

# Superior oblique split tendon elongation versus superior oblique recession for Brown syndrome: a case series

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## Abstract

**Objectives:** To compare outcomes between superior oblique split tendon elongation (STE) and superior oblique recession (SOR) for the treatment of Brown syndrome.

**Methods:** Medical records of patients aged  $\geq 3$  years who underwent either superior oblique STE or SOR for Brown syndrome by a single surgeon between January 2012 and December 2022 were retrospectively reviewed.

**Results:** In total, nine eyes in eight patients with congenital (n=8) or acquired (n=1) Brown syndrome underwent superior oblique STE (n=4) or SOR (n=5). Pre-existing horizontal strabismus was present in all four patients who underwent STE and in two patients who underwent SOR (five esotropia and one exotropia). The initial four eyes were treated with STE, whereas the subsequent five eyes were treated with SOR. All nine eyes achieved complete (n=6) or partial (n=3) success outcomes. The success rates were similar between the STE and SOR groups (complete success: 50% vs 80%; partial success: 50% vs 20%;  $p=0.52$ ). No patient experienced any complications.

**Conclusion:** Both STE and SOR for the treatment of Brown syndrome achieved stable long-term outcomes in terms of improving eye motility and correcting abnormal head posture.

## Introduction

Brown syndrome is an ocular motility deficit associated with both active and passive limitation of upgaze in adduction.<sup>1</sup> It can be congenital or acquired.<sup>2</sup> Congenital Brown syndrome is present at birth and is not associated with pain or inflammation. In contrast, acquired Brown syndrome develops after infancy and presents as limited elevation in adduction with pain and/or a clicking sensation in the superior nasal quadrant of the orbit.<sup>3,4</sup> Symptoms vary according to severity and are associated with vertical deviation in primary gaze with or without abnormal head posture and diplopia. Treatments include weakening or elongating the superior oblique tendon through Z-tenotomy, Knapp's tendon-lengthening procedure, silicone band tendon lengthening, split tendon elongation (STE), or superior oblique recession (SOR).<sup>5-13</sup> This study compared outcomes between superior oblique STE and SOR for the treatment of Brown syndrome.

## Methods

Medical records of patients aged  $\geq 3$  years who underwent either superior oblique STE or SOR for Brown syndrome by a single surgeon between January 2012 and December 2022 at the United Christian Hospital in Hong Kong were retrospectively reviewed. Patients were excluded if they had incomplete documentation, iatrogenic Brown syndrome (ie, after superior oblique tuck surgery), or other coexisting restrictive ophthalmopathy (eg, thyroid eye disease).

*Key words:* Ocular motility disorders; Oculomotor muscles

Surgical indications included hypotropia at primary gaze, abnormal head posture, co-existing esotropia, strabismus with notable hypotropia in primary gaze, and extraocular movement suggestive of Brown syndrome. Blood test results were negative for rheumatoid factor, thyroid function, or anti-acetylcholine receptor disorders. Computed tomography of the orbit showed no abnormalities. Tightness of the superior oblique muscle was assessed using the forced duction test before and after surgery.

For STE, the procedures followed those described by Wright.<sup>14</sup> A superotemporal fornix incision was made. A Jameson hook was placed beneath the superior rectus muscle, and the eye was retracted down. The nasal border of the superior rectus muscle was identified. The superior oblique tendon (shown as pearly white fibers) was usually located nasal to the superior rectus muscle, approximately 12 mm posterior to the superior rectus insertion. A small incision was made over the superior oblique tendon through the superior oblique sheath. Caution was taken to ensure the nasal intermuscular septum was not breached. The superior oblique tendon was split in a 'Z' manner, and the cut ends were tied together with a non-absorbable 5-0 Ethibond suture.

For SOR, a superotemporal fornix incision was made through conjunctiva to expose the superior rectus muscle. The eye was depressed, and the superior oblique tendon was perpendicular to the superior rectus muscle, which was secured with double armed 6-0 Vicryl sutures and was disinserted and recessed 8 mm from its insertion.

Surgical success was defined as improvement or resolution of (1) hypotropia in primary position, (2) abnormal head posture, and (3) appearance in nine-gaze photographs. Partial success was defined as achieving just one or two of these outcomes.

## Results

In total, nine eyes in eight patients with congenital (n=8) or acquired (n=1) Brown syndrome underwent superior oblique STE (n=4) or SOR (n=5) [Table]. The patients' ages at surgery ranged from 3 to 70 years in the STE group and from 3 to 53 years in the SOR group. Pre-existing horizontal strabismus was present in all four patients who underwent STE and in two patients who underwent SOR (five esotropia and one exotropia).

The initial four eyes were treated with STE, whereas the subsequent five eyes were treated with SOR. At follow-up durations ranging from 3 months to 8 years for the STE group and from 1 to 5 years for the SOR group, all nine eyes achieved complete (n=6) or partial (n=3) success outcomes. The success rates were similar between the STE and SOR groups (complete success: 50% vs 80%; partial success: 50% vs 20%; p=0.52). Differences in outcomes may be due to the learning curve and more complex cases in the STE group. No patient experienced complications such as iatrogenic superior oblique palsy, torsional diplopia, lost muscle, or fat adherence.

**Table. Eight patients underwent superior oblique split tendon elongation (STE) or superior oblique recession (SOR) for Brown syndrome.**

Patient	Sex/age, y	Affected eye	Preoperative angle	Procedures	Outcome	Follow-up duration, y
<b>STE</b>						
1	M/3	Right	Esotropia 30 PD, hypotropia >90 PD	Medial rectus recession 7 mm, inferior rectus recession (maximal), STE 6 mm	Partial success, exotropia 10 PD, hypotropia 15 PD, residual Brown syndrome	8
2	M/2.8	Right	Esotropia 30 PD, hypotropia <10 PD	Medial rectus recession 4-4.5 mm, STE 6 mm	Complete success, straight	7
3	F/20	Right	Esotropia 40 PD, hypotropia 12 PD	Medial rectus recession 6.5 mm, lateral rectus resection 6.5 mm, STE 6 mm	Partial success, hypotropia 10 PD, no esotropia, mild residual Brown syndrome	0.25
4	F/70	Left	Esotropia 30 PD, hypotropia 8 PD	Medial rectus recession 6 mm, lateral rectus resection 6 mm, STE 3.5 mm	Complete success, straight, minimal residual Brown syndrome	0.75
<b>SOR</b>						
5	F/3	Right	Esotropia 50 PD, hypotropia <10 PD	Medial rectus recession 6 mm, SOR 8 mm	Complete success, straight	1
6	F/6	Right	Straight (Brown syndrome occurred when gazing left)	SOR 8 mm	Complete success, straight, unmasking left-eye Brown syndrome	3
6	F/8	Left	Straight (Brown syndrome occurred when gazing right)	SOR 7 mm	Complete success, straight	1
7	M/53	Left	Hypotropia	SOR 8 mm	Partial success, straight, slight residual Brown syndrome	5
8	M/8	Right	Intermittent left-eye exotropia 18-20 PD	SOR 8 mm	Complete success, straight to slight exotropia	2

Abbreviation: PD=prism diopters

In the STE group, patient 3 had undergone bilateral medial rectus recession 6.5 mm for left esotropia 11 years earlier at age 9 years. A year later, she developed recurrent esotropia. At age 20 years, a forced duction test revealed a tight superior oblique muscle in the right eye (**Figure 1**). She underwent scar dissection, medial rectus re-recession to 12.5 mm from limbus, lateral rectus resection 6.5 mm, superior oblique STE 6 mm, and a subconjunctival injection of 0.4 mL triamcinolone diluted from 40 to 5 mg/mL. Postoperatively, she had residual hypotropia 10 prism diopters (PD) and slight residual esotropia <5 PD but the abnormal head posture had resolved.

In the SOR group, patient 6 had abnormal head posture when gazing left, hypotropia on levoversion, and limited elevation on adduction of the right eye since the age of 11 months. At age 6 years, her primary gaze was straight; hypotropia was most apparent in her left gaze (**Figure 2**). She underwent SOR 8 mm of the right eye, which corrected the abnormal head posture but unmasked Brown syndrome of the left eye with hypotropia on right gaze when gazing right. At age 8 years, she underwent SOR 7 mm of the left eye. Postoperatively, she had complete resolution of Brown syndrome and abnormal head posture.

## Discussion

For congenital Brown syndrome, a high proportion of patients can be managed conservatively. As patients grow taller, they do not need to look up and hence the motility disturbance and abnormal head posture improve.<sup>6</sup> Spontaneous resolution is observed in 16% of patients with acquired non-traumatic Brown syndrome, and hence conservative management is the first line of treatment.<sup>2</sup> However, in patients with severe Brown syndrome with limited elevation in adduction, downshoot on adduction, and vertical deviation in primary gaze with or without abnormal head posture, surgical correction is indicated.<sup>10</sup> The choice between superior oblique STE and SOR is mainly based on the surgeon's preference.

Superior oblique STE has several advantages. It enables gradual weakening of the muscle, with more predictable and stable results, in contrast to tenotomy, due to the fixed amount of tendon elongation and preservation of the fan-shaped insertion of the superior oblique muscle. No foreign body, such as a silicone expander, is inserted, decreasing the risk of extrusion or infection. STE has high rates of resolution of compensatory head posture and improvement in eye motility, with no intra- or



**Figure 1.** Patient 3: nine-gaze photographs showing (a) limited elevation of the right eye especially on adduction and (b) improved elevation of the right eye in primary position, with mild residual Brown syndrome.



**Figure 2.** Patient 6: nine-gaze photographs showing (a) hypotropia on levoversion with Brown syndrome in the right eye, (b) superior oblique recession of the right eye unmasking Brown syndrome in the left eye when gazing right, with hypotropia on dextroversion, and (c) complete resolution of Brown syndrome and abnormal head posture after superior oblique recession of the left eye.

post-operative complications reported. A case series of STE showed excellent results.<sup>11</sup> Nonetheless, STE is technically challenging; it requires exploration of the superior oblique tendon via a superonasal approach to preserve the tendon and intermuscular septum.

SOR was first described in 1970.<sup>12</sup> It poses technical challenges, as the superior oblique tendon is located far posterior from the limbus, and the fan-shaped insertion of the tendon makes it difficult to retrieve the entire muscle. Nonetheless, SOR enables adjustment of the tendon weakness, reoperation (as the location of tendon is known), and adjustment of the suture technique.<sup>13</sup> Complications include limited depression in abduction, over-convergence on looking down (the 'V' pattern), and incarceration syndrome.<sup>15</sup>

This study is limited by its retrospective design and small sample size operated by a single surgeon. Two patients were lost to the 1-year follow-up and late postoperative complications were not known. A surgical learning curve may have influenced the outcomes. There are no standardized guidelines for either STE or SOR; clinical outcomes may vary.

## Conclusion

Both STE and SOR for the treatment of Brown syndrome achieved stable long-term outcomes in terms of improving eye motility and correcting abnormal head posture. No intra- or post-operative complications were reported.

## Contributors

All authors designed the study, acquired the data, analyzed the data, drafted the manuscript, and critically revised the manuscript for important intellectual content. All authors had full access to the data, contributed to the study, approved the final version for publication, and take responsibility for its accuracy and integrity.

## Conflicts of interest

All authors have disclosed no conflicts of interest.

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## Data availability

All data analyzed in this study are available from the corresponding author upon reasonable request.

## Ethics approval

This study was approved by Kowloon Central/Kowloon East Cluster Research Ethics Committee (reference: KC/KE-23-0201/ER-1). The study was conducted in accordance with the tenets of the Declaration of Helsinki. The patients provided written informed consent for all treatments and procedures and for publication.

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