

# Posterior Fossa And Foramen Magnum Decompression With Versus Without Duraplasty For Chiari Malformation Type I

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## Citation

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## Abstract

Chiari malformation type 1 (CM) is known as the downward migration of the cerebellar tonsils and the medial part of the caudal cerebellar lobules through foramen magnum (FM) into the upper cervical canal leading to obstruction and disturbance of cerebral spinal fluid (CSF) circulation at the level of FM, which result in syringomyelia (SM). Many authors advocate that only FM decompression is sufficient, while others insist that duraplasty or additional methods as different types of shunts are mandatory. A retrospective study of 28 patients who had undergone operations from 2014 to 2018, of posterior fossa and foramen magnum decompression alone or with duraplasty, and their records and radiographic data of MRI and CT were analyzed and compared. Decompression alone was done in 14 patients, and decompression with duraplasty was done also in 14 patients. The clinical improvement was significantly higher in duraplasty group (71.4%) when compared to the decompression group (42.8%,  $p < 0.05$ ). FM and posterior fossa decompression with duraplasty is superior to decompression only in CM associated with or without syringomyelia, however a higher complication rate when duraplasty is done.

## INTRODUCTION

Chiari malformation type 1 (CM) is known as the downward migration of the cerebellar tonsils and the medial part of the caudal cerebellar lobules through foramen magnum (FM) into the upper cervical canal leading to obstruction and disturbance of cerebral spinal fluid (CSF) circulation at the level of FM, which result in syringomyelia (SM). (1) SM is defined as a widened cystic cavity in the spinal cord matter. In about 90% of SM cases, there is association with CM, in which the success rate of surgical decompression varies widely from 40% to 85%. This group of patients present with SM or brainstem compression symptoms. (2,3)

There is no fixed protocol regarding the ideal surgical intervention for CM associated with SM. However, many different modalities have been proposed, approaches include FM decompression with or without duraplasty, syringostomy, obex plugging and syringo-subarachnoid shunting. (4,5) Many authors advocate that only FM decompression is sufficient, while others insist that duraplasty or additional methods as different types of shunts are mandatory. (6) In the current study we compare the

clinical outcome of posterior fossa and FM decompression with versus without duraplasty in CM.

Posterior fossa and foramen magnum decompression remains the first surgical procedure for the surgical management of CM as shunt techniques are often associated with increased risk of iatrogenic cord trauma. (7-9) However, duraplasty when done during posterior fossa decompression remains a matter of debate, and many previous studies have been conducted regarding posterior fossa and FM decompression with versus without duraplasty. (10) In order to identify the surgical outcome between posterior fossa and FM decompression with and without duraplasty in CM in adult patients, we retrospectively studied the clinical data of patients who had undergone operations from 2014 to 2018.

## METHODOLOGY

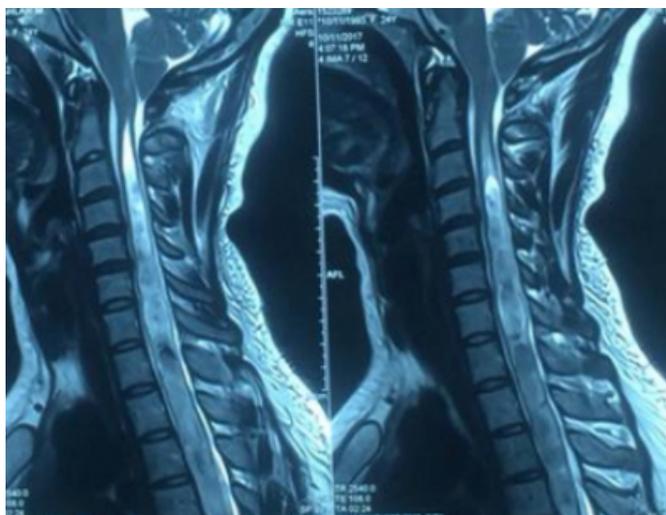
A retrospective study of 28 patients who had undergone operations from 2014 to 2018, of posterior fossa and foramen magnum decompression alone or with duraplasty, and their records and radiographic data of MRI and CT were analyzed and compared.

Inclusion criteria involved all patients aged above 18 years, in addition to a radiological evidence of Chiari malformation type 1 with or without syringomyelia in MRI. Indication for surgery was progressive disabling manifestations as head and neck pain, extremity pain, weakness and/or hypoesthesia, gait difficulties, cranial nerves deficit, hyperreflexia, abnormal temperature discrimination in the extremities, imbalance, and drop attacks. While, exclusion criteria were patients who were under 18 years old, presence of other cranio-vertebral junction abnormalities such as basilar invagination or other anomalies, tumors, infections and trauma, and patients with poor general condition such as renal or hepatic failure patients. Also patients who had already previous surgery such as shunts were all excluded from the current study.

CT scan and MRI of the brain with gadolinium enhancement were obtained and analyzed to describe the degree of hind brain descent, and outline the location and extent of syrinx cavity if present Figure 1.

**Figure 1**

MRI T2 sagittal view showing caudal decent of hindbrain and extensive syrinx.



**Surgical technique**

The surgical procedure was chosen and performed according to surgeon`s preference with or without duraplasty. All patients had general anesthesia and placed in Mayfield head fixator in prone position with slight neck flexion. A midline incision from the occipital protuberance till the C2 spinous process was performed, occipital fascia was kept intact for duraplasty in some cases. Exposure of the edge of the occipital bone, atlantoaxial posterior arch, C1 and C2

spinous processes and laminae was done, then removal of the caudal part of the occipital bone extending at least 3 cm above the foramen magnum with a width of approximately 4 cm, 1-1.5 cm on both sides of C1 lamina of C1 Figure 2-3. Usually after the bony decompression, a thick band-like tissue that compressed the dura was seen and released.

If duraplasty will be done, under the microscope the dura was incised cautiously through a midline incision. Then, the inferior pole of the cerebellar tonsils and the spinal cord were exposed, where a sharp dissection for the arachnoid scarring and adhesions was usually required. A dural graft was done using occipital fascia or using artificial dural substitute. After the duraplasty, the layers were sutured anatomically to achieve the possible anatomical reduction.

Clinical outcomes were evaluated at the first, sixth and twelfth month following the operation. The postoperative condition were evaluated based on: Improved, if improvement of the neurological deficit; stable, if cessation of progression of the neurological deficit; and poor, if further deterioration of neurological function occurred as suggested in the literature [12][20].MRI study was done during the follow-up period, including evaluation of the syrinx cavity resolution if it was recorded postoperatively.

All statistical analyses were performed using statistical software SPSS Version 22.0, SPSS. IBM Corp. P values<0.05 were considered statistically significant.

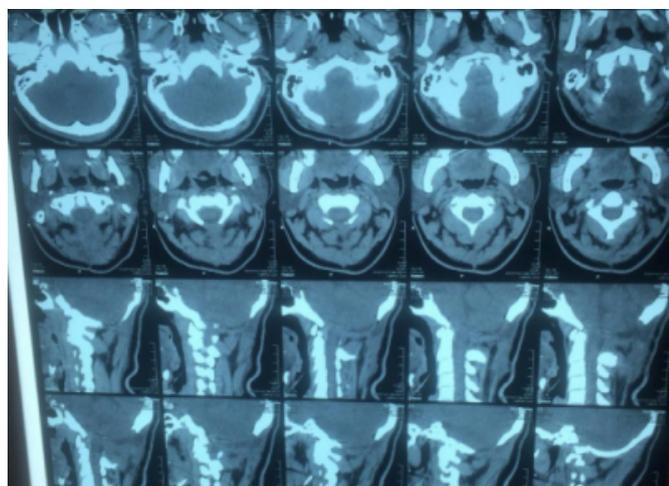
**Figure 2**

Postoperative CT skull with 3D reconstruction showing the suboccipital craniotomy and c1 laminectomy.



**Figure 3**

Postoperative CT skullbase and cervical showing the suboccipital craniotomy and c1 laminectomy.



**RESULTS**

The ages of the patients involved in our study ranged between 19 and 62 years, with a mean age of 51 years. The follow-up period varied between 12 to 46 months, with a mean of 36 months. 15 patients (54%) were males and 13 (46%) females (Table 1).

**Table 1**

Study cohort demographics

Demographics	Decompression n=14	Duraplasty n=14
Sex		
Male	8	7
Female	6	7
Mean age, years	54	48
Symptom duration, months	60.43 ± 40	64.70 ± 80
Hospital stay, days	5 (3-10)	5 (3-13)

The presenting symptoms of both groups are described in Table 2, they were classified into two main groups, pain and non-pain symptoms; there was no statistically significant difference between both groups as regard the preoperative symptoms.

**Table 2**

Main presenting symptoms of study cohort

Symptoms	Decompression n=14	Duraplasty n=14
Pain symptoms	10	9
Headache	10	8
Neck pain and back pain	2	2
Upper extremity pain	4	4
Nonpain symptoms	8	9
Sensory loss or parathesia	5	4
Muscle weakness	4	5
Gait disturbance	3	2
Tinnitus	2	1
Ataxia	2	2
Hoarseness	2	2
Hearing difficulty	1	
Dizziness	2	2
Numbness and tingling	3	4
Dysphagia	1	1

Decompression alone was done in 14 patients, and decompression with duraplasty was done also in 14 patients. The clinical improvement was significantly higher in duraplasty group (71.4%) when compared to the decompression group (42.8%, p<0.05).

Table (3) describes the prevalence and extent of syringomyelia in both groups, besides it outlines the prevalence of postoperative syringomyelia regression in size (when existed), being higher in duraplasty group (80%) than the decompression group (40%, p<0.05). The syrinx cavity dimensions remained the same in 20% of patients who had duraplasty and 60% of patients who did not. None of the patients in non-duraplasty group with persistent SM improved clinically, however, no worsening occurred.

**Table 3**

Syrinx prevalence in the study

Presence of Syrinx	Decompression n=14	Duraplasty n=14
Preoperative MRI	5	5
Cervical	5	5
Beyond cervical	1	2
Regression	2	4

One case in the duraplasty group had CSF leakage on the 4th day postoperatively, subsequently the patient needed another repair procedure with the use of fascia lata graft, the repair was successful and no further CSF leakage was recorded postoperatively. Three cases in the non-duraplasty group required another surgery as no clinical improvement occurred, all of them had an additional duraplasty. The improvement during the follow-up period seen in Table 4. Two cases died postoperatively, one in each group, 1 of 2 patients had apnea on the 5th postoperative day, whom belong to duraplasty group. The other patient died from deep wound infection and subsequent bacterial meningitis two weeks after surgery.

**Table 4**

Follow up and outcome of the study.

The follow-up and outcome	Decompression n=14	Duraplasty n=14
Improved	6	10
Stable	4	3
Poor	3	0
Dead	1	1

The overall complication rate was 10.7%, with 7% in the non-duraplasty group and 14% in the duraplasty group, which is slightly higher but not statistically significant Table 5. There was no statistically significant relationship between clinical improvement and preoperative symptoms duration.

**Table 5**

Associated mortality and morbidity in the study cohort.

Complications	Decompression n=14	Duraplasty n=14
Wound infection	1	
CSF leakage		1
Apnea		1
Reoperation	3	1
Death	1	1

**DISCUSSION**

Clinical presentation of Chiari malformation type-I greatly varies between patients; where, according to literature, the most common presentation is pain; occipital, in the nape, and upper extremities.(11–13) Other manifestations include sensory loss, numbness, weakness, and cranial nerves deficit. In our current study, 67.8 % of subjects had pain symptoms, and the most frequent recorded pain symptom was in the form of headache then upper limbs pain then back pain, which matches many studies.(10,14,15)

Some authors have concluded that posterior fossa decompression is sufficient, others have suggested the duraplasty step. In literature, the surgical outcome between decompression alone and the decompression with duraplasty are not significantly different, but the complications are more encountered in the duraplasty group, which matches our study findings.(6,16–19) The only difference between the procedures complications was the occurrence of CSF leakage in the duraplasty group. This difference was related to the fact that duraplasty requires dural opening and re-sealing the dura with different types of materials. This might harm the integrity of the dural tissue itself and increases the morbidity of CSF-related complications.(7,20–23)

Shweikeh et al. evaluated more than 1500 patients who had posterior fossa decompression alone and around 1000 patients who had duraplasty and compared the complications and hospital charges in a huge study.(15) The patients who had duraplasty had more reoperations (2.1% vs. 0.7%), as well as more procedures related morbidities (2.3% Vs 0.8%), and more length of stay at hospital (4.4 days 3.8 days). So , they concluded that duraplasty was associated with more morbidities and required more surgeries for management. While, Posterior fossa decompression alone was shown to be more safe by requiring fewer hospital resources . However, Mc Girt et al. also considered that decompression alone for hind brain herniation extending below the level of C1 posterior arch was associated with a higher risk of symptomatic recurrence when compared to decompression with duraplasty.(24) In our study, there was no statistically significant difference between both groups regarding complications and mortality, however, the duraplasty group showed more symptomatic relief and regression of syrinx when compared to decompression only group.

The materials for duraplasty remains controversial. Autogenous pericranium, fascia lata and processed collagen matrix have all been used for duraplasty in CM.(14,21) Fascia lata grafting was done in 8 patients in our study while the other 6 patients had pericranium graft, and the only case of postoperative CSF leakage was noted in a patient who had a pericranium graft, it was then successfully managed by a fascia lata graft with consequent closure and prevention of CSF leakage. Such finding is consistent with the results of similar studies. Non-autologous dural grafts have been associated with many complications as foreign body reactions, scarring, healing problems, and wound dehiscence. Autogenous fascia lata have the advantage of

being non-immunogenic, and readily available.(10,14,25)

Erdogan et al. reported that with decompression alone, without duraplasty, syrinx regression rate was only 28% (26), while, Ramnarayan et al., stated that 8 of 11 patients benefited from decompression alone and the syrinx regressed in 50% of cases, whereas, in the duraplasty group, 20 of 23 patients improved and the syrinx regressed in all of them.(27) They concluded that duraplasty is effective in CM cases that are associated with syrinx.(27,28)

The clinical symptoms of the patients having persistent syrinx remained unchanged (stable), however the patients whom syrinx regressed, achieved symptoms relief or improvement. Three of the 5 patients with persistent syrinx were in the non-duraplasty group and they improved clinically after another redo with duraplasty technique. None of the patients who were in the duraplasty group deteriorated neurologically. These findings prove that duraplasty is superior to decompression without duraplasty in CM associated with syrinx.

## LIMITATIONS

The present study has all of the limitations of any retrospective study design. A prospective multicenter study with a large and equal number of patients in both groups might provide an evidence for solid identification of the indications and benefits of each technique.

## CONCLUSION

FM and posterior fossa decompression with duraplasty is superior to decompression only in CM associated with or without syringomyelia, however a higher complication rate when duraplasty is done. A larger number of case series is needed, for more solidification of current conclusion.

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