

Can Forced Duction Test (FDT) Determine Surgical dose in Thyroid Eye Disease (TED)-Related Strabismus: A Case Series

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Abstract

Objective: To evaluate the effectiveness of inferior rectus muscle test

Design: Case series

Participants: Eleven patients with restrictive vertical diplopia due to thyroid ophthalmopathy underwent inferior rectus recession and were followed for a minimum of 3 months after initial surgery

Intervention: All eleven patients underwent unilateral inferior rectus recession which using force duction test grading to determine surgical dose from 2021 to 2022 in Rajavithi hospital

Main Outcome Measures: Post-operative alignment less than 10 PD and the absence of vision-threatening complications related to strabismus surgery is considered successful

Result: nine out of eleven patients (81.1%) achieved acceptable alignment with no vision-threatening complications

Conclusion: Surgical dose determined by force duction test grading alone gave satisfying success rate and may be a useful alternative in some patients who cannot tolerate adjustable-sutured method; however, further studies should be performed

Key words: forced duction test, strabismus, Thyroid Eye Disease, adjustable suture

Introduction

Thyroid eye disease (TED) is an autoimmune disorder with characteristic clinical signs including muscle enlargement and orbital inflammation, which result in limitation of extraocular muscle motility and diplopia. TED primarily affects the inferior rectus muscle resulting in restrictive hypotropia, surgery especially muscle recession is beneficial but more complex in TED-associated strabismus than in other classes of strabismus¹. There is no consensus guideline in determining the surgical dose of correcting thyroid-associated strabismus. Many studies report variable success and reoperation rates ranging from 43-100% and 17-45% respectively². Moreover, vertical muscle surgery was reported to have a lower success rate compared to horizontal or combined surgery³.

Many studies prefer the adjustable suture technique as an additional method to improve the outcome of the surgery despite associated pain and risk of scar elongation, muscle slippage, and late over-correction. However, many previous reports showed that successful surgical outcomes varied between 47–92% with adjustable sutures and 38–82% without adjustable sutures⁴⁻⁵. There is a suggestion to perform forced duction test (FDT) preoperative and intraoperative, but no study demonstrates any relationship between FDT and surgical dose⁶⁻⁷.

Patients and Methods

Patients participating in this study are those who were diagnosed with TED-associated strabismus and underwent unilateral inferior rectus muscle recession for hypotropia between January 2021 and July 2022 in Rajavithi hospital. The study was approved by the Office of Research Ethics Committee Rajavithi Hospital. All operations were performed by either surgeon (RP or WT). Patients with horizontal strabismus (more than 15 PD) requiring simultaneous horizontal rectus

muscle surgery, history of prior strabismus surgery, or comorbidity affecting the choice of treatment and data collection were excluded.

The Krimsky test was performed at 6 meters. A forced duction test was performed after a retrobulbar block was done and graded from 1 to 3, where grade 1 = the pupil can pass the midline, 2 = the pupil is at the midline, 3 = the pupil cannot pass the midline respectively. Hertel exophthalmometers were used to examine the exophthalmometry value of the patients and proptosis was defined as an exophthalmometry value exceeding 20 mm or a difference of more than 3 mm between eyes⁶. Strabismus surgery was indicated when patients experienced vertical diplopia. All patients were euthyroid at the time of surgery, their clinical activity score and strabismus were also stable for at least 6 months prior to surgery. The following data were collected: age, gender, smoking status, BCVA, diplopia symptom before and after surgery, the duration of thyroid disease, history of compressive optic neuropathy, previous orbital decompression surgery, history of radiotherapy or systemic steroid therapy, exophthalmometry value, the amount of deviation before and after surgery, surgical dose inferior rectus recession, and the duration of follow-up.

Surgical procedure

Combination of 2% lidocaine and 0.5% bupivacaine in 1:1 ratio for 4 ml was used for retrobulbar block before forced duction test was performed. All patients received retrobulbar block by a single person (LS). The amount of inferior rectus muscle recession was determined by forced duction test grading regardless of the amount of deviation. The surgical dose in each FDT grade was decided by a single surgeon (RP) based on personal experience (Table 1). All patients received unilateral inferior rectus recession combined with lysis adhesion around the inferior rectus

Table1 Surgical dose of unilateral inferior rectus recession in TED-related hypotropia

FDT grading	Amount of IR recession (mm.)
1 (pupil can pass midline)	3
2 (pupil at midline)	4
3 (pupil cannot pass midline)	5-6

muscle and deep to the globe equator.

Postoperative measurement

Postoperative alignment at distance was measured at 1 and 3 months after surgery. Success was defined with an ocular deviation ≤ 10 PD and the absence of diplopia symptoms. Undercorrection and overcorrection were defined with deviation of 10 PD or more.

Result

Eleven patients with vertical diplopia caused by thyroid ophthalmopathy were included in the study. Mean age of the patients was 56.18 years old (48 - 65 years old), the majority of the patients (5/11, 45.45%) had FDT grade 3. Eight out of eleven patients (72.7%) resolved diplopia in primary position postoperatively. Mean follow-up time was 2.55 (Table 2). The Mean preoperative alignment was 32 PD, mean surgical dose was 4.2 mm (3 – 6 mm), nine out of eleven patients achieved acceptable distance postoperative alignment of less than 10PD in the primary position (Table 3.).

Patient 1

A 51-year-old man presented with vertical diplopia. He was diagnosed with Grave's disease for 2 years. His thyroid status has been stable for more than 6 months and no history of smoking. On initial evaluation, his BCVA was 20/20 for both eyes. Exophthalmometer readings were 11 mm for both eyes. He had left hypotropia of 20 PD, and his FDT was grade 3.

He underwent left inferior rectus recession of 5 mm. Six months after surgery, his left eye remained hypotropia 2 PD but no diplopia symptom in the primary position.

Patient 2

A 62-year-old man with known TED. He was diagnosed with Grave's disease for 7 years. His thyroid status has been stable for many years. He quit smoking 1-year prior to initial examination. He had a history of compressive optic neuropathy of the left eye which was treated with systemic steroid therapy in 2014 but had poor response; consequently, he underwent left orbital decompression in January 2015. After that, he received right orbital decompression in November 2015 for treatment of proptosis. The muscle clinic was consulted to manage his vertical diplopia symptom. At initial evaluation, His BCVA was 20/50-1 and 20/25-1 in right and left eye, respectively. Exophthalmometer readings were 17 mm in the right eye and 13 mm in the left eye. He had left hypotropia of 45 PD, and his FDT was grade 3.

He underwent left inferior rectus recession of 6 mm. Six months after surgery, his eyes were orthotropic in primary position at distance and his BCVA remained stable.

Patient 3

A 65-year-old woman presented with vertical diplopia. She was diagnosed with Grave's disease for 2 years. Her thyroid status has been stable for

Table 2 Demographic and Clinical Characteristics of the Study Patients

Characteristics	Total (n=11)
Gender	
Male	4 (36.4)
Female	7 (63.6)
Age	
Mean $\pm$ SD	56.18 $\pm$ 6.71
Right Orbital decompression	
Yes	2.0 (18.2)
No	9.0 (81.8)
Left Orbital decompression	
Yes	2.0 (18.2)
No	9.0 (81.8)
Radiotherapy	
Yes	1.0 (9.1)
No	10.0 (90.9)
Systemic steroid therapy	
Yes	2.0 (18.2)
No	9.0 (81.8)
Right VA	
20/20	9.0 (81.8)
20/25 – 20/30	1.0 (9.1)
$\leq$ 20/40	1.0 (9.1)
Left VA	
20/20	6.0 (54.5)
20/25 – 20/30	4.0 (36.4)
$\leq$ 20/40	1.0 (9.1)
Side	
Right	5.0 (45.5)
Left	6.0 (54.5)
FDT Grade	
1	3.0 (27.3)
2	3.0 (27.3)
3	5.0 (45.4)
Right Exophthalmometer value (Mean $\pm$ SD)	14.91 $\pm$ 2.55
Left Exophthalmometer value (Mean $\pm$ SD)	15.64 $\pm$ 2.87
Surgical dose (Mean $\pm$ SD)	4.27 $\pm$ 1.01
Postoperative Distance alignment (Mean $\pm$ SD)	5.00 $\pm$ 7.86
F/U time (Mean $\pm$ SD)	2.55 $\pm$ 0.52
Postoperative diplopia in primary position	
Yes	3.0 (27.3)
No	8.0 (72.7)

Value were represented as n (%) and Mean $\pm$ SD

Table 3 Preoperative and Postoperative patient findings

Patient No.	Age (yrs)/ Sex	Orbital decompression	Radiotherapy	Systemic steroid therapy	VA	Preoperative alignment(PD)	FDT grade	Exophthalmometer value	Operation	Postoperative alignment(PD)	F/U time
1	50/M	N	N	N	20/20,20/25	LHoT 20	3	11,11	LIR recess 5 mm	LHoT 2	3
2	62/M	Y (R,L)	N	Y	20/50-1,20/25-1	RHoT 45	3	17,13	RIR recess 6 mm	0	3
3	65/F	N	N	N	20/20,20/20	LHoT 30	1	12,14	LIR recess 3 mm	LHoT 4	3
4	51/M	N	N	N	20/20,20/20	RHoT 25	2	14,14	RIR recess 4 mm	RHoT 6	3
5	62/M	Y (L)	N	N	20/20,20/20	LHoT 40	3	16,16	LIR recess 5 mm	0	3
6	55/F	N	N	N	20/20,20/40	RHoT 40	2	14,15	RIR recess 4 mm	RHoT 14	3
7	48/F	Y (R)	N	Y	20/32,20/20	RHoT 30	3	12,18	RIR recess 5 mm	RHoT 25	2
8	51/F	N	Y	N	20/20,20/20	LHoT 30	2	17,18	LIR recess 4 mm	0	2
9	65/F	N	N	N	20/20,20/32	LHoT 30	1	17,18	LIR recess 3 mm	0	2
10	49/F	N	N	N	20/20,20/20	LHoT 45	3	19,21	LIR recess 5 mm	LHoT 4	2
11	60/F	N	N	N	20/20-1,20/25	RHoT 20	1	15,14	RIR recess 3 mm	0	2

RHoT/LHoT = right or left hypotropia

RIR/LIR = right or left inferior rectus

R = right, L = left

M = male, F = female, Y = Yes, N = No

*Follow-up since first strabismus operation

more than 6 months and no history of smoking. On initial evaluation, her BCVA was 20/20 for both eyes. Exophthalmometer readings were 12 and 14 mm in the right and left eye, respectively. She had left hypotropia of 30 PD, and her FDT was grade 1.

She underwent left inferior rectus recession of 3 mm. Six months after surgery, her left eye remained hypotropia 4 PD but no diplopia symptom in the primary position.

Patient 4

A 51-year-old man presented with vertical diplopia. He was diagnosed with Grave's disease for 3 years. His thyroid status has been stable for more than 6 months and he denied a history of smoking. On initial evaluation, his BCVA was 20/20 for both eyes. Exophthalmometer readings were 12 mm in both eyes. He had right hypotropia of 25 PD, and his FDT was grade 2.

He underwent a right inferior rectus recession of 4 mm. Six months after surgery, his right eye had residual hypotropia 6 PD without diplopia symptom in primary position.

Patient 5

A 62-year-old man with known TED. He was diagnosed with Grave's disease for 13 years. He received left orbital decompression surgery in 2019 for treatment of proptosis. At initial evaluation in the muscle clinic, his thyroid status and eye deviation have been stable for more than 6 months. He denied a history of smoking. His BCVA was 20/20 for both eyes. Exophthalmometer readings were 16 mm in both eyes. He had left hypotropia of 40 PD, and his FDT was grade 3.

He underwent a left inferior rectus recession of 5 mm. Six months after surgery, his eyes were orthotropic in primary position at distance and his BCVA remained stable.

Patient 6

A 55-year-old woman presented with vertical diplopia. She has been diagnosed with Grave's disease for 7 years. Her thyroid status has been stable for more than 6 months and no history of smoking. On initial evaluation, her BCVA was 20/20 in the right eye and 20/40 in the left eye. Exophthalmometer readings were 14 and 15 mm in the right and left eye, respectively. She had right hypotropia of 40 PD, and her FDT was grade 2.

She underwent a right inferior rectus recession of 4 mm. Six months after surgery, her right eye had residual hypotropia 14 PD, and vertical diplopia remained to a lesser degree.

Patient 7

A 48-year-old woman with known TED. She was diagnosed with Grave's disease for 18 years. She received right orbital decompression surgery and radiotherapy in 2019 for treatment of proptosis. At initial evaluation in the muscle clinic, her thyroid status and eye deviation have been stable for more than 6 months. She denied the history of smoking. Her BCVA was 20/32 in the right eye and 20/20 in the left eye. Exophthalmometer readings were 12 and 18 mm in the right and left eye, respectively. She had right hypotropia of 30 PD, and her FDT was grade 3.

She underwent a right inferior rectus recession of 5 mm. Three months after surgery, her right eye had residual hypotropia 25 PD, and diplopia symptom was still present.

Patient 8

A 51-year-old woman with known TED. She was diagnosed with Grave's disease for 10 years. She received radiotherapy because of active TED. Her thyroid status has been stable for more than 6 months and no history of smoking. On initial evaluation, her BCVA was 20/20 for both eyes. Exophthalmometer

readings were 17 and 18 mm in the right and left eye, respectively. She had left hypotropia of 30 PD, and his FDT was grade 2.

She underwent a left inferior rectus recession of 4 mm. Three months after surgery, her eyes were orthotropic in primary position at distance and her BCVA remained stable.

Patient 9

A 65-year-old woman presented with vertical diplopia. She was diagnosed with Grave's disease for 4 years. Her thyroid status has been stable for more than 6 months and no history of smoking. On initial evaluation, her BCVA was 20/20 in the right eye and 20/32 in the left eye. Exophthalmometer readings were 17 and 18 mm in the right and left eye, respectively. She had left hypotropia of 30 PD, and her FDT was grade 1.

She underwent left inferior rectus recession of 3 mm. Three months after surgery, her eyes were orthotropic in primary position at distance and her BCVA remained stable.

Patient 10

A 49-year-old woman presented with vertical diplopia. She was diagnosed with Grave's disease for 2 years. Her thyroid status has been stable for more than 6 months and no history of smoking. On

initial evaluation, her BCVA was 20/20 in both eyes. Exophthalmometer readings were 19 and 21 mm in the right and left eye, respectively. She had left hypotropia of 45 PD, and her FDT was grade 3.

She underwent left inferior rectus recession of 5 mm. Three months after surgery, her left eye had residual hypotropia 4 PD, and still had vertical diplopia in primary position which can be corrected by mild chin up position.

Patient 11

A 60-year-old woman presented with vertical diplopia. She was diagnosed with Grave's disease for 2 years. Her thyroid status has been stable for more than 6 months and no history of smoking. On initial evaluation, her BCVA was 20/20 in both eyes. Exophthalmometer readings were 15 and 15 mm in both eyes. She had right hypotropia of 20 PD, and her FDT was grade 1.

She underwent a right inferior rectus recession of 3 mm. Three months after surgery, her eyes were orthotropic in primary position at distance and her BCVA remained stable.

She underwent a right inferior rectus recession of 3 mm. Three months after surgery, her eyes were orthotropic in primary position at distance and her BCVA remained stable.

Table 4 Mean improvement per 1 mm of correction surgery grouped by FDT grade

FDT grading	Mean improvement per mm of recession	Minimum improvement	Maximum improvement
1	8.44	6.67	10
2	6.25	4.75	7.5
3	5.66	1	8.2

Discussion

Approximately 0.6-20% of all patients with TED-related strabismus will require correction surgery⁸⁻¹⁰. The main objective when managing significant vertical strabismus is to achieve a single binocular vision in the primary position or diplopia-free field in mild chin-up posture for severely affected patients¹¹. Strabismus surgery in TED remained challenging even for experienced surgeons due to its restrictive nature; there was no standard surgical dose-response for vertical muscle recession in TED patients¹². Many studies preferred the adjustable suture technique because of the difficulty in predicting surgical dose and reported good surgical outcomes¹²⁻¹⁵; however, the adjustable suture technique had various unique complications including vagal reaction during suture adjustment, increased postoperative inflammation which can result in suture granuloma or subconjunctival infection, late-overcorrection, exposed sutures, slipped adjustable suture knot, nausea and vomiting, and ocular pain which prevented patients from getting suture adjustment¹⁶⁻¹⁷.

This prospective case series of patients with TED-related hypotropia who received unilateral inferior rectus muscle recession with surgical dose based on FDT grading. In this study, nine out of eleven patients achieved acceptable distance postoperative alignment of less than 10PD in the primary position; however, one of them still reported a lesser degree of diplopia that required further correction by prism. The success rate of 80% was comparable to other studies using the adjustable suture technique in TED-related strabismus. The unresponsive cases may be due to the hypothesis which states that restrictive strabismus in TED is caused by 2 different mechanisms: muscle involvement, and posterior orbital fibrosis with adherence to the globe¹⁸. Although in this study we performed lysis adhesion around muscle and deep to the equator, posterior orbital fibrosis possibly made the procedure less effective. In

addition to the posterior orbital fibrosis, the inadequate surgical dose and incomplete lysis adhesion were possible causes of treatment failure. Mean improvement per 1 mm recession grouped by FDT grade (Table 4) showed that muscle recession in patients who had low FDT grade gave more improvement in ocular alignment. This can be explained by posterior orbital fibrosis which causes high involvement of the fascial tissues and their attachment to the Tenon's capsule making muscle recession less effective in some patients who show severe restriction in forced duction test despite only having mild ocular misalignment.

Conclusion

The standard surgical dose for thyroid-related strabismus is still not available. Many reports suggested using the adjustable suture technique with acceptable outcomes; however, the procedure often failed to be performed due to ocular pain and is associated with many complications. Muscle recession surgery with a surgical dose determined by FDT grading is a possible alternative in some selected cases. Further prospective study with larger population and longer follow-up period should be performed to quantify the relationship between surgical dose and FDT grading. Moreover, further study in unresponsive cases should be performed to identify the causes of treatment failure.

References

1. Yuliawati P, AryPramita IA, Utari NM, Djelantik AAAS, Triningrat AAM, Manuaba IB. Exophthalmometry value in normal and proptosis eye OF reconstruction, OCULOPLASTY AND oncology patients in Sanglah General Hospital bali. Biomed Pharmacol J. 2021;14(2):749-53.
2. Akbari MR, Mirmohammadsadeghi A, Mahmoudzadeh R, Veisi A. Management of thyroid eye disease-related strabismus. J Curr Ophthalmol. 2019; <https://doi.org/10.1016/j.joco.2019.10.002>

3. Lyons CJ, Al Qahtani ES, Godoy F, Rootman J, Kersey J. Clinical pearls and management recommendations for strabismus due to Thyroid Orbitopathy. *Middle East Afr J Ophthalmol*. 2015;22(3):307. <https://doi.org/10.4103/0974-9233.159731>
4. Kaus DJ, Bullock JD. Treatment of thyroid ocular myopathy with adjustable and nonadjustable suture strabismus surgery. *Trans Am Ophthalmol Soc*. 1993;91:67-84.
5. Evans D, Kennerdell JS. Extraocular muscle surgery for dysthyroid myopathy. *Am J Ophthalmol*. 1983;95:767-71.
6. Yan J, Zhang H. The surgical management of strabismus with large angle in patients with graves' ophthalmopathy. *Int Ophthalmol*. 2007;28(2):75-82.
- Wallang BS, Kekunnaya R, Granet D. Strabismus surgery in thyroid-related eye disease: Strategic decision making. *Curr Ophthalmol Rep*. 2013;1(4):218-28.
7. Yuliawati P, AryPramita IA, Utari NM, Djelantik AAAS, Triningrat AAM, Manuaba IB. Exophthalmometry value in normal and proptosis eye Of reconstruction, OCULOPLASTYAND oncology patients in Sanglah General Hospital bali. *Biomed Pharmacol J*. 2021; 14(2):749-53.
8. Bartley G, Fatourehchi V, Kadrmas E, Jacobsen S, Ilstrup, D, Garrity J, Gorman C. The treatment of Graves' ophthalmopathy in an incidence cohort. *Am J Ophthalmol*. 1996;121(2):200-6. [https://doi.org/10.1016/s0002-9394\(14\)70585-9](https://doi.org/10.1016/s0002-9394(14)70585-9)
9. Rajendram R, Bunce C, Adams GGW, Dayan CM, Rose GE(2011). Smoking and strabismus surgery in patients with thyroid eye disease. *Ophthalmology*. 2011;118(12):2493-7. <https://doi.org/10.1016/j.optha.2011.06.003>
10. Bartley G, Fatourehchi V, Kadrmas E, Jacobsen S, Ilstrup, D, Garrity J, Gorman C. The treatment of Graves' ophthalmopathy in an incidence cohort. *Am J Ophthalmol*. 1996.121(2):200-6. [https://doi.org/10.1016/s0002-9394\(14\)70585-9](https://doi.org/10.1016/s0002-9394(14)70585-9)
11. Dagi LR. Management of graves myopathy. *J AAPOS*. 2018;22(4):252-5. <https://doi.org/10.1016/j.jaapos.2018.01.020>
12. Schotthoefer EO, Wallace DK. (2007). Strabismus associated with thyroid eye disease. *Curr Opin Ophthalmol*. 2007;18(5):361-5. <https://doi.org/10.1097/icu.0b013e32827038f2>
13. Tsai CB. Adjustable rectus muscle plication for management of strabismus in thyroid eye disease. *J AAPOS*. 2017;21(4). <https://doi.org/10.1016/j.jaapos.2017.07.164>
14. Volpe NJ, Mirza-George N, Binenbaum G. Surgical management of vertical ocular misalignment in thyroid eye disease using an adjustable suture technique. *J AAPOS*. 2012;6(6):518-22. <https://doi.org/10.1016/j.jaapos.2012.08.010>
15. Lueder GT, Scott WE, Kutschke PJ, Keech RV. Long-term results of adjustable suture surgery for strabismus secondary to thyroid ophthalmopathy. *Ophthalmology*. 1992;99(6):993-7. [https://doi.org/10.1016/s0161-6420\(92\)31866-4](https://doi.org/10.1016/s0161-6420(92)31866-4)
16. Nihalani BR, Hunter DG. Adjustable suture strabismus surgery. *Eye*. 2011;25(10):1262-76. <https://doi.org/10.1038/eye.2011.167>
17. Eustis HS, Elmer TR, Ellis, G. Postoperative results of absorbable, subconjunctival adjustable sutures. *J AAPOS*. 2004;8(3):240-2. <https://doi.org/10.1016/j.jaapos.2004.01.013>
18. Mazow ML. Thyroid ophthalmopathy: Are adjustable sutures the real answer? *Am Orthopt J*. 1985;35(1):90-5. <https://doi.org/10.1080/0065955x.1985.11981670>

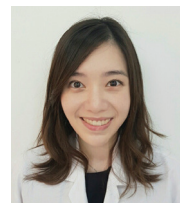
รายงานผลการผ่าตัดตาเขจากโรคไทรอยด์โดยใช้ขนาดผ่าตัดตามค่าความตึงของกล้ามเนื้อ



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บทคัดย่อ:

วัตถุประสงค์: เพื่อศึกษาผลการผ่าตัด inferior rectus recession โดยใช้ขนาดการผ่าตัดที่กำหนดโดยความตึงของกล้ามเนื้อจาก forced duction test ในคนไข้ตาเขจากโรคไทรอยด์

วัสดุและวิธีการ: การศึกษาไปข้างหน้า โดยนำผู้ป่วยที่เข้าเกณฑ์จำนวน 11 ราย มาทำการผ่าตัด unilateral inferior rectus recession ซึ่งใช้ขนาดผ่าตัดที่กำหนดจาก forced duction test และติดตามผลการผ่าตัดอย่างน้อย 3 เดือน โดยผลลัพธ์ที่ต้องการหลังผ่าตัดคือผู้ป่วยมีตาเขเหลือน้อยกว่า 10PD และไม่มีภาวะแทรกซ้อนที่ส่งผลต่อการมองเห็นจากการผ่าตัด

ผลการศึกษา: ผู้ป่วย 9 ใน 11 ราย (81.1%) มีผลลัพธ์ที่น่าพึงพอใจหลังผ่าตัด และไม่มีผู้ป่วยรายใดเกิดภาวะแทรกซ้อนจากการผ่าตัด

สรุป: การผ่าตัด inferior rectus recession เพื่อแก้ไขภาวะตาเขจากโรคไทรอยด์ โดยใช้ขนาดการผ่าตัดที่กำหนดจาก force duction test เพียงอย่างเดียว พบว่าให้ผลลัพธ์การผ่าตัดที่น่าพึงพอใจเทียบได้กับการผ่าตัดเทคนิค adjustable suture และอาจเป็นทางเลือกในการรักษาผู้ป่วยตาเขจากโรคไทรอยด์บางรายที่ไม่สามารถทนผลข้างเคียงในการผ่าตัดเทคนิค adjustable suture ได้ อย่างไรก็ตาม เนื่องจากการศึกษานี้มีจำนวนคนไข้น้อยและระยะเวลาติดตามที่สั้น จึงควรมีการศึกษาเพิ่มเติมเพื่อหาความสัมพันธ์ระหว่างค่าความตึงตัวของกล้ามเนื้อกับขนาดการผ่าตัดต่อไป

คำสำคัญ: ความตึงของกล้ามเนื้อ, ตาเข, อาการทางตาจากโรคไทรอยด์, การผ่าตัดแบบปรับการเย็บได้

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