Contralateral eye surgery with adjustable suture for management of third nerve palsy with aberrant regeneration

Phuong Thi Thanh Nguyen, Shailja Tibrewal, Suma Ganesh

Aberrant regeneration of the third nerve following its palsy is commonly seen after trauma and compressive lesions. This phenomenon is thought to result due to misdirection of the regenerating axons. Surgical management is a great challenge in the third nerve palsy owing to multiple muscle involvement and is often accompanied by ptosis and poor Bell’s phenomenon. We present a case of a 27-year-old male who developed isolated complete third nerve palsy of the left eye following head trauma. Features of aberrant regeneration were seen after 6 months, namely, inverse Duane’s sign and Pseudo-Von Graefe’s sign. He underwent recess-resect procedure in the unaffected eye with adjustable suture technique which not only corrected the deviation but also the ptosis by utilizing the oculomotor synkinesis. Thus, contralateral eye surgery combined with adjustable suture technique resulted in an accurate alignment of the eye and obviated the need for ptosis correction.

Key words: Aberrant regeneration, strabismus, strabismus surgery, third nerve palsy

Aberrant regeneration of third nerve or oculomotor synkinesis is a result of misdirection of regenerating axons seen after traumatic or compressive lesions of the nerve.[1-5] This phenomenon may lead to neuronal misconnection causing synergistic movements of eyelid with eye movements. Most notable is the Inverse Duane sign wherein the upper eyelid gets elevated when the eye is adducted. Judicious use of this phenomenon may help in correction of ptosis associated with strabismus in third nerve palsy without the need for any eyelid surgery. A few cases where this mechanism is applied have been reported before.[6-8] We performed contralateral eye surgery combined with adjustable suture technique in a case of traumatic third nerve palsy with aberrant regeneration to get accurate results. A detailed description of the case and the applications of the surgical procedure are discussed below.

Case Report

A 27-year-old male presented to our hospital 2 months after head injury following a bike accident. His chief complaints were drooping of eyelid and ocular limitation of the left eye that started immediately after the trauma. At presentation, his best-corrected distance vision, as recorded by LogMAR visual acuity chart, was 20/20 in the right eye and 20/30 in the left eye and near vision, recorded by Snellen’s near vision chart, was N6 in the right eye and N9 in the left. His right eye examination was within normal limits including consensual light reflex. Inspection of the left eye revealed complete ptosis with poor Bell’s phenomenon. Anterior segment evaluation revealed semi-dilated nonreacting pupil. Posterior segment evaluation did not reveal any abnormality. Orthoptic evaluation revealed limited ocular ductions in elevation (−4), depression (−4), and adduction (−6). There was no compensatory head posture due to complete ptosis in the left eye. Corneal light reflex test revealed exotropia of 30°. The primary deviation was measured using a prism cover test, which was found to be 50 prism diopters (PD) of exotropia with 4 PD of the left hypotropia for distance and 65 PD exotropia with 6PD of the left hypotropia for near. Other cranial nerve examinations were unremarkable. Neuroimaging of the brain and the orbit revealed no abnormality. He was diagnosed as having posttraumatic isolated complete third nerve palsy in the left eye.

Six months posttrauma, he returned with the chief complaint of horizontal and vertical binocular double vision. His ptosis and strabismus had recovered partially. He had moderate ptosis with MRD 1 of zero. There was no compensatory head posture as he was not able to fuse both images in any position. The adduction had improved greatly (−2), but there was no change in elevation and depression since the first visit. Prism cover test revealed 40 PD exotropia and 6 PD left hypotropia in primary position for distance and 50 PD exotropia for near [Fig. 1b]. He had developed prominent signs of aberrant regeneration of the third nerve. There was elevation of the ptotic lid on ipsilateral adduction – inverse Duane’s sign [Fig. 1a] and downgaze – Pseudo-Von Graefe’s sign [Fig. 1d]. He was advised to undertake strabismus surgery for the same and monocular occlusion to avoid diplopia in the interim period.

The patient returned to the clinic 1½ years posttrauma with persistence of binocular diplopia. The palpebral fissure height was 5 mm in the left eye with MRD 1 of zero. The ocular movement limitation was −3 on elevation, −3 on depression, and −1 on adduction [Fig. 2]. Orthoptic evaluation revealed a primary deviation of 18 PD exotropia with 4 PD left hypotropia for both distance and near. The plan of utilizing synkinesis...
elevation of the left upper lid on attempted adduction to simultaneously correct the ptosis and strabismus was explained to the patient, and he was therefore counseled for contralateral eye surgery. Furthermore, adjustable suture was planned to optimize the strabismus correction. He was also counseled that he might require prism glasses for any residual horizontal or vertical deviation. He underwent right eye 9.0 mm lateral rectus (LR) recession using hang-back sliding noose technique and 3.5 mm medial rectus resection with fixed scleral sutures. A paralimbal conjunctival incision was used on the lateral side to facilitate postoperative adjustment.

Six hours postsurgery, he had binocular uncrossed diplopia due to consecutive esotropia of 10 PD for both distance and near. Therefore, the LR muscle was advanced 2 mm under sterile precautions under topical anesthesia. After adjustment, he had 6 PD esotropia and 2 PD hypotropia of the left eye for both distance and near without any diplopia.

At follow-up visit of 4 months after surgery, the patient was diplopia free in straight ahead gaze. Ptosis of the left eye was corrected in primary gaze with similar palpebral fissure height of both the eyes. Left ocular ductions remained unchanged [Fig. 3]. He had orthophoria in primary gaze, 10 PD left hypotropia on upgaze, and 14 PD left hypertropia on downgaze. The signs of aberrant regeneration were the same as before [Fig. 4]. There was persistence of vertical diplopia on attempted upgaze and downgaze. He was, however, able to manage day-to-day activities with compensatory head movement.

**Discussion**

The mechanism of aberrant regeneration phenomenon is thought to be peripheral misdirection of regenerating axons.[1,2] Histological evidence suggests that it typically occurs when damage results from transection and subsequent disruption of endoneurial integrity.[2,3] A bridging matrix of Schwann cells, fibroblasts, and macrophages is formed that regenerates several neuronal sprouts. These sprouts can then innervate multiple end organs which leads to cocontraction.[2] Our patient showed two signs of aberrant regeneration – Pseudo-Von Graefe’s and inverse Duane’s sign. However, there are other signs as well such as abnormal retraction of globe on attempted
vertical movements, pupillary constriction with attempted adduction (pseudo-Argyll Robertson pupil), and ipsilateral adduction on attempted verticalduction which should be looked for in such patients.[1,4,5]

Surgical management of strabismus in the third nerve palsy is complicated due to multiple muscle involvement. In addition, correction of ptosis is also difficult owing to poor Bell’s phenomenon. The oculomotor synkinesis between affected eye levator palpebrae superioris and ipsilateral medial rectus (MR) muscle provides an opportunity to correct the ptosis through strabismus surgery in selected cases.[6,7] Performing a recess-resect procedure on the contralateral fixing eye forces it into an adducted position. Due to Hering’s law of equal innervation of yoke muscles, fixation duress is created on the affected eye medial rectus muscle, pulling it into an adducted position when the fixing eye assumes fixation. Thereby, the ptotic lid is elevated and the need for ptosis surgery obviated.

Since O’Donnell et al.[6] promoted surgery in the contralateral eye to simultaneously correct strabismus and ptosis in a selected case of third nerve palsy with aberrant regeneration in 1980, there have been a few case reports in the past wherein this technique has been used. Parulekar and Elston[7] suggested large recession of the LR (7–8 mm) and a smaller medial rectus resection on the nonparetic eye. They also suggested combined downward transposition of the insertions of the medial and lateral recti to correct the vertical deviation. Gottlob et al.[8] managed two cases with traumatic third nerve palsy with similar technique. They also performed superior oblique anterior transposition in the affected eye in all their cases due to the presence of large exotropia. When the exotropia is too large, additional ipsilateral large LR recession can be added. Resection of the ipsilateral medial rectus should be avoided in the presence of aberrant regeneration. We performed 9.0 mm LR recession and 3.5 mm medial rectus resection. Muscle transposition was not done as the preoperative vertical deviation was very small. In addition, we used hang-back technique with adjustable suture. Adjustable suture technique is advised in cases in which the results of conventional surgery are unpredictable.[9] As the patient was predominantly bothered by the double vision, the use of adjustable suture technique helped us to obtain more accurate ocular alignment therefore eliminating diplopia and avoiding reoperation.

Conclusion

Aberrant regeneration (inverse Duane’s sign) occurring after traumatic third nerve palsy could be recognized as an opportunity to correct the ptosis along with exotropia. Contralateral eye surgery combined with adjustable suture technique could obtain more accurate results.

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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