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J Case Rep Images Opthalmol 2022;5(2):5–10.
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CASE REPORT PEER REVIEWED | OPEN ACCESS

Double-under muscle transposition in long-standing sixth nerve palsy: A case report

Withawat Sapthanakorn, Warakorn Thiamthat, Suntaree Thitiwichienlert

ABSTRACT

Introduction: To report a case of acquired esotropia after long-standing sixth nerve palsy with double-under muscle transposition technique correction.

Case Report: A 41-year-old male presented with diplopia from an unruptured and thrombosed mid-basilar aneurysm that caused isolated left sixth nerve palsy for 18 months after undergoing surgery. He had left face turn, 66 prism diopters (PD) esotropia of the left eye, and a complete left abduction deficit. To improve a complete sixth nerve palsy, we performed a double-under muscle transposition (DUT) technique, vertical recti [superior and inferior (SR) and (IR)] were transposed under left lateral recuts (LR) muscle along with medical recuts (MR) recession. Following postoperative result at three months, he was found to be orthotropia at near and 8 PD of exotropia at distance. He also improved diplopia in the primary position and he could slightly abduct the left eye. He did not have any postoperative complication.

Conclusion: We demonstrated that a DUT technique can be a procedure of choice in patients with large angle deviation from paralytic strabismus.

Keywords: Diplopia, Double-under muscle transposition, Sixth nerve palsy

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Received: 17 April 2022
Accepted: 19 June 2022
Published: 20 July 2022

How to cite this article

Sapthanakorn W, Thiamthat W, Thitiwichienlert S. Double-under muscle transposition in long-standing sixth nerve palsy: A case report. J Case Rep Images Opthalmol 2022;5(2):5–10.

Article ID: 100030Z17WS2022

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doi: 10.5348/100030Z17WS2022CR

INTRODUCTION

Sixth nerve palsy is the most common ocular motor nerve paralysis in adults. The sixth cranial nerve controls lateral rectus function. Acquired sixth nerve palsies cause binocular diplopia due to abduction deficit and incomitant esodeviation due to the exertion of the antagonist medial rectus muscle. Acquired sixth nerve palsies in adults can be due to microvascular ischemia, neoplasm, aneurysm, trauma, infection, inflammation, demyelination, and idiopathic etiologies [1]. Treatment of sixth nerve palsy usually requires a solution based on the underlying etiology and waiting for recovery of the cranial nerve for at least six months. Treatment of diplopia includes occlusion, base-out prisms, botulinum toxin, and strabismus surgery. Strabismus surgery is usually performed after stable angle of deviation. Muscle transposition surgery is performed in cases of complete sixth nerve palsy where there is no or less than 50% of lateral rectus muscle function.

Basilar artery aneurysm occurs in about 3–5% of intracranial aneurysms [2]. A large or giant basilar aneurysm may compress the midbrain and pons. The patient with an unruptured basilar aneurysm usually presents with headaches and neurological signs including sixth nerve palsy. We report a case with an unruptured

and thrombosed mid-basilar aneurysm who presents with complete sixth nerve palsy. We performed a double-under muscle transposition (DUT) procedure and can correct the angle deviation of 66 prism diopters (PD).

CASE REPORT

A 41-year-old male presented with severe headache and binocular horizontal diplopia. He was a heavy smoker and quit smoking for two years. He had no history of any underlying disease or medications. Initial computed tomography (CT) scan from a regional hospital showed an unruptured giant mid-basilar aneurysm. He underwent implantation of a blood flow diverter and clot removal surgery. Cerebral angiography revealed complete healing of the basilar aneurysm. He received a 6-month dual antiplatelet therapy following stent implantation. Follow-up magnetic resonance imaging (MRI) brain was found no significant change of a giant thrombosed basilar artery aneurysm (Figure 1). He still had diplopia after 18 months of primary treatment and he was referred for ophthalmologic consultation.

On eye examination, the best-corrected visual acuity (BCVA) was 20/20 in both eyes. The intraocular pressure (IOP) was 15 mmHg in the right eye and 13 mmHg in the left eye. The orthoptic examination revealed complete left abduction deficit with left esotropia. The primary deviation, measured by the alternate prism cover test with right eye fixation, was esotropia 66 prism diopters (PD) at distance (Figure 2). Slit-lamp examination showed normal anterior and posterior segment in both eyes. The pupil size was 3 mm both react to light without relative afferent pupillary defect (RAPD). The forced duction test (FDT) was positive in left medial rectus muscle. Preoperative MRI orbit showed an atrophic change of left lateral rectus muscle (Figure 3).

Surgical treatment

Preoperative botulinum toxin injection 5.0 units have been added at left medial rectus muscle. The patient had 50% of left adduction, but he still had esotropia 66 PD at one month after botulinum toxin injection. We planned to do both DUT and medial rectus recession procedures in one-time surgery under general anesthesia. Intraoperatively, the FDT was positive in left medial rectus muscle. We performed 3.0 mm recession of left medial rectus muscle with the fornix-based conjunctival incision. The DUT technique was initiated by a 240° limbal conjunctival peritomy. The Tenon capsule and the intramuscular septum surrounding the superior rectus, lateral rectus, and inferior rectus muscles were dissected free. The superior and inferior rectus muscles were split nasal half-tendon width (about 5 mm) up to approximately 10 mm from the insertion. The transposed nasal half-tendon width of vertical rectus muscles crossed under the remaining temporal halves of vertical rectus muscles with 5-0 vicryl double-armed sutured near the left lateral rectus muscle insertion by hang back technique (Figures 4 and 5). A limbal-based conjunctival incision was sutured by 8-0 vicryl.

Postoperative follow-up and alignment after surgery

The patient had improvement of alignment in the immediate postoperative period (Figure 6). At one week follow-up, he had the improvement to slightly abduct the left eye and he had orthotropia at near and distance (Figure 7). Slit-lamp examination revealed conjunctival chemosis of the left eye (Figure 8). We prescribed 1% prednisolone acetate every 2 hours for one week then tapered to four times a day for two weeks and twice a day for one week. At one month follow-up, he had 50% to abduct the left eye and he had esophoria 4 PD at near and 6 PD at distance (Figure 9). After one month, we noticed that he still had some chemosis, so we switched to 0.1% fluorometholone four times a day for two weeks. The patient received a course of topical corticosteroids for six weeks and he did not have steroid-induced ocular hypertension or glaucoma. He had IOP 14 mmHg of the left eye by Goldmann applanation technique. At postoperative three months, he was found to be orthotropia at near and exotropia 8 PD at distance (Figure 10).

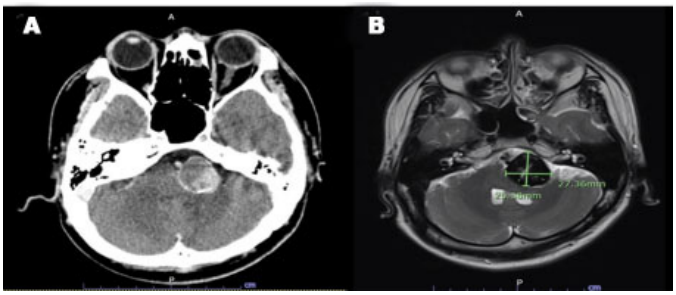

Figure 1: (A) contrast-enhanced preoperative CT brain show an unruptured giant mid-basilar aneurysm and (B) postoperative MRI brain axial view shows a 2.5 × 2.7 × 3.5-cm thrombosed basilar aneurysm after surgery and dual antiplatelet therapy.

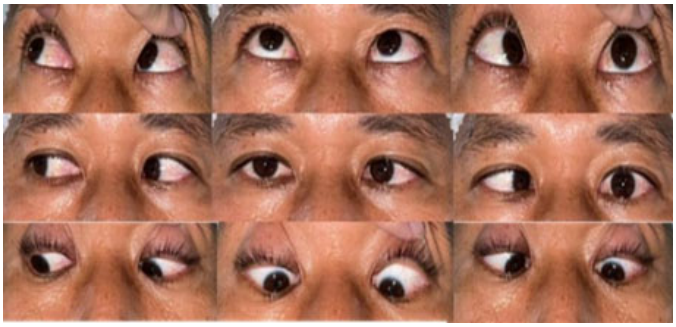

Figure 2: Photographs of the eye in nine positions of gaze show complete left abduction deficit with left esotropia.

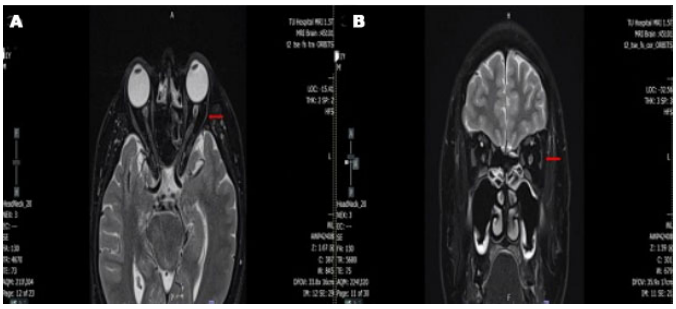

Figure 3: MRI orbit (A) axial view and (B) coronal view show atrophic change of left lateral rectus muscle (red arrow).

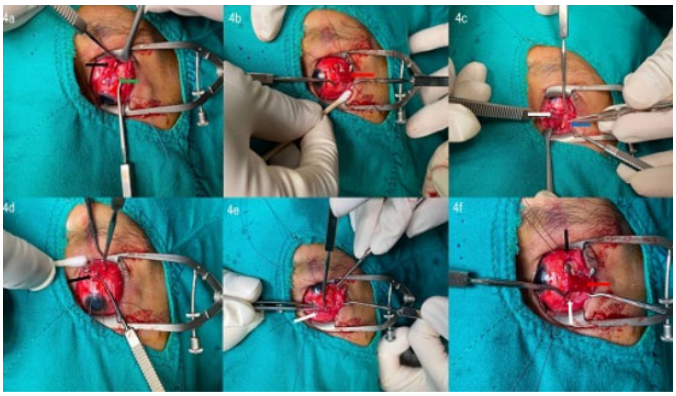

Figure 4: DUT procedure shows (A) the intermuscular septum of superior rectus (black arrow) and superior oblique (green arrow) muscles were dissected to expose the muscle belly behind the insertions, (B) the intermuscular septum of lateral rectus (red arrow) was dissected to expose the muscle belly behind its insertion, (C) the intermuscular septum of inferior rectus (white arrow) and inferior oblique (blue arrow) muscles were dissected to expose the muscle belly, (D) the superior rectus muscle was split nasal half-tendon width (black arrow) up to approximately 10 mm from the insertion with the help of a muscle hook, (E) the inferior rectus muscle was split nasal half-tendon width (white arrow) up to approximately 10 mm from the insertion with the help of a muscle hook, (F) the transposed nasal half-tendon width of superior rectus (black arrow) and inferior rectus (white arrow) muscles crossed under the remaining temporal halves of its muscle belly with 5-0 vicryl double-armed sutured near the left lateral rectus muscle insertion (red arrow).

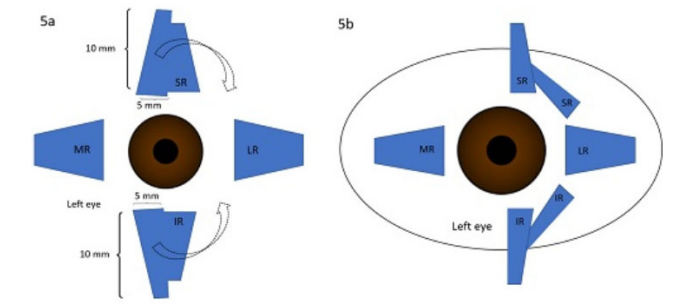

Figure 5: Schematic coronal view of left eye (A) shows superior and inferior rectus were dissected and split (5 mm width and 10 mm length), the nasal portions of superior and inferior rectus were disinserted and crossed under temporal half portions. The schematic sagittal view of left eye (B) shows the nasal half portions of superior and inferior rectus were transposed and fixed to sclera at the insertion point of left lateral rectus by hang back technique.

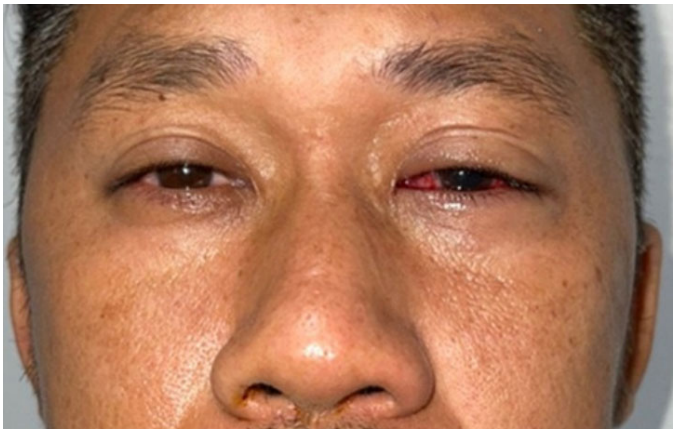

Figure 6: Improvement of alignment in the immediate postoperative period.

Figure 7: At one week follow-up, photographs of the eye in nine positions of gaze show that he had the improvement to slightly abduct the left eye and he had orthotropia at near and distance.

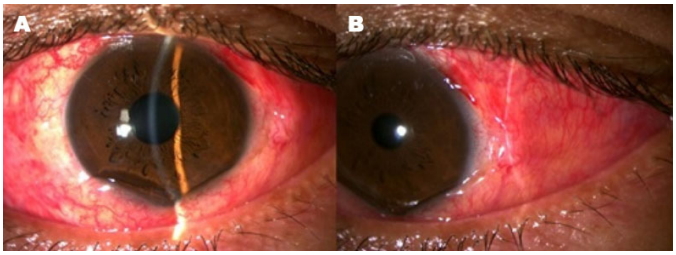

Figure 8: At one week follow-up, slit lamp examination revealed conjunctival chemosis of left eye.

DISCUSSION

The principle of muscle transposition surgery is to transfer force from other muscles to help the paralyzed muscle, a change in the vector forces of the transposed muscles will improve the ocular misalignment in the primary position [3]. In 1907, the partial vertical rectus muscle split transposition technique was first described by Hummelsheim for the management of complete sixth nerve palsy. Hummelsheim procedure will split and disinsert the temporal half-tendon width of the superior

Figure 9: At one month follow-up, photographs of the eye in nine positions of gaze show that he had 50% to abduct the left eye and he had esophoria 4 PD at near and 6 PD at distance.

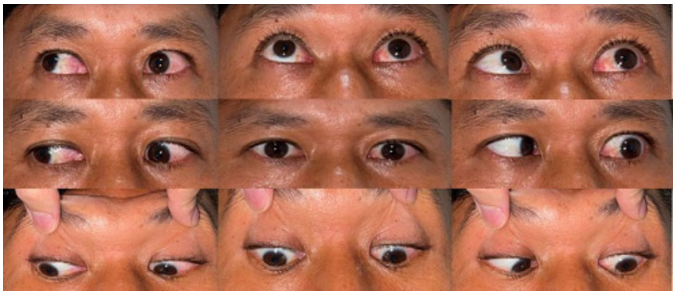

Figure 10: At three months follow-up, photographs of the eye in nine positions of gaze show that he was found to be orthotropia at near and exotropia 8 PD at distance.

rectus and inferior rectus muscles to the insertion of the lateral rectus muscle [4]. The results of Hummelsheim procedure have been reported to correct the angle deviation from 43 ± 5 PD before surgery to 6 ±7 PD after surgery. In 1946, Jensen et al. described Jensen procedure, in this procedure the split half-tendon width without dis-inserted of the superior rectus and inferior rectus muscles is tied with the lateral rectus muscle [5]. In 2003, Nishida et al. described Nishida procedure, in this procedure the split temporal half-tendon width of the superior rectus and inferior rectus muscles is sutured 8 mm posterior to the lateral rectus muscle insertion [6]. The results of Nishida procedure have been reported to correct the average angle deviation of 42.4 PD.

Recently, Furuse et al. described the double-under muscle transposition (DUT) procedure, in this novel procedure the split nasal half-tendon width of the superior rectus and inferior rectus muscles is crossed under both the remaining temporal halves with suture anchored near the lateral rectus muscle insertion. To increase the effectiveness of DUT procedure, recession of medial rectus muscle can be added along with this procedure in the case with a positive force duction test. The results of DUT procedure have been reported to correct the average angle deviation of 60 ± 6 PD [7]. However, cases of overcorrection have been reported.

There are several techniques of muscle transposition surgery for sixth nerve palsy. For the large angle deviation in sixth nerve palsy, the surgical technique can correct the esodeviation of 58.3 ± 10.8 PD [8–10]. Surgeons usually perform surgical technique depending on the residual lateral rectus function, degree of palsy, and lateral incomitance. In the case presentation, we performed combined DUT procedure and medial rectus recession because the patient had a positive FDT. Moreover, we believed that the split nasal half-tendon width instead of the split temporal half-tendon width of the vertical rectus muscles can enhance the force of the transposed muscles. We can correct the large angle deviation up to 66 PD. There was no postoperative complication including anterior segment ischemia. In complete palsy, DUT procedure may be an alternative procedure of choice.

CONCLUSION

We demonstrated that a DUT technique can be a procedure of choice in patients with large angle deviation from paralytic strabismus. This procedure can be performed simultaneously with medial rectus surgery, especially in cases with large angle of deviation with an evidence of medial rectus restriction. Our patient restored the binocular field and obtained satisfactory outcomes with the DUT procedure.

Take home messages

Always do force duction test of antagonist muscle in restrictive strabismus.

Muscle transposition is essential for correction in case of negative for force generation.

Double-under muscle transposition technique may take a role in large deviation case.

REFERENCES

1. Azarmina M, Azarmina H. The six syndromes of the sixth cranial nerve. J Ophthalmic Vis Res 2013;8(2):160–71.
2. Marco R. Pathogenesis, diagnosis and treatment of the cerebral aneurysm. J Neurol Neurophy 2021;12(8):550.
3. Gunton KB. Vertical rectus transpositions in sixth nerve palsies. Curr Opin Ophthalmol 2015;26(5):366–70.
4. Hummelshein E. Uber Schnentransplantation am Ague. Ophthal Gesselschft 1907;34:248–53.
5. Jensen CD. Rectus muscle union: A new operation for paralysis of the rectus muscles. Trans Pac Coast Otoophthalmol Soc Annu Meet 1964;45:359–87.

6. Nishida Y, Inatomi A, Aoki Y, et al. A muscle transposition procedure for abducens palsy, in which the halves of the vertical rectus muscle bellies are sutured onto the sclera. Jpn J Ophthalmol 2003;47(3):281–6.
7. Furuse T, Morisawa S, Kobashi R, Ohtsuki H, Hasebe S. Double-under muscle transposition: An effective surgical option for large-angle paralytic strabismus. J AAPOS 2021;25(4):209.e1–6.
8. Arfeen S, Azzab M, Saad Z, Awadein A, Kasem M, Elkamshoushy A. Comparison between Hummelsheim and Jensen procedures in the management of chronic sixth nerve palsy. Graefes Arch Clin Exp Ophthalmol 2022;260(1):363–9.
9. Singh P, Vijayalakshmi P, Shetty S, Vora P, Kalwaniya S. Double augmented vertical rectus transposition for large-angle esotropia due to sixth nerve palsy. J Pediatr Ophthalmol Strabismus 2016;53(6):369–74.
10. Foster RS. Vertical muscle transposition augmented with lateral fixation. J AAPOS 1997;1(1):20–30.

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Author Contributions

Withawat Sapthanakorn – Conception of the work, Design of the work, Acquisition of data, Analysis of data, Interpretation of data, Drafting the work, Revising the work critically for important intellectual content, Final approval of the version to be published, Agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

Warakorn Thiamthat – Conception of the work, Design of the work, Acquisition of data, Drafting the work, Revising the work critically for important intellectual content, Final approval of the version to be published, Agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

Suntaree Thitiwichienlert – Conception of the work, Analysis of data, Interpretation of data, Drafting the work, Revising the work critically for important intellectual content, Final approval of the version to be published, Agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

Guarantor of Submission

The corresponding author is the guarantor of submission.

Source of Support

None.

Consent Statement

Written informed consent was obtained from the patient for publication of this article.

Conflict of Interest

Authors declare no conflict of interest.

Data Availability

All relevant data are within the paper and its Supporting Information files.

ABOUT THE AUTHORS

Article citation: Sapthanakorn W, Thiamthat W, Thitiwichienlert S. Double-under muscle transposition in long-standing sixth nerve palsy: A case report. J Case Rep Images Opthalmol 2022;5(2):5–10.

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