Foramen magnum decompression with removal of the outer layer of the dura (Isu operation) for syringomyelia with Chiari type I malformation

Department of Neurosurgery, Kurume University School of Medicine

Takahiro Miyahara, Hisaaki Uchikado, Gousuke Hattori, Minoru Shigemori

No funds were received in support of this study.
Purpose

• The surgical treatment of Chiari type I malformation has not been standardized and still controversial.

• The surgical clinical results of foramen magnum decompression (FMD; Isu’s method) in consecutive 8 patients with primary syringomyelia associated with Chiari I malformations are reported.
Methods

- Symptomatic primary Chiari type I with syringomyelia
- The patients were four men and four women, ranging in age from 12 to 62 years (mean, 34.5 yr).
- A bony FMD combined with the removal of the outer layer of the dura mater was performed (Isu method) in 8 patients who had followed by more than 1 year.

- **Exclusion:** asymptomatic
  - recurrent Chiari type I
  - Chiari type II
  - secondary tonsilar herniation
  - achondroplasia
  - other abnormalities
Foramen magnum decompression with removal of the outer layer of the dura as treatment for syringomyelia occurring with Chiari I malformation.

Isu T, et al. Department of Neurosurgery, Kushiro Rousai Hospital, Japan.
Surgical strategy
for symptomatic Chiari I malformation with syringomyelia w/o hydrocephalus

FMD + C1 laminectomy (Isu method)
Dural open plasty /tosilectomy
syrinx shunting

Intraoperative US monitoring
Tonsil pulsation
Enlargement of CM space
CSF flow
foramen of Magendie adhesion

syrinx shunting
Anatomy

cranial dura
osteal layer
meningeal layer

spinal dura
meningeal layer
<table>
<thead>
<tr>
<th>Case</th>
<th>Age/Sex</th>
<th>Symptoms</th>
<th>Scoliosis</th>
<th>Syrinx</th>
<th>Follow-up (mo.)</th>
<th>Symptoms</th>
<th>Syrinx</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>62/M</td>
<td>Rt. U/E atrophy myelopathy</td>
<td>-</td>
<td>holo(C-T)</td>
<td>84</td>
<td>no change</td>
<td>decreased</td>
</tr>
<tr>
<td>2</td>
<td>47/F</td>
<td>Bil. U/E pain</td>
<td>-</td>
<td>cervical</td>
<td>72</td>
<td>no change</td>
<td>decreased</td>
</tr>
<tr>
<td>3</td>
<td>47/F</td>
<td>transient HA</td>
<td>-</td>
<td>cervical</td>
<td>46</td>
<td>reduced</td>
<td>decreased</td>
</tr>
<tr>
<td>4</td>
<td>12/M</td>
<td></td>
<td>+</td>
<td>holo(C-T)</td>
<td>36</td>
<td>-</td>
<td>decreased</td>
</tr>
<tr>
<td>5</td>
<td>16/M</td>
<td></td>
<td>+</td>
<td>holo(C-T)</td>
<td>36</td>
<td>-</td>
<td>decreased</td>
</tr>
<tr>
<td>6</td>
<td>36/M</td>
<td>Bil. shoulder pain</td>
<td>-</td>
<td>cervical</td>
<td>34</td>
<td>reduced</td>
<td>decreased</td>
</tr>
<tr>
<td>7</td>
<td>43/F</td>
<td>Bil. U/E numbness</td>
<td>-</td>
<td>cervical</td>
<td>26</td>
<td>improved</td>
<td>decreased</td>
</tr>
<tr>
<td>8</td>
<td>13/F</td>
<td>Lt. U/E numbness</td>
<td>+</td>
<td>holo(C-T)</td>
<td>12</td>
<td>improved</td>
<td>decreased</td>
</tr>
<tr>
<td>34.5/M:50%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>43.2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Illustrative case: 62 y.o., man
Illustrative case: 12 y.o., man


6 mo.

12 mo.
Size of the syrinx

Graph showing the size of the syrinx over time for different conditions.

- PreOp.
- 1 months
- 3 months
- 6 months
- 12 months

Lines represent different conditions, with markers indicating specific time points.
Results

• In an average postoperative follow-up period of 43.2 months (range, 12-84 months), symptoms and signs improved in six of eight patients and were unchanged in two patients.

• Postoperative magnetic resonance imaging (MRI) scans taken at 6 months after surgery showed a decrease in the size of the syrinx in all patients.

• The decompression of the foramen magnum proved to be sufficient, as disclosed by postoperative MRI.
Flow chart of Chiari I surgery

Posterior fossa craniectomy (FMD)

Tonsilar herniation >15mm

+C1 laminectomy

US:B-mode, CSF flow

Epidural band resection and Outer layer resection

US:B-mode, CSF flow (++)

Dural opening with Dural plasty

Resection of arachnoid and/or Tonsilectomy
Conclusion

• FMD by Isu surgical technique is advantageous because all the procedures are extradural and there are, therefore, fewer postoperative complications than the FMD with the dural opening techniques.

• FMD by the Isu surgical technique is effective as the initial surgical treatment for syringomyelia associated with Chiari I malformations.
Size of the syrinx

- **a**: maximum width of syrinx (mm)
- **b**: vertical line to a

Graph showing the size of the syrinx over time (PreOp to 12 months) with different colors representing different data sets.
Size of the syrinx

![Graph showing the size of the syrinx over time for different conditions. The x-axis represents time points (PreOp., 1 month, 3 months, 6 months, 12 months), and the y-axis represents the maximum width of the syrinx (mm). Different lines and markers indicate various conditions, each color-coded for easy distinction.]
Illustrative case: 13 y.o., woman
Anatomy

cranial dura  posterior layer
meningeal layer

spinal dura  meningeal layer

periosteum (dural band)