

Technical Note

Effectiveness of modified dural incision to preserve the patency of the occipital sinus in foramen magnum decompression for a patient with Chiari malformation type I

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Abstract

Background: Foramen magnum decompression (FMD) has been acknowledged as a standard surgical procedure for symptomatic patients with Chiari malformation type I (CM-I). However, even if dural incision is necessary during FMD, the procedure of cutting off the occipital sinus has not been regarded as a safe option.

Case Description: A 27-year-old woman with intractable occipital headache was diagnosed with CM-I without syringomyelia. Preoperative examination revealed a large oblique occipital sinus on her right side. During the first FMD, the dura mater was not incised to preserve the occipital sinus. However, her headache was not relieved with painkillers and cerebellar tonsillar ectopia remained. During the second FMD, two dural incisions were made, while preserving the occipital sinus patency. The dural patch was made using an autologous fascia for both dural incisions. Postoperatively, headache was completely resolved immediately, and cerebellar tonsil was elevated without any complication.

Conclusion: This dural incision, which is a modification of the method introduced by Pritz, would be a useful FMD option for patients of CM-I with dominant occipital sinus, which would lead to the serious neurological sequelae if the sinus flow is disturbed.

Key Words: Chiari malformation, dura, foramen magnum decompression, incision, occipital sinus

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INTRODUCTION

Chiari malformation type I (CM-I) is a well-known hindbrain disorder that is characterized by cerebellar tonsillar herniation behind the cervicomedullary junction, which is associated with the hypoplastic posterior cranial fossa, and often accompanied by syringomyelia.^[1,2,5] Foramen magnum decompression (FMD) has been acknowledged as a standard surgical procedure for most of the symptomatic pediatric and adult patients with CM-I.^[5,6] Incision of the dura mater

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at the posterior fossa is frequently required to relieve the symptoms; a Y-shaped dural incision is usually applied for effective decompression. In a case associated with large occipital sinus, however, a Y-shaped dural incision needs coagulation to cut off the sinus. The safety of the occlusion of the sinus flow remains unverified. Some serious neurological sequelae were reported to occur immediately after coagulation of the occipital sinus.^[7,8] We experienced a successful procedure using a modified Y-shaped dural incision, while maintaining the patency of the large occipital sinus, which resulted in excellent neurological and radiological outcomes. This procedure can be a useful instruction of FMD for CM-I patients with occipital sinus, which is thought to assume the venous return in the posterior fossa.

CLINICAL PRESENTATION

A 27-year-old woman suffered from occipital headache, which retracted downward and deteriorated when looking down. She consulted a local hospital and was diagnosed with CM-I with the use of magnetic resonance imaging (MRI) [Figure 1a]. Syringomyelia was not observed. She was referred to our hospital, but preoperative venography on computed tomography clearly revealed a large oblique occipital sinus on her right side [Figure 1b]. In addition, transverse and sigmoid sinuses on the same side were not developed. Therefore, venous return in the cerebellar hemisphere of the right side was considered to be dependent on the occipital sinus.

During the first FMD, dura mater was kept intact to preserve the occipital sinus after removal of the occipital bone and epidural fibrous band. However, the operation did not relieve her headache or improve cerebellar tonsillar herniation [Figure 2a]. Since her headache could not be controlled with painkiller and disturbed her daily

living activities, a second FMD, including dural opening was scheduled.

Surgical technique during the second FMD

Under general anesthesia, she was placed in prone position with skeletal fixation. Intraoperative administration of antibiotics was performed routinely. A linear suboccipital skin incision from 3 cm above theinion to the level of C4 was carried down to the pericranium. The fascia was harvested from both sides to make a dural patch after undermining the occipital scalp. Then, the dura mater was exposed in a 3 × 3 cm bone window made during the previous surgery. The running course of the occipital sinus was confirmed with a micro-doppler [Figure 3a]. No bony removal was added to this suboccipital craniectomy. A microscope was used for the following procedure, which was a modification of the method introduced by Pritz.^[10] In fact, the usual Y-shaped dural incision was modified with preservation of the occipital sinus patency. The dural incision consisted of two parts. First, a routine midline incision was made from the level of C1 to that of cervicomedullary junction. Following this procedure, the dura over the left cerebellar hemisphere was incised per the routine. Subsequently, the additional dural incision, which was located laterally to the right occipital sinus, was made using a modified circular and linear method to expose a wide area of the right cerebellar hemisphere [Figure 3b and c]. Intraoperatively, the occipital sinus was successfully confirmed using a micro-doppler to incise the dura mater safely. The dural patch was made with the autologous pedicled fascia for the medial incision and acaulescent fascia for the lateral incision sutured with 5-0 PROLENE®.

Postoperative clinical course was uneventful; her headache was completely resolved immediately after the operation. She was discharged home and returned to her previous work. In addition, a postoperative MRI obtained

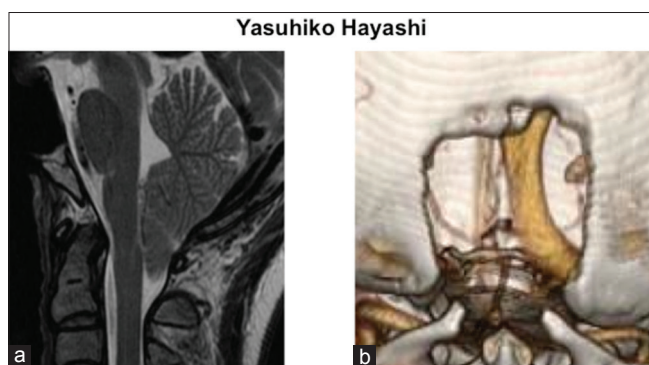


Figure 1: (a) Preoperative T2-weighted magnetic resonance image on the sagittal section clearly demonstrated the descent of the cerebellar tonsil and tightness of the cerebellar hemisphere in the posterior fossa. (b) The three-dimensional contrasted enhanced venography on the computed tomography scan clearly revealed the dominant occipital sinus on the right side, and undeveloped transverse and sigmoid sinuses on the same side

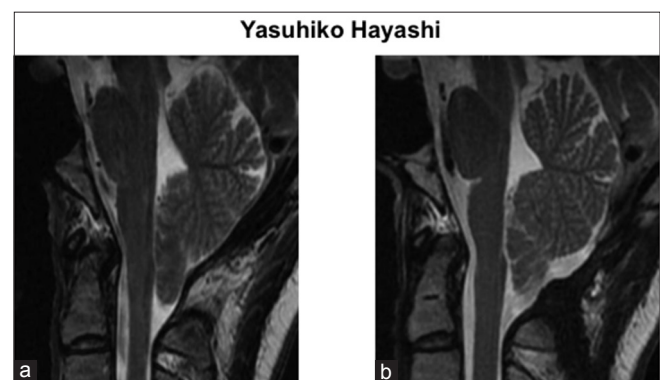


Figure 2: (a) Compared with the preoperative image, a T2-weighted magnetic resonance image on the sagittal section after the first foramen magnum decompression (FMD) showed no apparent change. (b) A T2-weighted MR-image of the sagittal section after the second FMD revealed the elevation of the cerebellar tonsil and opening of the retrocerebellar space over the cerebellar convexity, indicating that CM-I findings were remarkably improved

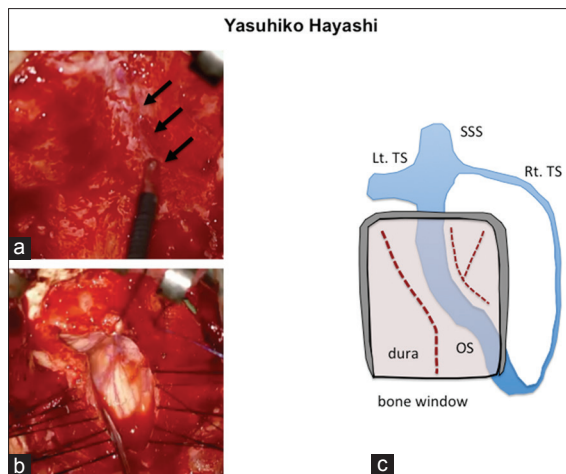


Figure 3: (a) The intraoperative picture revealed the confirmation of the occipital sinus (arrows) with micro-doppler. (b) The dural incision consisted of two parts as follows: a midline incision from the level of C1 to that of the cervicomedullary junction, and an incision over the left cerebellar hemisphere. (c) The scheme of the dural incisions in the present case. OS, occipital sinus; SSS, superior sagittal sinus; TS, transverse sinus

3 months after the operation revealed the elevation of the cerebellar tonsil, indicating that the findings of CM-I had improved remarkably [Figure 2b]. She has not encountered headache for 1 year since the operation.

DISCUSSION

Although Y-shaped dural incisions have been performed after coagulation of the occipital sinus, during FMD for cases of CM-I with the occipital sinus, this has mostly been based on the personal experience of each surgeon. No clinical studies have investigated the safety of performing coagulation of the occipital sinus, in terms of short- and long-term neurological outcomes.

In the present case study, there was a single, large occipital sinus in the patient with CM-I, and both transverse and sigmoid sinuses on the right side were undeveloped. Therefore, the venous return in the posterior fossa was considered to be mainly dependent on the occipital sinus. Only a bony removal without dural incision was performed during the first operation. However, persistent headache following the first surgery led us to perform the modified Y-shaped dural incision with preservation of the occipital sinus. Excellent functional and radiological outcomes were obtained following the second procedure.

Pritz reported a simplified technique using a curvilinear dural incision and autologous pericranial graft on one side, avoiding the occipital sinus. Although he outlined several advantages of this technique, we believe that the most useful one was the avoidance of the occipital sinus. In our patient, this technique removed her intractable headache, without any complication leading

to serious neurological deficits. Our results corroborated with Pritz,^[10] who also reported that this technique was associated with satisfactory clinical radiological outcomes and minimal complication in his series. However, he did not show a case of CM-I with dominant occipital sinus such as that reported here.

The occipital sinus can be found in 64.5% cases from adult cadaver study.^[4] It runs within the attached edge of the cerebellar falx from the confluence of sinuses toward the foramen magnum^[11] and can be divided into two marginal sinuses, which surround the foramen magnum, and drain into the jugular bulbs or venous plexus.^[2,7] Occasionally, the occipital sinus deviates to one side to join the sigmoid sinus as it passes through the jugular foramen, which has been termed the oblique occipital sinus.^[11,12] Although venous infarction associated with occipital sinus thrombosis or ligation was extremely rare, there is no evidence of whether the ligation is safe for cases with undeveloped ipsilateral sigmoid and transverse sinus, in terms of both short- and long-term functional prognosis.^[3]

The safety of the occipital sinus coagulation was considered from the viewpoint of embryological development. At the fetal developmental age of 4–5 months, five to seven venous channels originate from the primitive torcular area and from the medial portion of both transverse sinus, and communicate with the marginal sinus and the distal portion of the sigmoid sinus. They decrease in caliber and number due to diminution and fusion, with only a few prominent occipital sinuses being seen by the sixth or seventh month of gestation.^[7,9] Using contrast-enhanced magnetic resonance venography, one study identified the occipital sinus after birth in 91 (34.6%) of 263 male participants and 118 (40.4%) of 292 female participants, respectively.^[7] In the current study, the occipital sinus was observed less frequently in participants who were younger than 50 years. Coagulation or resection of the occipital sinus introduces the risk of unpredictable massive hemorrhage and disturbance of brain perfusion. Lee *et al.*^[8] reported that temporal clamping of the occipital sinus, using four curved mosquitos, before resection of the occipital sinus, was a useful method to avoid these complications. Nevertheless, the long-term prognosis of neurological deficits due to a disturbed venous return in the cerebellar vermis and hemisphere remain to be clarified.

CONCLUSION

This modified dural incision can be useful option to avoid a coagulation of a single, large occipital sinus, which seems to regulate the venous return in the posterior fossa, during FMD for patients with CM-I. Neurosurgeons should know this technique and preserve the dominant occipital sinus to avoid serious neurological deficits.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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