Foramen Magnum Decompression versus Foramen Magnum Decompression with Lax Duraplasty in Chiari-I Malformation- A Comparative Study

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Abstract
Background: Despite progress in the understanding of the causes and pathophysiology of Chiari-I malformation (CM-I), definitive surgical treatment remains unresolved. Various techniques have been propounded over the years, but there is no general consensus on the most appropriate surgical management for this condition.

Aim: To compare patients related surgical results of Foramen Magnum Decompression with and without lax Duraplasty in Chiari Malformation Type-I with syringomyelia.

Settings and Design: This is a patient related prospective surgical outcome study conducted during the period of four years from 2013 to 2017 in Stanley medical college, Chennai.

Materials and Methods: Thirty five cases of CM-I with Syrinx were included. There were 12 patients (34.3%) in the non-duraplasty Group-A and 23 patients (66.7%) in the Lax duraplasty Group-B. The rate of patient clinical improvement in the form of preoperative and postoperative VAS pain score and Nurick's score, reduction of postoperative Syrinx size, amount of tonsillar herniation, preoperative symptom duration and postoperative improvement, complications and reoperation rates were analysed for a minimum follow up period of one year.

Results: The rate of clinical improvement was significantly higher with Lax duraplasty Group-B (94.6%) than Group-A (15.4%) with significant p <0.05. The rate of postoperative syrinx regression was significantly higher in the duraplasty Group-B (94.6%) than in the non-duraplasty Group-A (15.4%). No case in the duraplasty Group-B needed a reoperation compared with five cases in the non-duraplasty Group-A.

Conclusion: FMD with Lax Duraplasty(Group-B) is superior to stand alone FMD(Group-A) in CM-I associated with Syrinx with the expense of a slightly higher procedure related complication rate.

Keywords: Chiari Malformation, Lax duroplasty, Syrinx, Tonsillar Herniation.

Introduction
There are six types of Chiari malformations are described in the literature. Chiari malformation type 1 (CM-1) is presented with the downward displacement of the cerebellar tonsils and the medial portions of the inferior cerebellar lobules through the foramen magnum into the upper cervical spinal canal. This causes out flow obstruction of cerebral spinal fluid (CSF) at the level of the foramen magnum, and thus changes the CSF hydro dynamics, causing syringomyelia (SM) or syrinx. Syringomyelia is defined as
longitudinal cystic cavity in the central canal of the spinal cord[12]. Syrinx is commonly associated with 90% case of CM-1. The success rate of surgical decompression ranges from 45% - 87% in various studies. Clinical presentation is commonly with brainstem compression, myelopathy secondary to syrinx formation. There is no ideal optimal surgical modality for the treatment of Chiari-I so far. Among the various surgical methods like foramen magnum decompression (FMD) with and without lax duraplasty, syringostomy, syringopleural (SP) shunt, plugging of obex, syringosubarachnoid shunt and fourth ventriculosubarachnoid shunt procedures are advocated by various authors. Some authors recommend only FMD is sufficient[5-7]. Few authors advocate duraplasty or some additional techniques like various shunt procedures[1,8,9]. Present study is undertaken to compare the surgical results of FMD with and without lax duraplasty in CM-1 associated with Syrinx.

Materials and Methods
Thirty five cases were enrolled for this study during the period of four years from 2013 to 2017 with informed consent. Two surgeons were involved in this study. One surgeon who believes in the stand alone Foramen magnum decompression procedure cases are categorised as Group-A (12 CASES). The other surgeon who prefers the FMD with lax duraplasty categorised as Group-B (23 cases). All patients with progressive neurological deficit and image evidence of syrinx cases are included in this study. Other types of Chiari malformation cases, craniovertebral anomaly cases, additional shunt procedure done cases are excluded from this study.

Patient in prone position, head in flexion with minimum two finger breadth distance from anterior chest wall and lower jaw, head fixed in May field three pins head holder, midline incision marked from external occipital protuberance to C4spinoous process level, after infiltrating the incision line with adrenaline saline with local anaesthetics like lignocaine and bupivacaine mixture, sub occipital cranium exposed via avascular plane through ligamentumnuchae. Foramen magnum decompression done with 3cm height vertically and 4 cm wide horizontally. C1 laminectomy done with atleast 2 cm width in the mid portion[1,10-12]. The non-duraplasty Group-A (only FMD with no manipulation to the dura mater) consisted of 12 patients and the lax duraplasty Group-B (FMD and laxduraplasty using a Fascia Lata autograft from the ipsilateral thigh and fixed in watertight manner and additional reinforcement done with tissue glue (Tisseal)) consisted of 23 patients. All patients related parameters are recorded preoperatively and post operatively at first day, one week, during discharge, one, three, six, twelve months for clinical improvement and imaging study.

Results
Totally there are thirty five patients. In Group-A (males-8, females-4), In Group-B (males-11, females-12) as shown in bar chart-1 and pie chart-2. The common clinical presentation is nuchal and occipital head ache, numbness and dissociative sensory loss, other clinical presentations are depicted in bar chart-3.
Chart-2 shows sex distribution of the study group

Chart-3 shows the patients clinical presentation spectrum

Chart-4 shows the common presentation of CHIARI-1 Malformation
Table 1 shows the comparative study results between two Groups

<table>
<thead>
<tr>
<th>S.No</th>
<th>Parameters</th>
<th>Group-A (FMD)</th>
<th>Group-B (FMD+Laxy Duraplasty)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Clinical improvement</td>
<td>Late</td>
<td>Early</td>
</tr>
<tr>
<td>2</td>
<td>Surgery time</td>
<td>&lt;1 Hour</td>
<td>&gt;1 Hour</td>
</tr>
<tr>
<td>3</td>
<td>Donor site morbidity with Fascia harvesting site</td>
<td>No</td>
<td>Present</td>
</tr>
<tr>
<td>4</td>
<td>CSF leak</td>
<td>No</td>
<td>Possible</td>
</tr>
<tr>
<td>5</td>
<td>Pseudo meningocele</td>
<td>No</td>
<td>Possible</td>
</tr>
<tr>
<td>6</td>
<td>Meningitis</td>
<td>No</td>
<td>Possible</td>
</tr>
<tr>
<td>7</td>
<td>Decompression</td>
<td>Inadequate,</td>
<td>Immediate</td>
</tr>
<tr>
<td>8</td>
<td>Tonsillar removal</td>
<td>Not possible</td>
<td>Possible</td>
</tr>
<tr>
<td>9</td>
<td>Tisseal application</td>
<td>Not needed</td>
<td>Needed</td>
</tr>
<tr>
<td>10</td>
<td>Ligation of occipital venous sinus</td>
<td>Not needed</td>
<td>Needed</td>
</tr>
<tr>
<td>11</td>
<td>Water tight dural closure</td>
<td>-</td>
<td>Must</td>
</tr>
<tr>
<td>12</td>
<td>Additional Blood transfusions</td>
<td>Not Needed</td>
<td>Often needed</td>
</tr>
<tr>
<td>13</td>
<td>Learning curve</td>
<td>Simple</td>
<td>Needs delicate work</td>
</tr>
<tr>
<td>14</td>
<td>Effectiveness</td>
<td>Indirect decompression and to wait for dura to expand by natural means</td>
<td>Direct restoration of CSF hydrodynamics</td>
</tr>
</tbody>
</table>

**Figure 1** pre op MRI Image shows the peg like elongation of cerebellar tonsil 7mm size in to the upper spinal canal

**Figure 2** Showing the stand alone Foramen Magnum Decompression

**Figure 3** Shows the post operative CT image of FMD procedure

**Figure 4** shows the Intra op picture of FMD+DURAPLASTY Procedure
Discussion

Chiari malformation type-I occurs due to congenital or acquired etiologies. It is commonly due to the cerebellar tonsils descends and peg into the cervical spinal canal like piston and alters the CSF hydrodynamics and leads to syrinx formation\(^2,4,14,16\). It is associated with syrinx in 30\%–70\% of cases\(^5,15\). In other words, 90\% of syrinx cases are associated with Chiari-I. Signs and symptoms are directly due to brainstem compression at the level of foramen magnum or syringomyelia\(^2,4\). Head and neck pain is the most common presentation\(^4,12\). Motor and sensory disturbances, long tract signs, cerebellar signs, lower cranial nerve disturbances, nystagmus, hyperreflexia, and ataxia are other neurological findings associated with Chiari-1 malformation\(^2,5,17\).

Clinical and radiological evidence are needed to diagnose this entity\(^11\). MRI is the gold standard diagnostic technique\(^2,18\). Cine flow MRI studies are advocated in decision making of the ideal surgical procedure\(^14,16,19,20\). CT Scan is must to understand the bone anatomy and surgical planning\(^11,17,21\). The optimal and ideal surgical procedure of choice is established based on the clinical findings\(^22\). Some authors states that FMD alone is sufficient\(^6,7,23\), whereas others suggest duroplasty or different shunt procedures \(^1,4,8,9\). Erdogan et al.\(^1\) reported that the symptoms and signs resolved in 83\% of their patients following FMD without duroplasty, but syrinx regression was only 28\%. Syrinx size reduction reported higher according to Ramnarayan et al with duroplasty\(^2\). Romero and Pereira et al\(^9\) reported that duroplasty is effective in Chiari-1 cases with spinal cord syrinx. Present study, the rate of postoperative syrinx regression was significantly higher in the duroplasty Group-B (94.6\%) than the non-duroplasty group (5.4\%, \(p<0.05\)). The syrinx size remained unchanged in 15.4\% of duroplasty patients and 94.6\% of non-duroplasty patients. In this study the clinical improvement is strongly associated with disappearance or reduction in size of the cervical cord syrinx. These results show
that FMD with laxduraplasty is superior to FMD alone.

**Conclusion**

According to the results of the present study, the Foramen Magnum Decompression should be supplemented with lax duraplasty in the surgical management of Chiari-I malformation. Even though the procedure is seem to be associated with more difficulty, needs experience, time consuming, and dural autograft donor site morbidity than simple FMD, it is the complete procedure and patients friendly procedure. Simple FMD is surgeons friendly procedure, but there is no direct and immediate decompression effect according to our study. Small sample size, single centre study and non randomisation of study population are few draw backs of this study.

**Conflict of Interest:** None to declare

**References**

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