

EXAFLEX GHOST®

Bovine Pericardium for Dural Reconstruction

Biological Excellence for Modern Neurosurgery

A safe, biocompatible and easy-to-handle biological solution for dural repair and reconstruction.

THE CLINICAL CHALLENGE

Dural Defects in Neurosurgery

The dura mater is the outermost meningeal layer protecting the brain and spinal cord. Dural reconstruction becomes necessary in:

- Brain tumor surgery
- Skull base procedures
- Trauma surgery
- Decompressive craniectomy
- Congenital defects
- Revision neurosurgery

Consequences of Inadequate Closure

⚠ Cerebrospinal fluid (CSF) leakage

Most common complication

⚠ Meningitis

Serious infection risk

⚠ Pseudomeningocele

CSF collection under scalp

⚠ Delayed wound healing

Increased recovery time

⚠ Reoperation

Additional surgical burden

The primary goal of duraplasty: watertight closure supporting tissue healing and minimizing complications.

CHARACTERISTICS OF AN IDEAL DURAL SUBSTITUTE

✓ Excellent Biocompatibility

Minimal immune response, safe for long-term implantation

✓ Minimal Inflammatory Response

Reduced risk of post-operative complications

✓ Watertight Closure

Prevention of CSF leakage — primary functional requirement

✓ Long-term Stability

Durable performance throughout the healing process

✓ Resistance to Tearing

Maintains structural integrity under surgical manipulation

✓ Immediate Availability

Off-the-shelf solution — no donor site required

✓ Easy Suturing

Reliable fixation with standard neurosurgical sutures

✓ Safe Tissue Integration

Progressive incorporation into host tissues

A biological material reproducing mechanical and biological characteristics of native dura is the preferred option for many neurosurgeons.

WHY BOVINE PERICARDIUM?

A Proven Biological Material

Pure bovine pericardium bilayer collagen with multidirectional braided fibres — used successfully across multiple surgical specialties for decades.

Collagen Composition

Predominantly Type I collagen with a lower percentage of Type III — known for its low tendency to cause immunological reactions.

Bilayer Architecture

Compact non-stick side — highly resistant to bacterial passage
Fibrillary side — ideal environment for cell revitalization

No donor site morbidity • Immediate availability

Key Advantages

✓ Natural collagen matrix

Preserves native biological structure

✓ High tensile strength

Mechanical reliability under surgical tension

✓ Excellent handling

Easy trimming, positioning and fixation

✓ Easy adaptation

Conforms to irregular defects

✓ Excellent suture retention

Reliable fixation with standard sutures

✓ Reduced operative time

Consistent and predictable performance

EXAFLEX GHOST® TECHNOLOGY

Proprietary Process

Deantigenisation without acetone or ethanol — preserving all active regenerative elements inside the membrane.

Dry-Freezing Technology

Lyophilisation maintains the natural 3D structure of collagen fibres, enabling optimal tissue integration after implantation.

Minimal Biological Mass

Up to 50% less biological material than dermal matrices — promoting integration even in poorly perfused areas.

Preserved Active Regenerative Components

COLLAGEN

Tensile strength
Bilayer scaffold

ELASTIN

Pliability &
adaptability

FIBRONECTIN

Cell adhesion
via Integrins

PROTEOGLYCANS

Compressive strength
Cell migration

HYALURONIC ACID

Hydration &
bacterial filtration

The way biologics are manufactured is as important as their origin.

ACTIVE BIOLOGICAL COMPONENTS

COLLAGEN

Main structural component. Two distinct layers:

- Compact watertight layer — barrier against external agents
- Multidirectional fibrillary layer — ideal environment for cell settlement and vascular proliferation

Provides tensile strength and the 3D scaffold for tissue regeneration.

ELASTIN

Makes the membrane extremely pliable and adaptable to the shape of the lesion.

Ensures comfortable handling intraoperatively and natural conformability to complex anatomical areas.

FIBRONECTIN

Acts as a molecular bridge between cells and the collagen matrix.

Fibronectin dimers have two collagen binding sites and two integrin binding sites on cell membranes — enabling cells to adhere, migrate and receive signals through the scaffold.

PROTEOGLYCANS

Fill intercellular spaces, conferring compressive strength.

Their porous, hydrated organisation allows rapid diffusion of water-soluble molecules and supports cell migration through the scaffold.

HYALURONIC ACID

Maintains hydration, plasticity and viscosity of the membrane.

Acts as a molecular filter: only low molecular weight particles pass freely — bacteria and higher molecular weight substances remain trapped in the network, reducing infection risk.

BIOLOGICAL REVITALIZATION PROCESS

The bi-layer membrane undergoes a progressive revitalization process driven by endogenous connective tissue in 3 sequential phases:

PHASE 1

Anchoring & Engraftment

Fibrocytes migrate into the fibrillary layer and contribute to anchoring the membrane to surrounding structures. A new membrane forms around the implant, securing initial integration.

1

Early phase
(weeks)

PHASE 2

Metabolic Adaptation

Fibrocytes penetrate deeper into the bi-layer membrane. Initially they do not synthesize new collagen, but adapt their metabolism to maintain the existing collagen fibre network.

2

Intermediate
(1-3 months)

PHASE 3

Remodeling & Neovascularization

Collagenases begin degrading the 3D structure. Collagen is progressively replaced by new fibrocytes. The neostructure is infiltrated and nourished by capillaries growing inside the scaffold.

3

Long-term
(months+)

Result: The membrane progressively transforms into a vascularized neostructure fully integrated with host tissues, while maintaining biomechanical performance throughout the remodeling process.

SURGICAL HANDLING ADVANTAGES

Designed for Everyday Neurosurgical Practice

Key Handling Features

- ✓ Easy cutting and shaping to fit any defect
- ✓ Excellent adaptation to complex anatomical areas
- ✓ Secure suturing with standard neurosurgical technique
- ✓ Resistance during manipulation — no tearing
- ✓ Conformability on curved surfaces

Ideal Applications

Cranial duraplasty

Skull base reconstruction

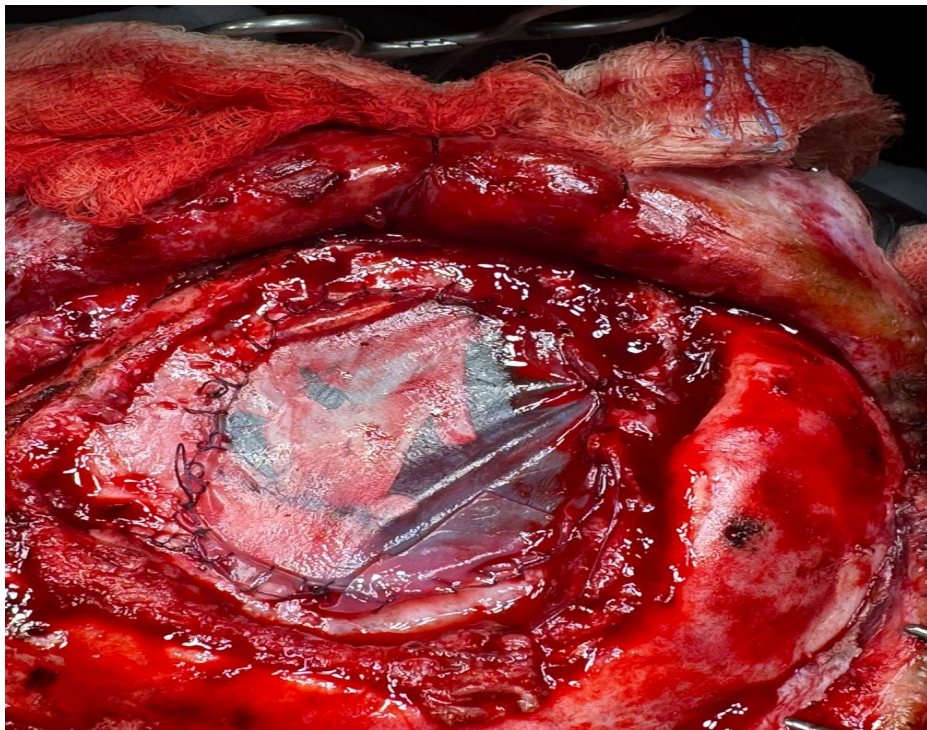
Brain tumor surgery

Trauma surgery

Posterior fossa procedures

INTRAOPERATIVE PERFORMANCE

EXAFLEX GHOST® in the Operating Room



Exceptional Transparency

The Ghost-effect membrane allows direct visualisation of underlying structures and potential bleeding — a unique intraoperative safety advantage.

Easy & Precise Suturing

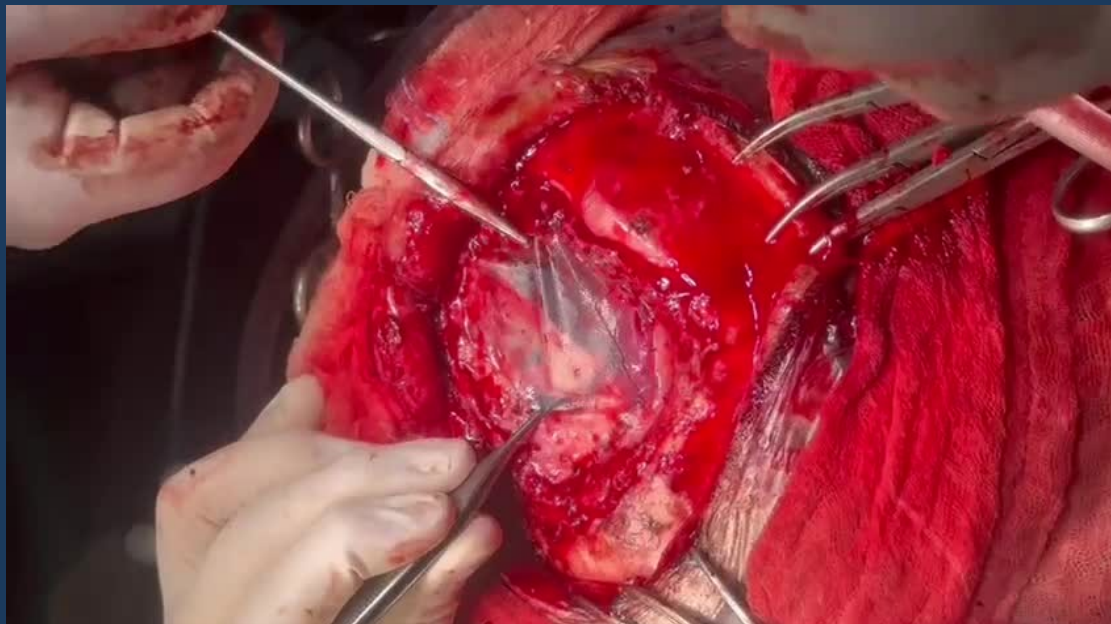
Reliable fixation with standard neurosurgical sutures. The fibrillary layer grips the needle naturally, reducing pull-through risk.

Superior Handling

Extreme pliability adapts to complex shapes. Trimmable to any size and repositionable without damage to the membrane.

EXAFLEX GHOST® — Intraoperative Video

Cranial Duraplasty • Ease of Handling & Suturing



Intraoperative video — cranial duraplasty with EXAFLEX GHOST®

► GUARDA IL VIDEO



*Inquadra con la fotocamera
del tuo smartphone*

dropbox.com → VIDEO-2026-01-15

SCIENTIFIC EVIDENCE

Clinical Experience with Bovine Pericardium



Excellent
Biocompatibility



Low
Complication Rates



Reliable Watertight
Closure



Good Long-term
Outcomes



No Graft-related
Adverse Events

Representative Publications

Lee et al. — Clinical Neurology and Neurosurgery

Safety and efficacy of bovine pericardium for dural closure

Di Rienzo et al. — Journal of Neurosciences in Rural Practice

Outcomes of duraplasty with bovine pericardium

Caroli et al. — Surgical Neurology

Long-term results of biological dural substitutes

Medeiros et al. — World Neurosurgery

Comparative analysis of dural substitute materials

Overall conclusions support bovine pericardium as a safe and effective dural substitute.

BIOLOGICAL vs SYNTHETIC SOLUTIONS

Feature	Bovine Pericardium (EXAFLEX GHOST®)	Synthetic Materials
Biological origin	✓ Yes	✗ No
Tissue integration	✓ Excellent	~ Variable
Flexibility	✓ Excellent	~ Moderate
Suture retention	✓ Excellent	~ Variable
Handling ease	✓ Excellent	~ Variable
Biocompatibility	✓ High	~ Material dependent
Active regeneration	✓ Yes (5 components)	✗ No

In the event of post-operative infection, biological grafts may offer clinical advantages due to their ability to integrate with host tissues and allow vascular and cellular infiltration, potentially supporting antibiotic penetration and infection management.

MARKET OPPORTUNITY

Growing Demand in Neurosurgery

Increasing incidence of brain tumors

Growth in skull base surgery

Rising cranial trauma cases

Complex reconstructive procedures

Target Customers

University Hospitals

Neurosurgical Centers

Oncology Hospitals

Trauma Centers

Private Neurosurgical
Clinics

Value Proposition: A premium biological solution combining scientific evidence, ease of use and surgeon confidence.

EXAFLEX GHOST®

Key Benefits at a Glance

✓ **Biological collagen matrix**

Pure bovine pericardium — Type I/III collagen

✓ **5 active components**

Collagen, Elastin, Fibronectin, Proteoglycans, HA

✓ **50% less biomass**

Better integration even in low-perfusion areas

✓ **High mechanical strength**

Watertight reconstruction support

✓ **Bilayer architecture**

Compact barrier + fibrillary regenerative layer

✓ **Proprietary process**

No acetone/ethanol — all regenerative elements preserved

✓ **Excellent handling**

Easy suturing, shaping and positioning

✓ **Progressive integration**

3-phase biological revitalization process

The Biological Choice for Modern Dural Reconstruction