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Case Report

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The Effect of Elastic Eyelid Band Application on Bilateral Severe Ptosis in a Patient With Bilateral Incomplete Claude's Syndrome: A Case Report

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HIGHLIGHTS

- A rare case of severe bilateral ptosis due to incomplete bilateral Claud's syndrome.
- Few cases are reported using nonsurgical treatment for bilateral neurogenic ptosis.
- Soft elastic bands can be an effective nonsurgical intervention for ptosis.

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The authors have no potential conflicts of interest to disclose.

ABSTRACT

Patients with brainstem stroke can present with various oculomotor disorders, including ptosis. Neurogenic ptosis, which results from total or partial dysfunction of the third cranial nerve and/or the Müller muscle, can significantly restrict activities of daily living and participation in rehabilitation. Therefore, surgical intervention is an effective therapeutic strategy. However, owing to complications associated with incomplete eyelid closure, such as exposure keratitis and corneal injury, patients with neurogenic ptosis should first be observed, as natural recovery without surgery can be expected despite a poor prognosis. We reported the case of a 66-year-old woman with bilateral Claude syndrome who presented with severe bilateral ptosis, quadriparesis, and cognitive impairment after a bilateral midbrain infarction. After 3 months of intensive rehabilitation using soft elastic eyelid bands, her ptosis improved without the need for eyelid bands and visual field significantly increased, with improved functional level to the point of walking independently without assistance. This report demonstrates the potential advantages of the simple yet effective nonsurgical intervention of a soft elastic eyelid band for ptosis to restore significant functional gains in patients with severe bilateral ptosis after acute stroke.

Keywords: Midbrain; Cerebral Infarction; Rehabilitation; Treatment Outcome

INTRODUCTION

As one of the deepest structures of the head, the brainstem has the following 3 major roles. First, it acts as a hub for message transfer between the cerebrum, cerebellum, and spinal cord. The brainstem relays sensory information to the cerebrum and sends motor commands to initiate movements. Second, the brainstem is involved in the integrative functions necessary for normal bodily processes, regulating the level of consciousness, controlling sleep–wake cycles, maintaining muscle tone and posture, and governing breathing and cardiovascular function. Third, being intimately connected to the cranial nerves, damage to certain areas of the brainstem can result in widespread and complex deficits [1,2]. Thus, lesions of the brainstem can manifest as cranial nerve dysfunction as well as cerebellar, somatosensory, and motor symptoms [3]. Ischemic vertebrobasilar strokes account for 23% of all ischemic brain strokes, with nearly half of them affecting the brainstem. Among

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Conceptualization: Kim YW; Data curation: Ham CR; Formal analysis: Ham CR; Funding acquisition: Kim YW; Investigation: Ham CR, Park JM; Methodology: Ham CR, Park JM; Project administration: Ham CR, Park JM; Resources: Ham CR, Park JM; Software: Ham CR, Park JM; Supervision: Kim YW, Park JM; Validation: Kim YW, Park JM; Visualization: Ham CR; Writing - original draft: Ham CR, Park JM; Writing - review & editing: Kim YW, Park JM.

brainstem strokes, the majority occurred in the pons (27%), followed by the medulla (14%) and midbrain (7%) [4,5].

Claude syndrome is a rare midbrain stroke syndrome characterized by ipsilateral ptosis, ophthalmoplegia, and contralateral ataxia [6]. It is caused by a stroke in the paramedian midbrain, involving structures such as the medial part of the red nucleus, third nerve fascicle, decussation of the superior cerebellar peduncle, and medial longitudinal fasciculus [7]. Few cases [8-12] have been reported in the medical literature since its first description by Henri-Charles-Jules Claude in 1912 [13]. In particular, bilateral Claude syndrome, as in our patient, has rarely been reported [14,15]. Bilateral ptosis in patients with midbrain infarction is rare and can interfere with various activities of daily living (ADL), such as walking and reduction of patient participation in rehabilitation. The condition indeed has received less attention owing to the limited research on its treatment options compared to the treatable symptoms of arm and leg weakness, cognitive impairment, aphasia, or dysphagia. Previous studies have reported surgical methods to improve bilateral ptosis [12], and little attention has been paid to the nonsurgical treatments for the condition.

Therefore, to expand on this area in the literature, we report the successful rehabilitation outcomes of a 66-year-old patient with bilateral Claude syndrome after bilateral paramedian midbrain infarction. Her marked improvement in functional status and level of ADL after a comprehensive rehabilitation program, involving the application of soft elastic eyelid bands, has been discussed.

CASE DESCRIPTION

A 66-year-old woman was admitted to the emergency room of a university hospital, while on an altered level of consciousness. The patient had a history of diabetes mellitus. Initial brain computed tomography findings were unremarkable (**Fig. 1A**); however, brain magnetic resonance imaging (MRI) revealed bilateral paramedian midbrain infarctions (**Fig. 1B**). Mechanical thrombectomy was performed in the neurology department, and MRI showed hemorrhagic transformation in the left midbrain (**Fig. 1C**). Six weeks after stroke onset, the patient was transferred to the rehabilitation department.

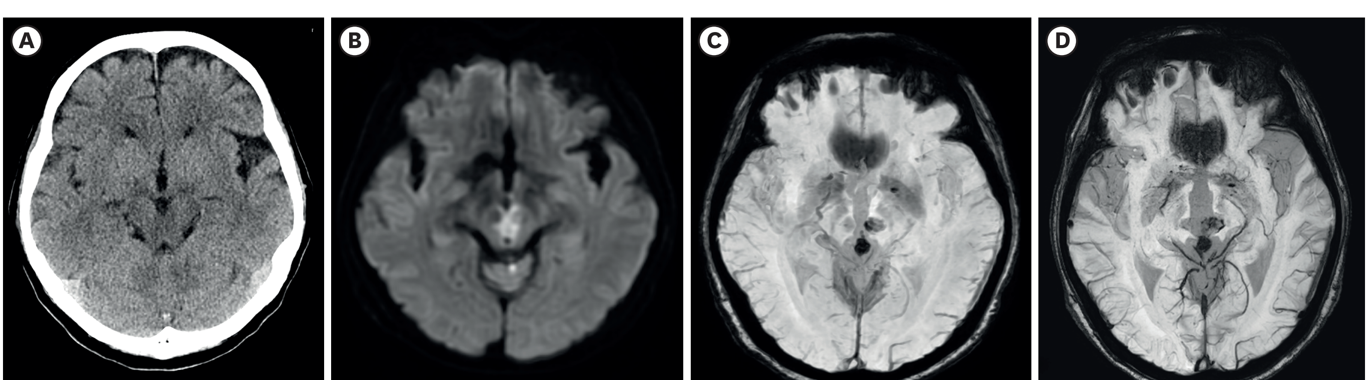

Fig. 1. (A) Initial computed tomography after ischemic stroke. (B) Diffusion-weighted imaging demonstrating bilateral midbrain infarction. (C) SWI demonstrating hemorrhage after thrombectomy. (D) SWI shows a decreased extent of hemorrhage after 3 months.
SWI, susceptibility-weighted imaging.

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Functional assessments were performed using the Korean version of the Berg Balance Scale (K-BBS) for balance assessment, Functional Ambulatory Category (FAC) for ambulation ability, Korean version of the Modified Barthel Index (K-MBI) and Functional Independence Measure (FIM) for ADL assessment, and Korean version of the Mini-Mental State Examination (K-MMSE) for cognitive function assessment. These admission assessments were conducted 6 weeks since stroke onset with eyelid bands on, at time-points such as the initial period of admission (to the rehabilitation department and first evaluated by a physician), 3 months after stroke onset with the application of eyelid bands (when the patient was discharged), and 6 months after stroke onset without eyelid bands (3 months after discharge). The first 2 assessments involved applying soft elastic eyelid bands, and the last one was without. On initial evaluation, the patient showed muscle weakness, for which the Medical Research Council Scale for muscle strength was 3 in both the upper and lower extremities. The patient had a FAC score of 2 and a K-BBS score of 20, which indicated that the patient was unable to walk independently without manual support. The patient's motor coordination was poor relative to her muscle strength, and bilateral finger-to-nose examinations confirmed dysmetria. In addition to functional impairment, the initial evaluation revealed marked bilateral ptosis and mydriasis, with left and right pupil diameters of 6 mm, severe vertical paresis, and moderate adduction limitation in both eyes. The patient's palpebral fissure height was uncheckable on the right side and was 1 mm on the left (**Fig. 2A**). Visual field tests performed after the ophthalmological consultation revealed severe visual field defects (**Fig. 3A**). The memory impairment was indicative with a K-MMSE score of 16 (3 for memory registration and 0 for memory recall), and the memory domain results (0.01th percentile) of the Full-Scale Intelligence Quotient score of 66 (1st percentile). The patient's FIM score was 86 and K-MBI score was 74, which required moderate assistance in ADL. Three-dimensional temporal and spatial gait parameters as well as postural stability could not be assessed as the patient was initially unable to walk independently.

Comprehensive rehabilitation programs were initiated, with each daily session including the following: the patient attended a 1-hour physical therapy and virtual reality gait training session 5 times per week. The physical therapy was managed by a physical therapist with the goals of enhancing the range of motion, strength, static and dynamic standing and improving gait endurance. A virtual reality treadmill (C-mill; Motek Medical, Houten, The Netherlands) was used to strengthen balance and gait endurance. Occupational therapy consisted of individual 30 minutes sessions, 5 days per week, with the goal of enhancing ADL skills needed to take care of personal hygiene and feeding requirements. Cognitive training was also performed for individual 30 minutes sessions, 2 days per week.

Before commencing the rehabilitation, as the patient had severe bilateral ptosis, we applied soft elastic eyelid bands (width, 2 mm; depth, 0.2 mm), widely used for cosmetic purposes

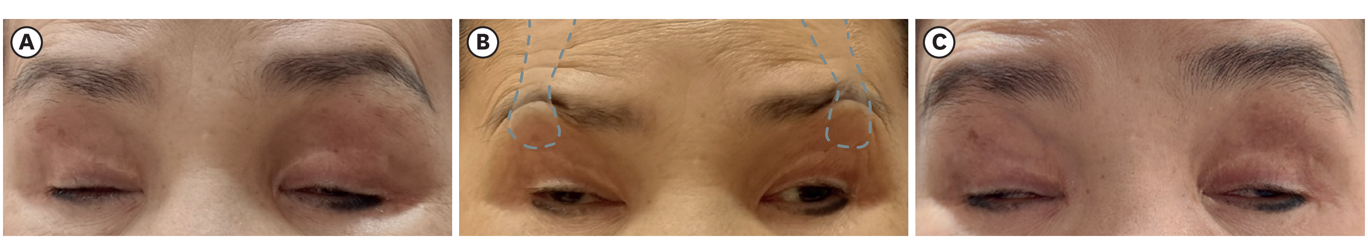

Fig. 2. (A) Photograph obtained before the application of the soft elastic eyelid bands. The palpebral fissure height was uncheckable on the right and 1 mm on the left. (B) Follow-up photograph after the application of the eyelid bands (gray dotted line). Ptosis improved by 2.5 mm on the right and 4 mm on the left. (C) Follow-up photograph after 3 months. Without eyelid bands, ptosis improved by 1.5 mm on the right and 2.5 mm on the left.

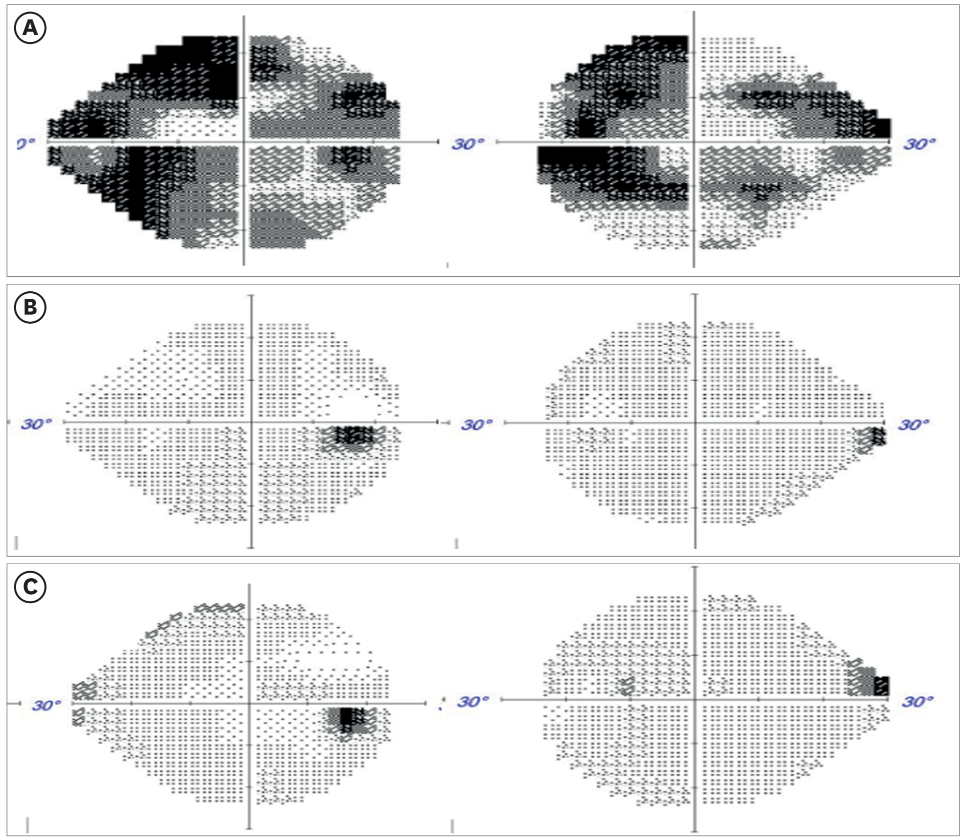

Fig. 3. (A) Visual field evaluation findings before the application of the elastic eyelid bands. (B) Follow-up visual field evaluation obtained after the application of the eyelid bands. The patient showed significant improvement in the visual field area, especially in the right and left upper quadrants. (C) Follow-up visual field assessment 3 months after discharge. The visual field improvement remained similar.

to lift the facial line. The patient bought approximately 100 transparent eyelid bands from a nearby drug store; the bands were unobtrusive and required only a few minutes to apply (with a finger) and remove. The soft eyelid bands were applied during daylight hours, including weekdays and weekends, except during sleeping hours. Three days after applying the eyelid bands, the patient reported dryness of the eye, and lubricants were, therefore, used to prevent exposure to keratopathy. The patient and her caregiver were instructed on the optimal application of the bands and their diurnal change, which thereby recreated the stretching force, while at the hospital. They were also instructed to wear eyelid bands and continue facial exercises even when not receiving treatment. This process was diligently followed throughout the 3-month hospitalization. The patient had expressed satisfaction as the bands were easy to use and improved her visual field limitations.

At the 3-month point after stroke onset, the patient's ptosis improved by 2.5 mm on the right side and 4 mm on the left side (**Fig. 2B**), with improvement of the visual field limitations (**Fig. 3B**). The patient demonstrated a great degree of independence in performing ADL and showed improvement in functional status and cognition. The K-BBS and FIM-motor scores improved from 20 to 39 and from 63 to 75, respectively. The 6-minute walk test was initially performed with constant moderate assistance from a therapist but was performed independently in later assessments by the patient, improving from 246.8 m at the start to 321.6 m in 3 months. The patient's K-MMSE score increased from 16 to 27, and the FIM-

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cognition score improved from 23 to 31. With improvement in functional performance, the patient was able to walk independently without assistance and was discharged. At the 3-month post-discharge evaluation, the patient's ptosis improvement was maintained without eyelid bands (**Fig. 2C**), as was the visual field improvement (**Fig. 3C**). The functional levels also improved, with a K-BBS score of 51 and a FAC score of 4. The 6-minute walking test distance increased, and the 10 m walking test and timed up and go test times decreased. The 3-dimensional time–space gait parameters showed an increase in stride time and a decrease in the side-to-side difference in stride length (**Table 1**). In the postural stability assessment using the C-mill, the center of pressure velocity decreased, and the area decreased when standing on one foot, which improved postural stability (**Fig. 4**).

DISCUSSION

Ptosis of the upper eyelid is defined as an abnormally low-lying upper eyelid margin in the primary gaze, leading to palpebral fissure narrowing, and partial covering of the eye [16]. Ptosis can be categorized based on the levator function. Levator function is expressed as the distance between the excursion of the upper lid margin from a full downward gaze to full upward gaze [17] and is categorized as mild (> 10 mm), moderate (5–10 mm), or severe (0–4 mm) [18]. This patient was classified as having severe ptosis, with an upper eyelid height of 5 mm, and upper levator function of 0 mm on the right and 1 mm on the left.

Ptosis may be congenital or acquired owing to neurogenic, myogenic, mechanical, aponeurotic, or traumatic causes. However, bilateral ptosis has a limited etiology and can be classified as neurogenic or congenital [19]. Considering the sudden onset of the presentation, neurogenic causes accompanied by bilateral midbrain infarctions were considered. In our study, brain imaging and neuroanatomical analysis suggested neurogenic ptosis due to bilateral midbrain infarcts. The oculomotor nerve innervates 4 of the 6

Table 1. Rehabilitation outcomes

Variables	At admission (6 wk after stroke onset)	At discharge (3 mon after stroke onset)	Follow-up (6 mon after stroke onset)
K-MMSE	16	27	29
FSIQ	66 (1 percentile)		102 (95 percentile)
MBI	74	87	87
FIM Motor	63	75	75
FIM Cognition	23	31	33
K-BBS	20	39	51
FAC	2	4	4
6-minute walking test (m)	247*	322	357
10-meter walking test (sec)	12*	11	9
TUG (sec)	15*	13	12
Three-dimensional temporal-spatial gait parameters			
Average stride times (sec)	NT	Right: 0.76 Left: 0.75	Right: 0.99 Left: 1.02
Average step length (m)	NT	Right: 0.21 Left: 0.08	Right: 0.19 Left: 0.18
Postural stability			
One leg standing CoP velocity (cm/sec)	NT	40.38	22.11
Limits of stability CoP area (cm^2)	NT	206.74	164.11

K-MMSE, Korean version of the Mini-Mental State Examination; FSIQ, Full-Scale Intelligence Quotient; MBI, Modified Barthel Index; FIM, Functional Independence Measure; K-BBS, Korean version of the Berg Balance Scale; FAC, Functional Ambulatory Category; TUG, Timed Up and Go Test; NT, non-testable; CoP, center of pressure.
*The patient was assessed with ongoing moderate assistance from a therapist.

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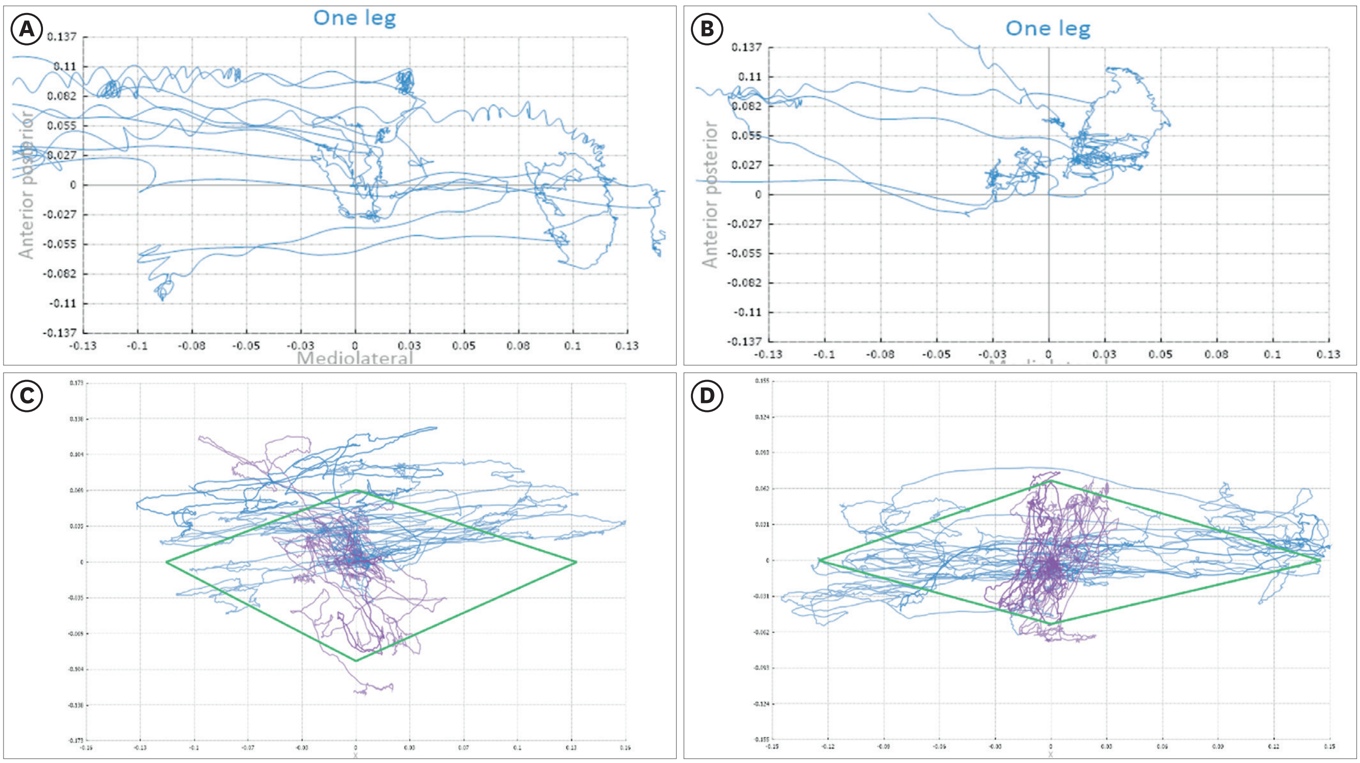

Fig. 4. Testing postural stability with a C-mill. Change in center of pressure trajectory when standing on one leg. (A) Initial and (B) follow-up. The area of the center of pressure and limit of stability. (C) Initial and (D) follow-up.

extraocular muscles, along with levator palpebrae muscles that elevate the eyelids [20]. The oculomotor nucleus lies in the ventromedial part of the gray matter in the midbrain and consists of a lateral somatic cell column, caudal central nucleus, and medial cell column. The Edinger–Westphal nucleus, called the accessory oculomotor nerve nucleus, is located at the dorsomedial region of the oculomotor nerve nucleus [21]. Large or mid-position fixed pupils are caused by dysfunction of the Edinger–Westphal nucleus or its fibers. The brain MRI scans revealed hyperintensities in the bilateral paramedian midbrain, including the third nerve fascicle and Edinger–Westphal nucleus. This explained the reason for the presentation of ptosis, vertical gaze palsy, and fixed pupils. The patient had limited adduction in both eyes due to lesions in the medial longitudinal fascia, and the dysmetria of both hands could be explained by lesions in the bilateral superior cerebellar peduncles and red nucleus. The clinical findings and location of the stroke on MRI indicated that the patient had bilateral Claude syndrome.

Bilateral ptosis, such as that in this patient, is rare in midbrain stroke and has only been reported in case studies, with no data on its incidence. In a 2005 study, Kim et al. [22] examined 40 patients with pure middle cerebral infarction and found that only 2 (5%) had bilateral ptosis. Ogawa et al. [23] observed eleven patients with oculomotor nerve palsy due to middle cerebral artery infarction, and only 2 (18.2%) had bilateral ptosis due to bilateral infarction. In another study, Thurtell and Halmagyi [24] reported 3 cases of complete ptosis due to bilateral midbrain–thalamic infarcts, suggesting that cases of neurogenic ptosis due to bilateral midbrain infarcts are not only rare but also have a poor prognosis for recovery. Two of the 3 patients died, and their ptosis remained unchanged until death, while the surviving patient had progressive improvement in ocular exotropia but persistent third nerve and vertical gaze palsy [24].

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The general treatment of ptosis depends on the cause and severity of the condition. Mild-to-moderate congenital ptosis may improve over time, without ocular complication [25]. However in most cases, ptosis is corrected by surgery. The surgical procedure is determined according to the severity of ptosis and levator function [16], which can be classified into 3 different groups: frontalis sling, anterior approach over the levator palpebrae, and posterior approach over the Müller muscle. However, surgical correction is confounded by the significant risks of corneal exposure due to orbicularis weakness; poor blink response [26]; and other complications, such as under-over-correction, bleeding, and infection. Furthermore, cataracts, ocular motility limitations, and blepharitis may negatively affect postoperative prognosis [27]. For these reasons, nonsurgical correction was considered to improve patients' quality of life. Nonsurgical treatments of ptosis include cosmetic glues, glasses made with a crutch attachment to hold up the lid [28], and soft elastic eyelid bands used for the formation of a temporary double eyelid. In 2022, Jeong et al. [27] reported a case of severe ptosis due to myotonic dystrophy improving with the application of elastic eyelid bands. Herein, the middle-aged man with myotonic dystrophy type 1 wore disposable eyelid bands throughout the day, and the application of eyelid bands led to a significant increase in palpebral fissure height and visual field.

Bilateral neurogenic ptosis upon midbrain infarction is a rare manifestation, and its clinical, radiologic, and diagnostic aspects are mainly studied, with only one case of surgical correction published by Kim et al. in 2013 [17]. There have been no nonsurgical reports on its correction, till date. In our case, the initial ophthalmological evaluation demonstrated that the patient presented with severe ptosis and levator function, implying the requirement of frontalis suspension surgery. However, a frontalis sling was contraindicated because the patient did not show Bell's phenomenon, which predisposed the patient to exposure keratitis [28]. Therefore, we attempted compensatory methods to hold the eyelid up using disposable elastic eyelid bands. The ready-made band was comfortable for application and personalization using scissors. Every morning before starting intensive rehabilitation, these bands were applied to both eyelids 2 mm above the superior marginal cilia. After 2 months, the application of elastic eyelid bands significantly increased the bilateral palpebral fissure heights by 2.5 mm on the right and 4 mm on the left side (**Fig. 2B**). After 3 months, without the eyelid bands, the ptosis improved by 1.5 mm on the right and 2.5 mm on the left side. The patient showed a significant post-intervention improvement in the visual field area (**Fig. 2C**).

In conclusion, this case report demonstrates the effectiveness of the combination of a comprehensive rehabilitation program and nonsurgical treatment in a patient with bilateral paramedian midbrain infarction and bilateral Claude syndrome presenting with bilateral ptosis. As ptosis is known to frequently interfere with various domains of ADL and gait and can also affect patients' participation in rehabilitation, nonsurgical approaches, such as soft elastic eyelid bands, can be an effective treatment option without the complications associated with surgical correction.

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