• Clinical Research •

Optimal timing for cataract surgery in patients with thyroid-associated ophthalmopathy

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Abstract

• **AIM:** To investigate the optimal timing and therapeutic effects of cataract surgery in patients with moderate to severe thyroid-associated ophthalmopathy (TAO).

• **METHODS:** Data from TAO patients who underwent cataract surgery between 2014 and 2024 were analyzed. patients were categorized into two groups based on the hospital where their cataract surgery was performed: an external hospital surgery group and an in-house hospital surgery group. Patients in external hospital presenting with complications within six months postoperatively were assessed for clinical features, imaging, thyroid function, and outcomes. Patients who underwent surgery at West China Hospital were evaluated for clinical status, imaging, laboratory findings, and manifestations.

• **RESULTS:** In the external hospital group (n=31), common symptoms included eyelid swelling (64.52%) and diplopia (51.61%), with restricted eye movement in all patients. Most patients were in the active stage (87.10%) and exhibited various complications, such as dysthyroid optic neuropathy (DON) in 4 patients, misdiagnosis of glaucoma in 1 patient, and enucleation due to fungal infection in 1 patient. In the West China Hospital group (n=30), 2 patients were in the active stage, and 28 were in the inactive stage. Postoperative visual acuity improved in 36 eyes, except for in 2 eyes with DON. Active TAO patients with mature cataracts had effective inflammation control and no complications at the 6-month follow-up.

• **CONCLUSION:** In patients with moderate to severe active TAO complicated by cataracts, delaying cataract surgery until 6mo of TAO control should be considered if cataracts are stable. Simultaneous anti-inflammatory treatment and cataract surgery should be performed for mature/hypermature cataracts, and TAO management should be continued after surgery.

• **KEYWORDS:** thyroid-associated ophthalmopathy; cataract surgery; surgical timing

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INTRODUCTION

Thyroid-associated ophthalmopathy (TAO) is a complex autoimmune disorder that affects orbital tissue and manifests as a variety of ocular symptoms, such as eyelid retraction, eyelid swelling, and proptosis. In severe cases, exposure keratitis and dysthyroid optic neuropathy (DON) may occur, potentially leading to visual impairment or even blindness, which significantly impacts the physical and psychological well-being of patients[1-3]. The management of TAO varies depending on whether the disease is in its active or inactive stage; however, the current method for assessing disease activity relies primarily on the clinical activity score (CAS)[4-6]. Nevertheless, the CAS has been found to be inadequate for accurately evaluating disease activity in all patients because of its subjective nature and lack of specificity[7-9].

Cataracts are currently the leading cause of blindness, with surgery being the only effective treatment. Although generally considered an elective procedure, cataract surgery requires timely execution due to potential complications such as uveitis, crystalline lens dissolution, and glaucoma, especially in patients with mature or hypermature cataracts. Postoperative diplopia can result in significant visual impairment and affect the quality of life of patients following cataract surgery. The etiology of diplopia is multifactorial, with TAO being one of the contributing factors[10-11]. Several studies have reported an association between TAO and a subset of cases of postoperative diplopia[12-13]. Case reports have documented the occurrence

or exacerbation of TAO following cataract surgery[14], with Yi *et al*[15]. reporting an average interval of 7.4wk for its onset or exacerbation in five patients. The TAO population is relatively small, and an extensive epidemiological survey revealed that the incidence rate among Asian populations ranges from 0.1% to 0.3%[16]. TAO patients are commonly elderly, thus warranting further investigation into the optimal surgical timing for patients with both TAO and cataracts.

PARTICIPANTS AND METHODS

Ethical Approval This clinical study followed the principles of the Declaration of Helsinki and was approved by the Biomedical Ethics Review Committee of West China Hospital, Sichuan University (Approval No. 2022-1982). Each participant signed a written informed consent form before the study.

This retrospective study was conducted at the Orbital Disease Specialist Clinic of West China Hospital, Sichuan University. Patients were included from January 2014 to January 2024. The diagnosis of TAO was made for all patients in our outpatient clinic based on the Bartley and Gorman[17] diagnostic criteria. Activity was assessed *via* CAS combined with orbital enhancement magnetic resonance imaging (MRI)[1,8,18], and severity was assessed *via* the NOSPECS score[4].

Participants Grouping In this study, patients were categorized into two groups based on the hospital where their cataract surgery was performed: an external hospital surgery group and an in-house hospital surgery group.

External hospital surgery group Patients who underwent cataract surgery at an external hospital and subsequently experienced new or exacerbated symptoms, such as diplopia and strabismus, during the six-month postoperative period were referred to our specialized clinic for TAO. This report aims to gather information on patients' demographics, chief complaints, clinical manifestations, physical examination findings, thyroid function status, treatment modalities employed, outcomes achieved and prognosis. The inclusion criteria for this group of patients were as follows: 1) patients with moderate or severe TAO who were misdiagnosed before cataract surgery; 2) patients with TAO who were diagnosed before cataract surgery but were in the active stage of TAO or had a stationary stage of TAO with restrictive strabismus and underwent cataract surgery; 3) patients who received treatment and follow-up for 6mo. The exclusion criteria for this group of patients were as follows: 1) patients who experienced diplopia, strabismus, or similar symptoms within 6mo after cataract surgery unrelated to TAO or patients who experienced symptom exacerbation; 2) patients whose follow-up data were incomplete.

In-house hospital surgery group Comprehensive data were collected from patients with moderate-to-severe TAO who underwent cataract surgery at the Ophthalmology Department of West China Hospital, Sichuan University. The data included overall health conditions, preoperative and postoperative ocular manifestations, thyroid function status, ancillary examinations, and outcomes. In addition to documenting the aforementioned information, the ophthalmologist captured facial photographs of all patients. The inclusion criteria for this group of patients were as follows: 1) patients with moderate to severe TAO who underwent cataract surgery at our hospital; 2) patients who received treatment and follow-up for 6mo.

Statistical Analysis Statistical analysis was performed *via* SPSS 25.0 software (IBM Corp., Armonk, NY, USA). The quantitative data are presented as the means±standard deviations (SD), whereas the descriptive statistics are expressed as percentages. Repeated-measures ANOVA was used to examine the differences/changes in best corrected visual acuity (BCVA), intraocular pressure (IOP), and CAS before and after cataract surgery. $P<0.05$ indicated statistical significance.

RESULTS

External Hospital Surgery Group

Demographic data A total of 31 patients were included, including 8 males and 23 females, with an average age of 69.06±8.59y. The duration of the disease ranged from 1 to 72mo (median: 6mo), and the time from cataract surgery to the ophthalmological outpatient clinic was 1 to 24mo (median: 5mo). Hyperthyroidism was observed in 12 patients (38.71%), whereas subclinical hyperthyroidism was present in 3 patients (9.68%). Additionally, hypothyroidism was identified in 9 patients (29.03%), and normal thyroid function was found in 7 patients (22.58%). The relationships among the affected eye, cataract surgery, onset of TAO clinical symptoms and signs, clinical activity stage, and severity grade were shown in Table 1.

Ophthalmic symptoms and clinical findings The most prevalent symptoms observed in patients included a sensation of eyelid swelling (64.25%) and diplopia (51.61%), followed by visual impairment (38.71%) and photophobia (19.35%). The most frequently encountered physical findings include impaired eyeball motility (100%), delayed ptosis of the eyelid (67.74%), and eyelid edema (64.52%; Table 1).

Cataract surgery and TAO affected eyes Among the 27 patients with moderate to severe active TAO, bilateral cataract surgery was performed in 14 patients, whereas unilateral cataract surgery was performed in 13 patients. Among the patients who underwent bilateral cataract surgery, 11 had bilateral TAO, and 3 had unilateral TAO. Among the patients who underwent unilateral cataract surgery, 11 had bilateral TAO, 1 had TAO in the operated eye, and 1 had TAO in the non-operated eye. The four patients with inactive TAO presented with bilateral cataracts and underwent bilateral cataract surgery.

Treatment and follow-up Among the patients who received treatment between cataract surgery and their outpatient visit to our hospital, 24 patients remained untreated, whereas 7 patients were treated. Following surgery, medication was prescribed to reduce IOP in 2 patients; however, only one patient achieved normal IOP after treatment, whereas the other patient exhibited uncontrolled IOP. Intravenous bolus injections of methylprednisolone were administered to two patients but did not yield significant improvement.

Additionally, triamcinolone was peri-orbitally injected in 2 patients; temporary improvement lasting more than 10d before recurrence was observed in 1 patient, whereas no improvement was noted in the other patient. Finally, enucleation was required for 1 patient due to postoperative fungal keratitis.

The treatment outcomes of outpatient visits in our hospital were evaluated in 27 active patients with TAO. Among them, 12 patients received periorbital injections of triamcinolone (40 mg per eye, administered monthly for 2–4 cycles), whereas the remaining 15 patients underwent combined treatment with periorbital triamcinolone injections and orbital radiation therapy (total radiation dose: 20 Gy, delivered in 10 fractions). Follow-up assessments were conducted at 1, 2, 3, and 6mo posttreatment. Significant improvements in clinical signs, including chemosis, conjunctival congestion, and eyelid swelling, were observed. At the end of the six-month follow-up period, chemosis improved by 83.33%, conjunctival congestion improved by 80.00%, and eyelid edema improved by 77.78%. Additionally, among the four stable TAO patients included in this study cohort, one patient experienced resolution of diplopia symptoms after strabismus correction surgery; the remaining three patients were followed up for observation.

In-house Hospital Surgery Group

General conditions A total of 30 patients (41 eyes), including 14 males and 16 females, with a mean age of 61.90±9.72y, were included in the study. Among them, 28 patients were in the inactive stage, whereas 2 were in the active stage. Based on NOSPECS severity classification of the included participants, 30 patients (41 eyes) were categorized as follows: Grade 3, 9 eyes (21.95%); Grade 4, 28 eyes (68.29%); Grade 5, 1 eye (2.44%); and Grade 6, 3 eyes (7.32%; Table 2). The thyroid function status, disease activity stage, and severity of NOSPECS were presented in Table 2.

Ophthalmic symptoms and clinical findings The symptoms most frequently reported by patients during consultation were blurred vision (100%), followed by a sensation of eye swelling (34.21%) and eye pain (18.42%). The most prevalent physical findings upon examination included proptosis (71.05%), followed by eyelid lag (57.89%) and eye movement limitation (47.37%; Table 2).

Table 1 Characteristics of 31 patients undergoing cataract surgery at an outpatient clinic

Characteristics	Patients/eyes
Sex (male/female)	8/23
Age (y)	69.06±8.59
Affected eyes (unilateral/bilateral)	6/25
Activity assessment (active/inactive)	27/4
TAO severity	
Moderate (NOSPECS, 4)	46
Severe (NOSPECS, 5/6)	2/8
Time relationship between cataract surgery and TAO clinical presentation	
Preoperative	20
Postoperative (0/1/5/6mo)	6/1/1/3
Ophthalmic symptoms	
Eye swelling sensation/diplopia	16
Visual decreased/photophobia	12/6
Tearing/foreign body sensation	6/6
Clinical findings	
Eye movement limitation/lid lag	31/21
Eyelid swelling/eyelid retraction	20/16
Strabismus/proptosis/chemosis	13/12/7
Conjunctival congestion/lagophthalmos	10/6
Elevated intraocular pressure/corneal disorders	4/4
Thyroid function	
Hyperthyroidism/hypothyroidism	12/9
Subclinical hyperthyroidism/normal	3/7

TAO: Thyroid-associated ophthalmopathy.

Table 2 Characteristics of 30 patients undergoing cataract surgery at our hospital

Characteristics	Patients/eyes
Sex (male/female)	14/16
Average age (y)	61.90±9.72
Affected eyes	41
Activity assessment (active/inactive)	2/28
TAO severity	
Moderate (NOSPECS, 3/4)	9/28
Severe (NOSPECS, 5/6)	1/3
Ophthalmic symptoms	
Blurring of vision	38
Sensation of eye swelling/eye pain	13/7
Foreign body sensation/tearing	7/7
Clinical findings	
Proptosis/eyelid lag	27/22
Eye movement limitation	18
Eyelid retraction/eyelid swelling	17/13
Conjunctival congestion/lagophthalmos	5/3
Elevated intraocular pressure/chemosis	4/3
Thyroid function	
Hyperthyroidism/hypothyroidism	5/6
Subclinical hyperthyroidism/normal	2/17

TAO: Thyroid-associated ophthalmopathy.

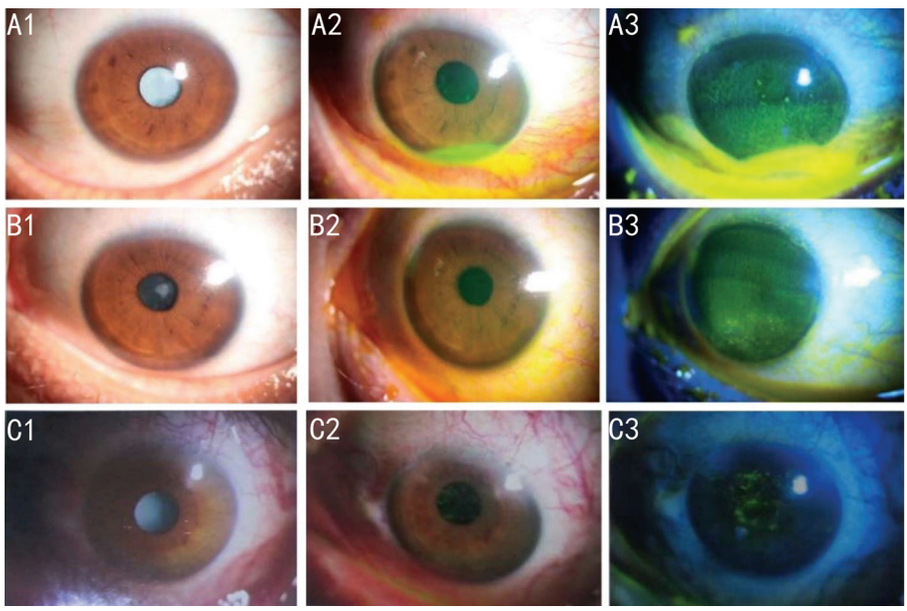

Figure 1 Two cases of anterior segment findings in patients with active thyroid-associated ophthalmopathy A1: A 40-year-old female with conjunctival hyperemia and right lens opacification; A2: Two weeks after right eye cataract surgery, conjunctival hyperemia and central corneal epithelial spotty loss; B1: Left eye conjunctival hyperemia with uneven lens opacities; B2: One week after left eye cataract surgery, conjunctival hyperemia; A3, B3: One-month post-cataract surgery, both corneas exhibited extensive and diffuse fluorescein staining; C1: A 51-year-old male with conjunctival hyperemia and left lens opacification; C2: Four days after left eye cataract surgery, conjunctival hyperemia and central corneal epithelial spotty loss; C3: One-month post-cataract surgery, spotty fluorescein staining of the central cornea of the left eye.

Table 3 Postoperative assessment of visual acuity, IOP, and CAS in 28 patients

Parameters	Preop.	Postop. 1mo	Postop. 6mo	[a]*P*	[b]*P*
BCVA (logMAR)	0.75±0.78	0.26±0.49	0.23±0.50	<0.001	<0.001
IOP (mm Hg)	17.00±5.48	15.95±4.42	15.97±4.52	0.084	0.083
CAS	0.66±0.78	0.63±0.75	0.47±0.65	0.711	0.017

[a]Postop. 1mo *vs* preop., [b]Postop. 6mo *vs* preop. BCVA: Best corrected visual acuity; IOP: Intraocular pressure; CAS: Clinical Active Score.

Within the group of severe TAO patients, the duration from the inactive stage to cataract surgery ranged from 3mo to 30y, with an average interval of 40.64±78.96mo. Among these patients, all 30 underwent cataract phacoemulsification combined with intraocular lens implantation surgery; single-eye surgery was performed on 19 patients, whereas bilateral surgery was conducted on 11 patients, with surface anesthesia used as the chosen method.

Treatment and follow-up In the cohort of 28 patients with stable TAO, which included 38 eyes, cataract surgery resulted in improved visual acuity in 36 eyes, whereas no improvement was observed in 2 patients (2 eyes) with concurrent DON. Importantly, none of the patients experienced any significant postoperative complications. Among the 28 stable-stage TAO patients, thirteen had concomitant restrictive strabismus. Eight patients underwent preoperative strabismus correction to align their eye position. Additionally, five patients presented with diplopia before surgery; among them, two developed diplopia after surgery and were advised to seek further evaluation at a strabismus outpatient clinic. Postoperatively, at both 1 and 6mo after cataract surgery, a statistically significant improvement in visual acuity compared with the preoperative values was observed (P<0.05). However, no statistically significant differences were found in the IOP or CAS between the preoperative measurements and those taken at 1 and 6mo postoperatively, as shown in Table 3.

In addition, 2 cases (involving 3 eyes) of moderate to severe active TAO were observed, characterized by mature cataracts with complete opacification and whitening of the lenses. To prevent potential complications related to cataracts, cataract surgery was performed on these 2 patients in the active phase while simultaneously administering anti-inflammatory treatment for their TAO condition. The patients subsequently received continued postoperative anti-inflammatory therapy and were followed up for 6mo. Notably, effective control of inflammation was achieved without any occurrence of additional postoperative complications (Figure 1).

Cases Reports

A case misdiagnosed as glaucoma A case of misdiagnosis as glaucoma due to elevated IOP reported. The patient underwent phacoemulsification combined with intraocular lens implantation and goniosynechialysis in both eyes, with

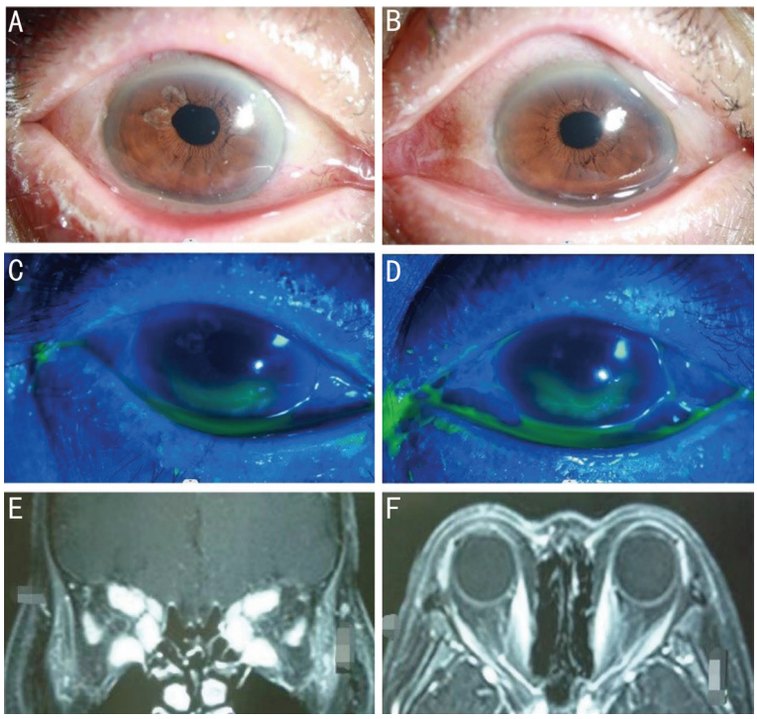

Figure 2 A patient misdiagnosed with glaucoma A, B: Bilateral conjunctival congestion with properly positioned intraocular lenses; C, D: Patchy fluorescein staining indicative of abnormal corneal epithelium; E: Thickening and significant enhancement of the inferior, superior, and medial rectus in TIWI-enhanced coronal imaging; F: Thickening and enhancement of the medial rectus in TIWI-enhanced sagittal imaging.

a two-day interval between surgeries. Postoperative medical treatment for IOP was administered, but the effect remained unsatisfactory. Eventually, the patient was diagnosed with TAO. The symptoms and signs at the time of presentation included blurred vision in both eyes, eyelid swelling, eyelid retraction and lid lag, limited ocular motility, patchy corneal epithelial defects in both eyes, a cup-disc ratio of 0.5 in both eyes, visual acuity of 0.1 in the right eye and 0.08 in the left eye, and an IOP of 36.4 mm Hg in the right eye and 24.6 mm Hg in the left eye. Additional examinations revealed thickening and enhancement of the inferior, medial, and superior rectus muscles on magnetic resonance imaging (MRI) with contrast and elevated levels of thyroid-stimulating hormone, thyroglobulin antibody, thyroid peroxidase antibody, and thyrotropin receptor antibody on thyroid function tests. Treatment consisted of a periorbital injection of 40 mg of triamcinolone acetonide (half in each upper and lower quadrant of both eyes) and orbital radiotherapy (Figure 2). The patient did not return for follow-up visits after treatment.

A case with severe complications A case presented with a 3-month history of eyelid edema. Past medical history included cataract surgery in the right eye three months prior, fungal keratitis in the right eye two months prior, and enucleation of the right eye one month prior. Additionally, the patient had a two-year history of hyperthyroidism treated with iodine-131, resulting in hypothyroidism, which is currently managed with levothyroxine.

Ophthalmic examination revealed bilateral eyelid swelling, with sutures in place on the right eyelid. Conjunctival congestion and chemosis were evident, with partial exposure of the conjunctiva (Figure 3A). The left upper eyelid exhibited contraction (Figure 3B), lagophthalmos, and incomplete closure, with partial restriction of upward movement. The lateral bulbar conjunctiva was congested and chemotic, with punctate corneal epithelial defects and lens opacities. Orbital contrast-enhanced MRI showed significant thickening and enhancement of the bilateral superior rectus muscle bellies. The right inferior and medial rectus muscles, as well as the superior oblique muscle belly, were also thickened and enhanced. The belly of the left inferior rectus muscle was slightly thickened and enhanced (Figure 3C). The patient received three periorbital triamcinolone injections and local orbital radiation therapy at our institution. Following a 2-month follow-up, the patient's ocular condition significantly improved (Figure 3).

DISCUSSION

Cataract surgery in patients with TAO poses unique challenges and requires careful consideration of disease activity, cataract status, and postoperative management strategies. Our study focused on investigating the optimal timing for cataract surgery in patients with moderate to severe TAO, emphasizing the importance of timely intervention and appropriate follow-up care. The results from our case series provide valuable insights into the outcomes and management strategies for cataract surgery in this specific patient population.

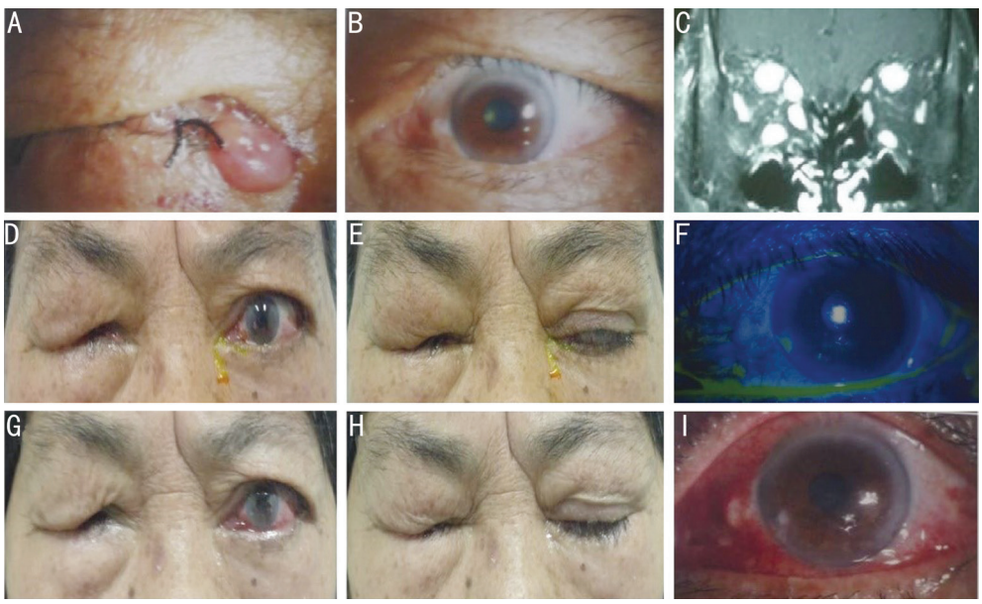

Figure 3 A patient with severe complications following cataract surgery A-C: Before treatment; D-F: After 1mo of treatment, conjunctival congestion and edema in both eyes, mild exposure in right eye, left upper eyelid contraction, incomplete closure of the left eyelid, inferior corneal epithelial punctata, patchy fluorescein staining were observed; G-I: After 2mo of treatment, right eye with no conjunctival exposure, left upper eyelid contraction, conjunctival congestion and edema, left eyelid complete closure, conjunctival congestion, chemosis, and inferior corneal epithelial patchy deficiency.

In this study, the majority of patients in both groups exhibited bilateral TAO, emphasizing the importance for clinicians to consider both eyes during cataract surgery in TAO patients rather than solely focusing on the operated eye.

In both groups, the majority of patients with severe TAO were elderly and presented with more advanced disease stages. According to the NOSPECS severity classification, all 31 patients (56 eyes) in the outpatient group were classified as Grade 4 or above, whereas the majority of patients in our hospital group (30 patients; 41 eyes) were Grade 4. This finding was consistent with previous studies highlighting that older TAO patients tend to exhibit more severe disease manifestations[16].

Patients in the external hospital group primarily sought treatment at our facility due to eyelid edema (64.52%) and diplopia (51.61%), with ocular motility impairment (100%) being the most common sign. A significant proportion (64.52%) of patients presented with clinical signs of TAO prior to cataract surgery, primarily manifesting as strabismus and diplopia. When monocular cataracts are severe, diplopia can be masked; however, following cataract surgery and improvement in visual acuity, diplopia becomes more apparent, driving patients to seek medical attention. Eight patients (29.63%) in this group were diagnosed with moderate-to-severe active-phase TAO, despite the absence of clinical signs, such as conjunctival hyperemia, eyelid edema, and corneal lesions. Based on CAS scoring, these patients were considered to be in the quiescent phase. However, orbital MRI with contrast enhancement suggested inflammatory activity in extraocular muscles, which is consistent with previous reports indicating that CAS scoring may not accurately reflect disease activity in all patients[7,19]. This inaccuracy may lead to a misdiagnosis of quiescence and subsequent cataract surgery in those with low CAS scores. Moreover, some cataract specialists may not be experts in thyroid eye disease and may overlook the examination of ocular adnexal structures, such as the eyelids, ocular alignment, and motility, which could result in the underdiagnosis of TAO patients with less pronounced eyelid signs. Postoperative diplopia or its exacerbation, elevated IOP, and orbital soft tissue inflammatory reactions can easily lead to medical disputes.

Several challenges were identified for patients who underwent cataract surgery at external hospitals, including misdiagnosis, exacerbation of TAO symptoms postoperatively, and delayed referral to specialized clinics. Indeed, some patients experienced severe complications postoperatively without adequate vigilance, such as compressive optic neuropathy, misdiagnosis of glaucoma, fungal infections, and even enucleation due to endophthalmitis. Therefore, a thorough medical history and comprehensive physical examination are essential prerequisites for accurate diagnosis and appropriate treatment.

According to previous studies, dry eye syndrome affects 65%–85% of patients with TAO and is a complex autoimmune disease that can lead to changes in tear composition[20]. The mechanical exposure of the ocular surface caused by

protruding eyeballs and the retraction of the upper eyelid can result in an unstable tear film[12]. TAO patients also reportedly experience a decrease in the number of meibomian glands[21], which is a risk factor for dry eye syndrome. Additionally, the incidence of dry eye syndrome significantly increases after cataract surgery, possibly because corneal nerve damage during the procedure affects tear film stability and triggers inflammatory reactions[22-24]. For TAO patients undergoing cataract surgery, both disease-related and surgical factors contribute to an increased risk of ocular surface damage. Failure to detect and treat corneal damage promptly may lead to severe corneal infections. In this study, one patient who underwent cataract surgery at another hospital developed a fungal corneal ulcer and eventually required enucleation of the affected eye contents. Although we cannot ascertain the preoperative condition of this patient's ocular surface, punctate loss of corneal epithelium was observed on the contralateral eye upon presentation at our hospital for treatment. This case highlights important considerations for clinicians: the eye should be thoroughly examined for corneal epithelial damage prior to cataract surgery in such patients; if any preexisting ocular surface diseases are identified before surgery, the patient should be actively treated to minimize postoperative risks, such as corneal ulceration and other infections.

In the group of patients undergoing cataract surgery in an external hospital setting, our analysis revealed a concerning trend where surgery was performed during the active phase of TAO. Due to limitations in retrospective data, precise determination of disease activity at the time of surgery was not feasible. This situation predisposed patients to a spectrum of complications, emphasizing the critical need for thorough clinical assessment prior to surgical intervention. Importantly, there appeared to be a correlation between the severity of TAO and an increased risk of postoperative complications such as exacerbation of diplopia, elevated IOP, and inflammatory reactions in orbital soft tissue. The most severe observed outcome was enucleation due to endophthalmitis, highlighting the catastrophic consequences that can arise when TAO activity is not adequately controlled before cataract extraction. These findings underscore the necessity for clinicians to meticulously evaluate TAO activity and consider postponing elective cataract surgery until the disease is quiescent in order to mitigate postoperative risks and optimize patient outcomes.

In this study, a significant proportion of patients in the external hospital group with moderate to severe active TAO demonstrated notable improvements in both symptoms and signs following treatment. Within our hospital group, 28 patients in the stable phase who underwent cataract surgery, along with 2 patients in the active phase who also received cataract surgery, were administered postoperative active anti-inflammatory treatment without any occurrence of serious complications. These findings not only support the efficacy of our treatment approach but also align with previous reports[25-27], thereby emphasizing the effectiveness of periorbital triamcinolone acetonide injection and local orbital radiotherapy for managing TAO[28].

According to a consensus statement published in 2022 by the American Thyroid Association and the European Thyroid Association, radiotherapy is an efficacious treatment modality for active moderate to severe TAO[29-30], particularly when progressive diplopia is the predominant symptom[1]. Radiotherapy plays a pivotal role in the management of TAO by suppressing inflammatory responses, attenuating proinflammatory cytokine secretion from activated lymphocytes, and modulating diverse inflammatory processes and cellular constituents[31-32]. The American Academy of Ophthalmology published a literature review in 2022 on the safety and efficacy of orbital radiotherapy for TAO. This article highlights the latest evidence regarding the role of orbital radiotherapy in treating TAO, emphasizing its effectiveness in preventing dysthyroid optic neuropathy, improving oculomotor disorders, reducing the clinical activity of TAO, and minimizing corticosteroid usage[33]. However, long-term data on orbital radiotherapy are scarce. Future studies should prioritize investigating the long-term efficacy and safety of this treatment modality in large patient cohorts while also exploring optimal combined therapeutic approaches.

Limited literature exists on optimal surgical timing for patients with moderate to severe TAO presenting with concomitant cataracts both domestically and internationally. Few case reports address occurrences of TAO following cataract surgeries. Within our cohort, 28 individuals diagnosed with moderate to severe stable-stage TAO undergoing cataract procedures demonstrated significantly improved postoperative visual acuity compared to pre-operation levels. Post-surgery observations revealed no major complications or statistical variance in IOP or CAS. The enhanced postoperative visual outcomes coupled with absence of significant complications underscore the safety profile of performing cataract surgeries during stable-stage TAO. For patients with moderate to severe TAO in the active phase and concurrent cataracts, it is recommended that treatment for TAO be prioritized, with active management of inflammation if the cataract condition remains stable. Following 6mo of clinical observation, comprehensive evaluation of CAS score and orbital MRI findings should be conducted to confirm stable TAO before considering cataract surgery.

Interestingly, within our in-house hospital group, two patients underwent cataract surgery during the active phase of TAO. Both individuals presented with mature cataracts; one patient

also had high myopia, while the other was diagnosed with diabetes mellitus. Despite apprehensions regarding potential complications, surgical intervention was deemed imperative due to the advanced nature of their cataracts. Postoperatively, these patients received ongoing anti-inflammatory treatment, and no significant complications were noted during a 6-month follow-up period. This indicates that with thorough preoperative evaluation and diligent postoperative care, cataract surgery can be safely conducted even amidst the active phase of TAO. Consequently, a thorough assessment of the ocular condition is imperative prior to surgical intervention. In cases where the cataract has reached a mature or hypermature stage, it should be addressed initially through cataract surgery, followed by sustained active anti-inflammatory treatment and vigilant monitoring of any changes in the condition.

While the current study primarily focused on the timing and outcomes of cataract surgery in patients with TAO, further investigation is warranted to explore potential relationships between radiation therapy, steroid therapy, and cataract progression. Given the established association of both radiation and steroids with cataract formation, investigating how these treatments influence cataract development in the context of TAO could yield valuable insights for optimizing therapeutic strategies. Future studies should aim to elucidate these interactions, potentially informing more tailored approaches to managing TAO and its ocular complications.

In conclusion, this study aims to serve as a reminder for clinicians regarding the importance of treating patients with TAO and cataracts, emphasizing the necessity of conducting a comprehensive medical history review and physical examination prior to cataract surgery. The optimal timing for performing cataract surgery should be carefully determined. For patients in stable stages of moderate-to-severe TAO, cataract surgery should be scheduled after 6mo of inflammation control. However, if the cataract is at an advanced stage (mature or hypermature), cataract surgery should be prioritized, followed by anti-inflammatory treatment for TAO. Rigorous preoperative and postoperative follow-up management must be implemented.

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