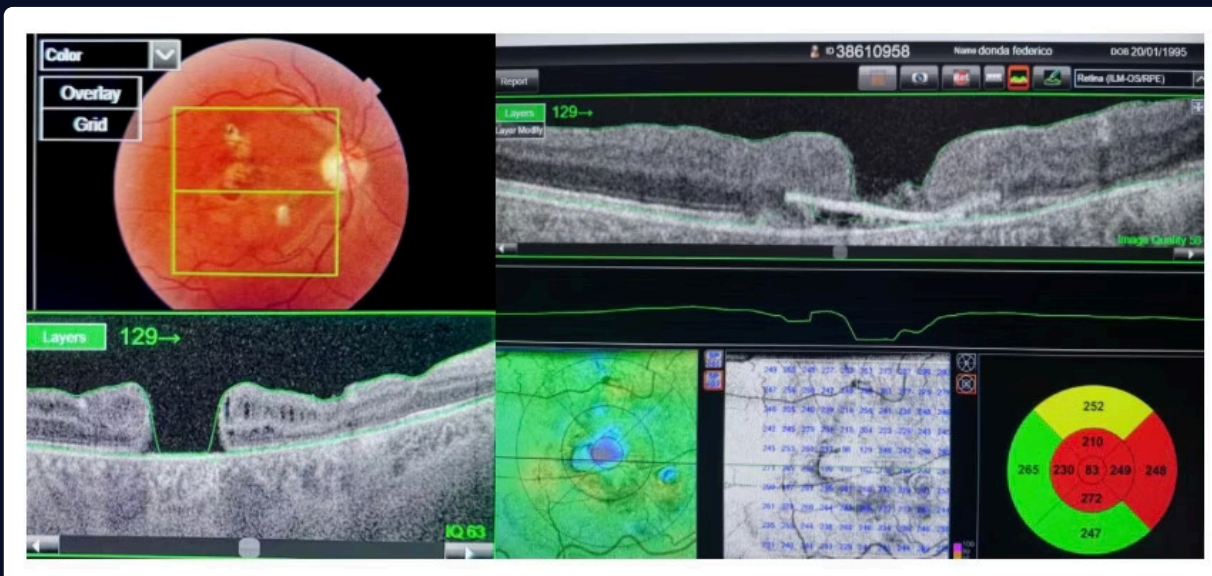
Surface Stability

Maintains consistent positional stability during standard intraoperative maneuvers, including fluid-air exchange and endolaser photocoagulation



Retinal Conformability

The membrane's pliable ECM conforms naturally to the three-dimensional curvature of the posterior retinal surface without folding or buckling



Donor Eligibility & Safety Standards

All tissue incorporated into Natarajan MacuSeal™ is recovered exclusively from **healthy, consenting donors** following live birth deliveries. Each donor undergoes a comprehensive eligibility evaluation conducted under the direct supervision of a qualified Medical Director. This evaluation is structured to identify and exclude donors who present risk factors for transmissible infectious disease or conditions that could compromise the safety of the recovered tissue.

The donor eligibility determination process integrates multiple layers of assessment, incorporating standardised screening criteria aligned with current regulatory requirements under **21 CFR 1271 Subpart C** and guidance from the American Association of Tissue Banks (AATB). The Medical Director's review ensures that all eligibility decisions are made with clinical rigour and documented in a manner that supports full traceability from donor to final allograft.

Screening Components

- **Medical and Behavioural Risk Assessment** – structured interview and record review to identify infectious disease risk factors
- **Infectious Disease Testing** – laboratory panels for relevant communicable diseases per 21 CFR 1271.85
- **Physical Examination & Record Review** – clinical evaluation and obstetric record assessment
- **Laboratory Data Evaluation** – corroborating serological and molecular test results reviewed by Medical Director

Regulatory Compliance Framework

21 CFR 1271 Subpart C

Donor Eligibility – core federal HCT/P regulatory standard

CGTP Compliance

Current Good Tissue Practice governing all processing, storage, and labelling operations

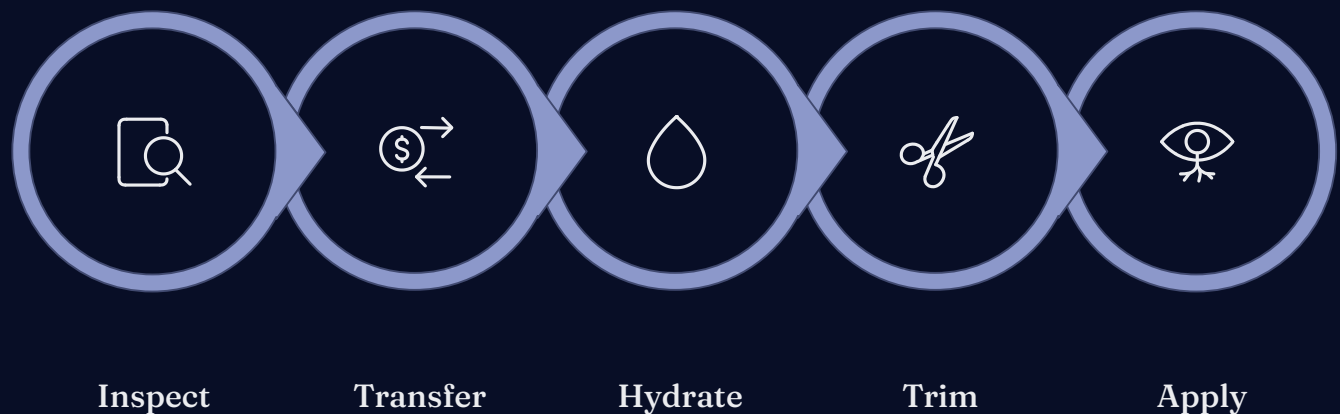
Applicable CGMP Standards

Manufacturing quality system aligned with applicable Good Manufacturing Practice requirements

Clinical Handling & Intraoperative Application

Natarajan MacuSeal™ is designated for use exclusively by **qualified vitreoretinal surgeons** with appropriate training and experience in posterior segment surgical techniques. The handling protocol is designed to be straightforward and compatible with standard vitreoretinal operating room workflows, minimising preparation time without compromising sterility or membrane integrity.

The membrane's dehydrated state facilitates convenient storage and handling. Upon transfer to the sterile field, the allograft may be used in its dehydrated form or briefly hydrated with balanced saline solution to achieve increased pliability, depending on the surgeon's preference and the specific anatomical requirements of the case. Trimming to the precise defect geometry is readily accomplished with standard ophthalmic micro-scissors.



The membrane conforms naturally to retinal tissue contours and maintains positional stability during standard intraoperative maneuvers, including fluid-air exchange. It may be applied as an **inlay** (placed within the boundaries of the defect) or as an **overlay** (covering the defect and a margin of surrounding retinal tissue), depending on the defect morphology and the surgeon's intraoperative assessment.

Storage, Sizing & Product Specifications

PRODUCT INFORMATION

Storage Requirements

Natarajan MacuSeal™ is designed for **room-temperature storage** in the original, sealed packaging. No specialised cold-chain infrastructure, refrigeration, or freezer storage is required at any point in the product's shelf life. This characteristic significantly simplifies inventory management in vitreoretinal surgical practices and operating theatre settings.

Do not use any unit if packaging integrity has been compromised. Inspect the outer and inner packaging for tears, punctures, or evidence of moisture ingress prior to use. Each unit is intended for **single-use only**; discard any unused portion following surgery.

Product Specifications — All Units



Dehydrated

Stable, low-moisture form enabling room-temperature shelf life



Room-Temperature Stable

No cold-chain requirement – store in original packaging at ambient conditions



SAL 10⁻⁶ Sterilised

Terminal gamma irradiation to the highest sterility assurance level



Individually Packaged, Single-Use

Each unit in dedicated sterile packaging; discard after single intraoperative use

Available in **multiple thicknesses and dimensions** to accommodate the full spectrum of posterior segment surgical defect geometries.

500 µm

Ideal for small-to-moderate macular holes requiring precise, minimal-footprint scaffolding

1000 µm

Versatile mid-range option for standard large macular holes (>400 µm) and routine overlay applications

1500 µm

Extended coverage for complex posterior pole defects and PVR-associated retinal repair

2000 µm

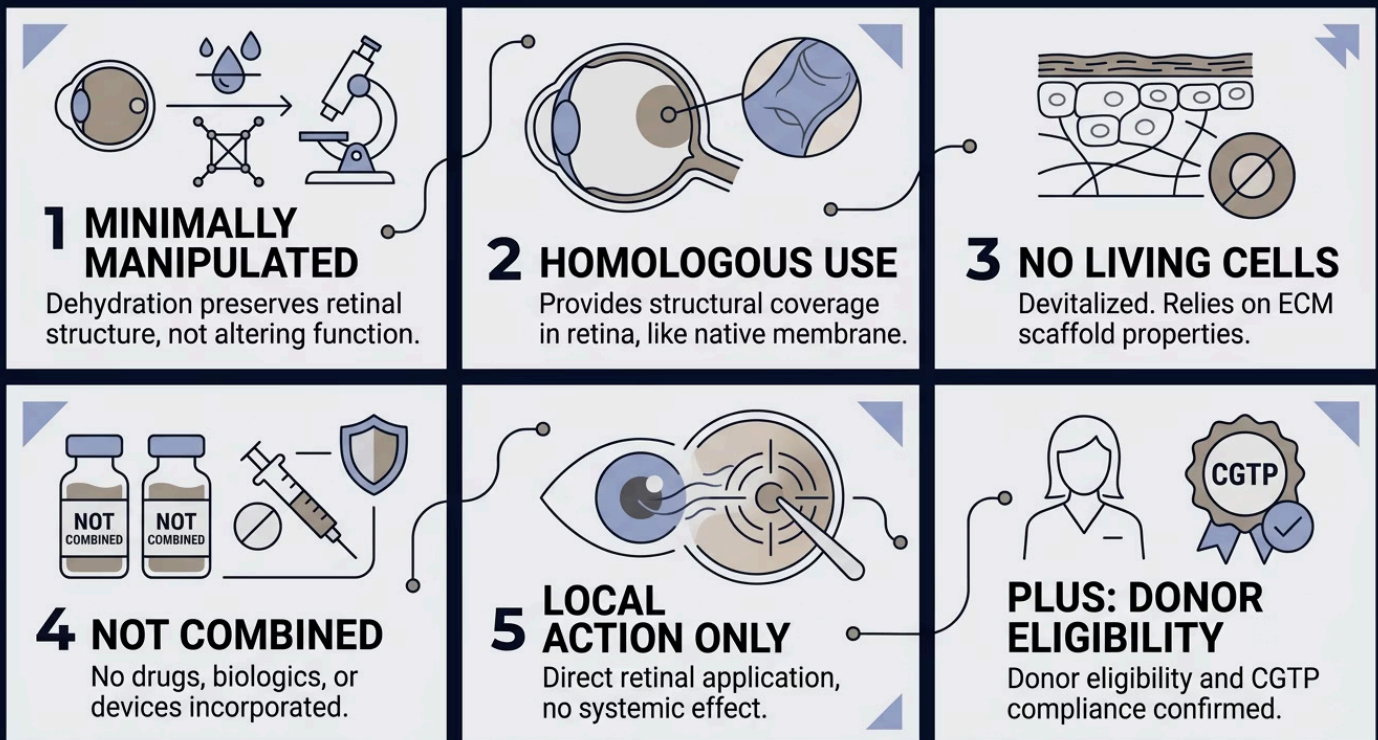
Maximum coverage for giant retinal tears, large posterior pole defects, and advanced reconstruction

Regulatory Positioning:

21 CFR 1271 · PHS ACT SECTION 361

Natarajan MacuSeal™ is positioned for regulation **solely under Section 361 of the Public Health Service Act** and 21 CFR Part 1271, without the requirement for premarket authorization as a drug, biologic, or medical device. This regulatory pathway is available to HCT/Ps that satisfy all five criteria enumerated in 21 CFR 1271.10(a). Natarajan MacuSeal™ meets each criterion, as detailed below.

This classification reflects the product's fundamental nature as a structurally preserved, minimally processed human tissue intended for a direct anatomical homologue of its natural function. The absence of living cells, the lack of combined articles, and the localised – non-systemic – mechanism of action collectively support this regulatory determination and distinguish MacuSeal™ from combination products or biologics requiring BLA or PMA review.



"Natarajan MacuSeal™ satisfies all five criteria of 21 CFR 1271.10(a) for regulation solely under Section 361 of the PHS Act – minimally manipulated, homologous use, no living cells, no combined articles, and local action only."

Manufactured By :

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