Zigzag Skin Incision Effectively Camouflages the Scar and Alopecia for Moyamoya Disease: Technical Note

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Abstract

Moyamoya disease is commonly diagnosed in children, and requires various vascular reconstruction to improve symptoms. Therefore, scar widening and hair loss after craniotomy, which sometimes occurs in this disease, are serious problems for patients. A variety of plastic surgical techniques in scalp have been reported to minimize the scar widening and hair loss. However, any neurosurgical reports describing this purpose have never been published for moyamoya disease. The objective of this study was to investigate whether these plastic surgical techniques could be applied to bypass surgery without any compromise of vascular reconstruction for moyamoya disease. We performed direct and indirect vascular reconstruction in six hemispheres of moyamoya disease patients not only in the middle cerebral artery territory but also in the anterior cerebral artery territory. The scalp incision was designed not parallel to the hair stream, and the bevelled incision was conducted not to jeopardize the hair follicles. The scar and hair loss were effectively camouflaged throughout the postoperative period in all cases. This study demonstrates that our design of scalp incision achieve effective vascular reconstruction and obscure the scar and hair loss.

Key words: moyamoya disease, scar widening, hair loss, extracranial-intracranial bypass, zigzag incision

Introduction

A certain amount of hair loss along a scalp incision is inevitable after craniotomy. However, some techniques in ordinary scalp incision exacerbate hair loss. In extracranial-intracranial (EC-IC) bypass surgery, arteries feeding the scalp are harvested and anastomosed to the cerebral arteries, resulting in more pronounced hair loss compared to other neurosurgical operations. Moyamoya disease is common in children, and complicated vascular reconstructions are sometimes needed.1,2 As a result, patients with moyamoya disease are often afflicted with obvious hair loss for years postoperatively.

Plastic surgeons usually apply specially designed scalp incisions to achieve minimal scar formation and avoid hair loss.3–5 However, application of such techniques to EC-IC bypass surgery is not simple, particularly for cases involving moyamoya disease. Various vascular reconstructions are used to treat moyamoya disease, such as superficial temporal artery (STA) to middle cerebral artery (MCA) bypass, or encephalo-duro-arterio-myo-synangiosis (EDAMS).1,2,6–10

Moreover, some patients who manifest symptoms due to hypoperfusion in the anterior cerebral artery (ACA) territory also undergo STA-ACA bypass.1,2,7,8,11 Both direct and indirect vascular reconstructions even in the ACA territory as well as the MCA territory are often used for moyamoya disease, and design of the scalp incision thus warrants special consideration. We successfully designed a skin incision to allow efficient bypass with minimal scar formation and hair loss.

Materials and Methods

We have performed direct and indirect vascular reconstruction in 6 hemispheres of 5 moyamoya disease patients so far (Table 1). All patients underwent STA-MCA bypass with indirect bypass. Five of six hemispheres underwent simultaneous STA-ACA bypass. Patients presented with transient ischemic attack (TIA) in two cases, intracerebral hemorrhage (ICH) in two cases, and cerebral infarction in one case (Table 1). All hemispheres were displayed a “misery perfusion” state according to single photon emission tomography of the MCA territory, and all but one case showed misery perfusion even in the ACA territory.
To camouflage the scar effectively, the scalp incision was designed not to be parallel to the hair stream. Special attention was paid to the scalp edge and hair follicles, to minimize scar formation and follicular injury.

**Surgical procedure**

The patient was positioned supine on the operation table. The head was rotated 30° to the opposite side, and secured using a Mayfield skull clamp (Ohwa Tsusho Co., Ltd, Tokyo). The scalp incision was designed as shown in Fig. 1. Each corner of the incision was designed to be approximately 120°. The skin incision was made using a scalpel, and not by monopolar cautery, under an operative microscope. The beveled incision was made parallel to the sloping axis of the hair follicles to minimize injury (Fig. 2). Stricture was mainly used for hemostasis of the scalp. Bipolar coagulation was avoided as much as possible, particularly around hair follicles. The STA was harvested subgaleally after scalp reflection. In most cases, three or more branches of the STA were harvested. After harvest of the STA, the procedure was performed as described previously. Vascular reconstruction was conducted directly with the STA-MCA and STA-ACA bypass and indirectly even in the median frontal area. After all anastomoses had been completed, indirect bypass, such as encephalo-myo-synangiosis (EMS), was performed. The gap in the galea after STA harvest was sutured using 4-0 polydioxanone (PDS) (Johnson & Johnson, Tokyo). A vacuum drain was placed subcutaneously, and the galea was sutured using 4-0 PDS. The superficial skin layer was closed with 4-0 nylon to avoid injury to hair follicles.

**Result**

All patients were discharged with no sign of infection or skin necrosis. Satisfactory vascular reconstruction was confirmed postoperatively in all cases by magnetic resonance angiography or digital subtraction angiography. The scar and alopecia were effectively camouflaged immediately postoperatively in all patients. (Fig. 3a) Hair loss around the incision and over the scalp flap was observed to some extent.
in all cases at 1 month postoperatively (Fig. 3b), but was well-camouflaged and gradually improved over the course of several months. Moreover, hair growth was observed even over the scalp (Fig. 3c). No cases were afflicted with alopecia at 6 months postoperatively (Fig. 3d).

With conventionally designed skin incisions, the incision line is almost linear and parallel to the hair stream in the temporal region. The area of hair loss remains noticeable even several years postoperatively, due to cicatricial alopecia and scar widening (Fig. 4). In the current study, hair loss was so inconspicuous that no patients felt compelled to change their hair style.

Discussion

EC-IC bypass is a standard treatment for occlusive cerebrovascular diseases, such as moyamoya disease. STA-MCA bypass was first performed by Yasargil in 1967, and various bypass techniques have since been reported. The carotid occlusion surgery study (COSS) recently revealed that EC-IC bypass was able to improve the oxygen extraction fraction, but prognosis was unimproved in patients who underwent bypass surgery. However, in moyamoya disease, direct bypass surgery including STA-MCA bypass and indirect bypass surgeries such as EDAMS, and multiple burr hole surgery have been developed, and the results have been established.

A certain degree of hair loss around the scar is inevitable. The easiest way to camouflage the scar and alopecia is to conceal them. The scar parallel to the hair stream is conspicuous if the hair falls naturally. Therefore, the incision line should not be made parallel to the hair stream especially in the temporal region. This is why we designed zigzag incision in the temporal region.

Complications affecting the scalp after EC-IC bypass surgery have been described, but few reports have indicated how to avoid such complications particularly hair loss. Scalp complications, such as alopecia or scalp necrosis, may have long-lasting psychological impacts on patients, so the utmost care must be taken to avoid or minimize such complications. In plastic surgery, various methods such as zigzag incisions have been recommended to achieve satisfactory esthetic results. The zigzag skin incision is sometimes used for the craniofacial area in the field of pediatric neurosurgery. However, no previous reports have described esthetic results for moyamoya disease. Some plastic surgical techniques are relatively complicated, and employment in neurosurgical operations is thus impractical. Among the various techniques, zigzag incisions are simple to employ, and beveled incisions are readily made using the microscope to minimize injury to the hair follicles. This is the largest dilemma in the current procedure, because moyamoya disease is established.

Hemostasis is essential particularly in case of pediatric surgery. Bipolar coagulation is ordinarily used for hemostasis in neurosurgery, but electrical cautery should be avoided to prevent injury to the hair follicles. This is the largest dilemma in the present procedure, because moyamoya disease is...
common in childhood. Astriction is employed, but bleeding from the scalp is difficult to totally control. Further study is needed into achieving thorough hemostasis simultaneously with protection of the hair follicles.

Our design for the scalp incision can be adapted to all frontotemporal craniotomies. On esthetic grounds, cases in which multiple operations will be performed represent the best candidates for our incision design.

Conclusion

Scar widening and alopecia can occur after EC-IC bypass for occlusive cerebrovascular disease including moyamoya disease. Such complications may have serious psychological impacts particularly on younger patients. We suggest that zigzag incisions and beveled incisions can effectively camouflage scalp problems and may provide psychologically better outcomes.

Conflicts of Interest Disclosure

There are no conflicts of interest for this article. All authors have registered online Self-reported Conflicts of Interest Disclosure Statement Forms through the website for the Japan Neurosurgical Society members.

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