Value Analysis Brief

Evidence for SYNTHECEL® Dura Repair
Introduction: Dural Repair

This value analysis brief presents evidence for SYNTHECEL® Dura Repair as a dural replacement for the repair of dura mater in adults.

- After intradural surgery, a graft is often required to replace, repair, or reinforce closure of the dura.
- The goal of duraplasty is to attain watertight closure to reduce the risk of cerebrospinal fluid (CSF) leak, infection, formation of a pseudomeningocele, CSF fistula, herniation of neural contents, inflow of blood and contaminants, and to provide a surface for neodura generation.¹
- Current materials used for dural replacement include human tissues, animal tissues, polymers, and biosynthetics.
- The ideal dural substitute material should be biocompatible, prevent CSF leakage, have no increased risk of infection, have no harmful foreign body reaction, provide excellent intraoperative handling, exhibit mechanical properties similar to human dura, and be readily available when needed.²,³
CSF Leaks

CSF leaks are widely recognized as commonly occurring postoperative complications of neurosurgical procedures. The prevention and management of CSF leakage is a primary concern in surgeries requiring dural repair.

- **Postoperative CSF leaks are seen in up to 34.6% of patients** following cranial surgeries, depending on anatomical region and most frequently in skull base procedures.4-6

- Intraoperative and postoperative **CSF leakage can result in serious complications** such as infections and meningitis.7,8

- **Treatment costs for patients with CSF leaks are approximately two times as much as for patients without CSF leaks**, resulting from extended length of hospital stay and higher intensity of care.4,9

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Grotenhuis et al. (2005)4</th>
<th>Piek et al. (2012)9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient with CSF Leak</td>
<td>29,798 € (US$ 32,044)</td>
<td>25,499 € (US$ 27,241)</td>
</tr>
<tr>
<td>Patient without CSF Leak</td>
<td>12,386 € (US$ 13,320)</td>
<td>14,079 € (US$ 15,140)</td>
</tr>
<tr>
<td>Incremental Cost of CSF Leak</td>
<td>16,962 € (US$ 18,241)</td>
<td>11,420 € (US$ 12,281)</td>
</tr>
</tbody>
</table>

*Note: Conversion from Euros to US dollars was made using a rate of $1.08/Euro.*

Dural Repair Substitutes

The search for the most suitable dura mater substitute continues because of various disadvantages of the materials used to date.

<table>
<thead>
<tr>
<th>Graft</th>
<th>Potential Drawbacks</th>
</tr>
</thead>
</table>
| Autograft  | • Difficulty achieving watertight closure10  
              • Formation of scar tissue10  
              • Insufficiently accessible graft materials to close large dural defects10  
              • Additional incisions for harvesting the graft and morbidity to the patient10,11 |
| Allograft  | • Has been associated with the transmission of viral infections and Creutzfeldt-Jakob disease (CJD)12 |
| Xenograft  | • Has been associated with the transmission of viral infections and have shown risk of hydrodynamic complications, including persistent CSF leakage, development of pseudomeningocele, noninfectious or aseptic meningitis, and delayed hydrocephalus7  
              • May be associated with graft dissolution, encapsulation, foreign body reaction, and scarring10 |
| Synthetic  | • Has been associated with deep wound infections when compared to autografts13 |
Autografts

Autografts consist of autologous human connective tissue (e.g., pericranium and fascia lata) obtained from the recipient, and remains the gold standard for dural repair. Autologous tissue is generally favorable because it minimizes the risk of infection and rejection. However, surgeons may avoid autografts if there is not be enough local replacement tissue of sufficient quality to repair the dural defect. In these instances, additional tissue must be harvested from another area of the body (e.g., fascia lata), requiring a second surgical site. This second surgery increases procedural time and morbidity to the patient. In addition, potential drawbacks such as difficulty achieving watertight closure and the formation of scar tissue can occur.

Allografts, Xenografts, and Synthetic Materials

Allograft dural tissue from human cadavers is not often used as it has been associated with the transmission of viral infections and Creutzfeldt-Jakob disease (CJD). Xenografts and synthetics are the two most commonly used dural graft materials; however, both present concerns for patients and surgeons. For example, synthetic grafts have been associated with deep wound infections. In addition, xenografts have been associated with the transmission of viral infections and have shown risk of hydrodynamic complications including persistent CSF leakage, development of pseudomeningocele, noninfectious or aseptic meningitis, and delayed hydrocephalus. Xenografts may also be associated with adverse effects such as graft dissolution, encapsulation, foreign body reaction, and scarring.

Although autografts are often preferred, allografts, xenografts, and synthetic materials are frequently used when an autograft is either unavailable locally and/or the surgeon wants to avoid the morbidity of a second surgical site. For these reasons, SYNTHECEL® Dura Repair provides an alternative to autografts, allografts, xenografts, and synthetics.
SYNTHECEL® Dura Repair

SYNTHECEL® Dura Repair is a dura repair solution based on biosynthesized cellulose technology. Biosynthesized cellulose has been used for various applications, such as wound dressings, bone tissue engineering, neural engineering, and artificial blood vessels.\textsuperscript{15,6} This material is produced by the organism \textit{Komagataeibacter nataicola} (previously known as \textit{Gluconacetobacter} or \textit{Acetobacter}), which is propagated in a nutritive culture media and naturally forms a cellulose pellicle. This process is utilized in the biofabrication of SYNTHECEL® Dura Repair to produce a graft of a specified weight and cellulose content.\textsuperscript{17} The resulting graft features a non-woven construction of interconnected cellulose fibers that provides a magnetic resonance (MR) safe, nonresorbable mechanical layer to protect and repair the dura.

An \textit{in vivo} laboratory study of 36 New Zealand rabbits evaluated the local response and efficacy of SYNTHECEL® Dura Repair compared to DuraGen® (Integra LifeSciences Corporation) and Dura-Guard Dural Repair Patch (Synovis Surgical Innovations).\textsuperscript{18} Gross evaluation and histopathologic evaluation was performed at the implant sites at 2, 4, and 13 weeks postimplantation. Observations demonstrated that SYNTHECEL® Dura Repair was comparable to DuraGen and Dura-Guard Dural Repair Patch when used to replace the dura. Qualitative evaluation of local inflammatory response 2 weeks postimplantation indicated that the local inflammatory response to SYNTHECEL® Dura Repair was between that of DuraGen and Dura-Guard Dural Repair Patch, with Dura-Guard displaying the greatest inflammatory response.

\textbf{Local inflammatory response to Dura-Guard, DuraGen, and SYNTHECEL® Dura Repair two weeks after implantation in a preclinical rabbit model.}\textsuperscript{18}

In addition to laboratory studies, SYNTHECEL® Dura Repair is clinically demonstrated.\textsuperscript{1} Rosen et al. conducted a 6-month prospective randomized controlled trial (RCT) to establish that SYNTHECEL® Dura Repair was non-inferior to other commercially available dural replacement products made of bovine collagen (97.3%) and synthetic material (2.7%) (n=99 total patients enrolled, 62 treated with SYNTHECEL® Dura Repair, 37 treated with control). Furthermore, superior handling qualities were observed with SYNTHECEL® Dura Repair compared to the controls in the RCT, including device strength ($P<0.0001$) and seal quality ($P=0.032$).\textsuperscript{1}
Key Features and Benefits

1. **Effective**
   - No significant difference was observed between SYNTHECEL® Dura Repair and controls for surgical site infection (P=1.0000), wound healing (P≥0.3685), or radiologic endpoints (P≥0.4061).\(^1\)

2. **Non-animal Derived**
   - SYNTHECEL® Dura Repair consists of entirely non-animal derived biosynthesized cellulose.
   - No material-based risk of transmissible spongiform encephalopathies (TSEs, e.g. CJD).

3. **Superior Strength**
   - SYNTHECEL® Dura Repair’s unique construction of non-woven, interconnected cellulose fibers provides strength.\(^16\)
   - Compared to controls, SYNTHECEL® Dura Repair exhibited superior device strength (P<0.0001).\(^1\)

4. **Superior Seal Quality**
   - SYNTHECEL® Dura Repair functions as a mechanical layer and barrier.\(^16\)
   - Compared to controls, SYNTHECEL® Dura Repair exhibited superior seal quality (P=0.032).\(^1\)
5. Excellent Suturability

- SYNTHECEL® Dura Repair ranked as excellent in suturability in 62.1% of cases vs 15.4% in the control group.¹

6. Ready to Use

- Handling, moving, and processing materials constitute 35% to 40% of total supply chain costs in hospitals. Improving medical supply inventory management provides an opportunity to improve overall hospital savings.¹⁹,²⁰
- As a single product for both onlay and suture applications, SYNTHECEL® Dura Repair provides intraoperative flexibility and may help streamline inventory management.²⁰

7. Easy to Use

- SYNTHECEL® Dura Repair is packaged hydrated and ready to use for onlay and suture applications.
- SYNTHECEL® Dura Repair is similar in thickness to human dura (0.26 mm and 0.35-0.58 mm thick, respectively) and is conformable.²¹,²²


Manufactured by:
Synthes USA, LLC
1101 Synthes Avenue
Monument, CO 80132

To order (USA): 800-523-0322
jnjmedicaldevices.com

© DePuy Synthes 2020. All rights reserved.
131711-200515-00US 05/20 OV

The third party trademarks used herein are the trademarks of their respective owners.

Please also refer to the package insert(s) or other labeling associated with the devices identified in this value analysis brief for additional information.

CAUTION: Federal Law restricts these devices to sale by or on the order of a physician.

Some devices listed in this value analysis brief may not have been licensed in accordance with Canadian law and may not be for sale in Canada. Please contact your sales consultant for items approved for sale in Canada.

Not all products may currently be available in all markets.