Posterior Fossa Reconstruction Using Titanium Plate for the Treatment of Cerebellar Ptosis After Decompression for Chiari Malformation

Vikram Udani, Langston T. Holly, Daniel Chow, Ulrich Batzdorf

Key words
- Cerebellar ptosis
- Chiari malformation
- Cranioplasty
- Dural ectasia
- Titanium plate

Abbreviations and Acronyms
CM: Chiari malformation
CSF: Cerebrospinal fluid
ePTFE: Polytetrafluoroethylene
PFD: Posterior fossa decompression


Department of Neurosurgery, David Geffen School of Medicine, University of California in Los Angeles, Los Angeles, California, USA

To whom correspondence should be addressed: Ulrich Batzdorf, M.D. [E-mail: ubatzdorf@mednet.ucla.edu]

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OBJECTIVE: **We describe our use of a perforated titanium plate to perform a partial posterior fossa cranioplasty in the treatment of cerebellar ptosis and dural ectasia after posterior fossa decompression (PFD).**

METHODS: **Twelve patients who had undergone PFD underwent posterior fossa reconstruction using a titanium plate. Symptoms were related to either descent of the cerebellum into the decompression or to dural ectasia into the craniectomy defect.**

RESULTS: **Twelve patients who had undergone large suboccipital craniectomies and who presented with persistent headaches and some with neurological symptoms related to syringomyelia, underwent reoperation with placement of a small titanium plate. Ten of 12 patients showed symptomatic improvement after reoperation.**

CONCLUSIONS: **Placement of a titanium plate appears to be an effective method of treatment of cerebellar ptosis and dural ectasia after PFD for Chiari malformation.**

INTRODUCTION

Management of Chiari malformation (CM) remains a challenging problem for neurosurgeons. Descent of the cerebellar tonsils into the foramen magnum results in impaired flow of cerebrospinal fluid (CSF) from the cranial to the spinal subarachnoid space. Pulsatile action of the descended cerebellar tonsils against the relatively isolated spinal subarachnoid space favors the development of syringomyelia (2, 7). Although posterior fossa decompression (PFD) is generally accepted as the treatment of CM, both without and with syringomyelia, there is considerable variation of the specific technique used by different neurosurgeons.

Management of persistent or recurrent symptoms after PFD often is challenging. The most frequent complication of PFD is CSF leakage from the incision, meningitis, and formation of a symptomatic pseudomeningocele (3, 9, 11). Cerebellar ptosis, also known as cerebellar slump or sag (1, 4, 8, 9), is another complication with potentially severe symptoms. Closely related is the problem of dural ectasia through a large bony defect. Patients with these problems generally present with headaches in the frontal, vertex, or orbital area, headaches that differ from the typical brief strain-related headaches encountered in patients with CM before decompressive surgery. The ptosed cerebellar tonsils also may re-establish contact with the brainstem, recreating partial obstruction of CSF flow, and thereby re-establishing conditions for filling of a syrinx cavity. Cerebellar ptosis has been described previously (4, 9, 14, 15), including treatment by partial posterior fossa cranioplasty, with or without intradural exploration, using methylmethacrylate (8). Dural ectasia as a source of recurrent headache had not been previously identified. In the present article we describe our use of a small, perforated titanium plate to perform partial suboccipital cranioplasty in selected patients.

METHODS

Patient Population

Twelve patients were selected for posterior fossa reconstruction using a titanium plate. All patients were evaluated for surgery at the University of California Los Angeles Medical Center between 2008 and 2010. The series included three men and nine women, ranging in age from 17 to 56 years (mean age, 35.8 years). All patients had previously undergone PFD procedures. Gender, age, primary complaints, presence or absence of a syrinx, and time interval since primary surgery were recorded (Tables 1 and 2). Three of the index procedures (patients 6, 9, and 11) were performed by one of the authors (U.B.) Clinical outcomes and changes in syrinx cavities were also tabulated. Of the five patients with syringomyelia, four had an initial decrease in size of the syrinx cavity after the index operation and one patient showed no response of the cavity to the first operation. The interval between the initial decompressive surgery and reoperation ranged from 2 to 12 years (mean, 4.8 years). The initial surgical procedure consisted of suboccipital craniectomy and duraplasty in eight patients, duraplasty with shrinkage of the cerebellar tonsils in two patients, and suboccipital craniectomy without dural opening in two patients. Four patients also underwent one

Table 1. Index Surgical Procedures: 12 Patients

			Estimated Size of Cranial Defect			Syrinx	
Case No.	Age	Previous Operations	By OR Report	Distance From FM Edge*	Dural Handling/Graft	Y/N	Effect of First Operation
1	27	SC, DP	2 cm below torcula	33 mm	Bovine pericardium	N	
2	41	SC	3.5 cm up from FM	35 mm	Autologous pericranium	Y	Collapsed, no secondary increase
3	49	SC, DP	N/A	22 mm	Fascia lata	Y	Improved, secondary increase
4	35	SC, DP	2 cm	H: 22 mm W: 20 mm	Synthetic over intact arachnoid	N	
5	20	†SC, DP, ‡VPS	N/A	H: 34 mm W: 22 mm	Bovine pericardium and preclude	Y	Collapsed, no secondary increase
6	56	SC, DP, ST	15 mm	H: 13 mm W: 18 mm	Endura	N	
7	22	†SC, ST, DP, ‡Cord Untethering	N/A	H: 19 mm W: 29 mm	N/A	N	
8	17	SC, DP	To torcula	H: 45 mm W: 25 mm	Outer layer of dura excised	N	
9	33	SC, DP	N/A	15 mm	Pericranium over intact arachnoid	N	
10	50	SC	1 cm below torcula	H: 46 mm	Dura scored	Y	No change
11	56	†SC, DP, ‡SP Shunt	N/A	H: 21 mm	Pericranium over intact arachnoid	Y	Decrease with shunt, secondary increase in cord edema
12	24	†SC, DP, ‡FV-SA Shunt	2 cm by 2 cm	H: 30 mm	GoreTex over intact arachnoid, replaced by	Y	Syrinx decrease, delayed increase in size

SC, suboccipital craniectomy; DP, duraplasty; ST, shrinkage of tonsils; FV-SA, fourth ventricle to subarachnoid shunt; VPS, ventriculoperitoneal shunt; SP, syringoperitoneal shunt; HA, headache; O-C, occipitocervical; N/A, information not available.
*Estimated distance from foramen magnum (FM).
†The patient's first prior operation.
‡The patient's second prior operation.

additional procedure after PFD: a ventriculoperitoneal shunt, a fourth ventricle subarachnoid shunt, a syringoperitoneal shunt, and cord untethering.

The 12 patients were divided into two groups. Group I consisted of four patients with bulging ectatic dura, but without evidence of cerebellar descent or ptosis into the decompression cavity. Group II consisted of eight patients with cerebellar ptosis, including three patients 3 with refilling of a syrinx cavity.

Headache, encountered in six patients, was the most the frequently reported symptom and was present in all four group 1 patients with dural ectasia. The headache was mainly located in the suboccipital region, but tended to radiate to the frontal, vertex, orbital, or jaw region. This headache was described as clearly different from the strain-related headache these patients experienced before PFD. Imaging studies demonstrated large craniectomy defects, bone removal often extending beyond the greater diameter of the cerebellar hemispheres (Figure 1A). The dura/duraplasty bulged beyond the edge of the bone. After initial evaluation, five of these patients underwent a 1- to 2-week trial of suboccipital counterpressure by placing a soft foam rubber pad against the decompression site, held in place with an elastic bandage. All five patients had symptomatic improvement with this trial and subsequently underwent partial titanium cranioplasty, as did the patients who did not undergo a preoperative trial of counterpressure and the two who showed no significant response. Patients with cerebellar ptosis presented with symptoms related to the CM, including strain-related headache, neck and back pain, gait ataxia, limb weakness, and sensory changes, as well as nystagmus. Imaging studies showed persistent descent of the cerebellar tonsils (Figure 1B), with syrinx formation in three patients (Figure 1C). This group of patients also had a trial of gentle counterpressure, as described previously, and underwent intradural exploration in addition to titanium cranioplasty. One patient with basilar invagination also underwent occipital cervical fusion.

Surgical Technique

After dissecting soft tissue from the suboccipital region and exposing the prior craniectomy defect, a suboccipital perforated titanium plate (Codman Co., Raynham, Massachusetts, USA) was positioned centrally along the inferior edge of the craniectomy defect, so as to support the dura over the cerebellar hemispheres, but not extending as far caudally as the foramen magnum. It was helpful to shape the flat titanium plate to make it slightly convex, at the same time bending the lateral extensions so that the plate lies flatly against the bone. Care was taken to prevent the inferior edge of the plate from contact with the dura to prevent dural