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Original Research Article

# Clinical Evaluation and Management of Restrictive Strabismus in Thyroid Ophthalmopathy

**Manish Raval[1], Pratham Raval[2]**

[1]Ex-Assistant Professor, Department of Ophthalmology, M & J Institute of Ophthalmology, B. J. Medical College and Civil Hospital, Ahmedabad, Gujarat, India; Consultant, Ved Eye Hospital, Ahmedabad, Gujarat, India.

[2]MBBS, Smt. NHL Municipal Medical College, Ahmedabad, Gujarat, India

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**Corresponding author: Dr. Manish Raval**

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**Abstract**

**Background:** Thyroid eye disease is an autoimmune orbital disorder that may cause extraocular muscle inflammation, enlargement, and fibrosis, resulting in restrictive strabismus and diplopia. The clinical presentation and treatment response vary according to the stage of the disease.

**Objective:** To describe the clinical characteristics, imaging findings, medical treatment, and surgical management of restrictive strabismus associated with thyroid eye disease.

**Methods:** A retrospective descriptive study was conducted among 50 patients with thyroid eye disease-related restrictive strabismus. Clinical records were reviewed for demographic characteristics, disease phase, extraocular muscle involvement, imaging findings, treatment received, and clinical outcomes. Descriptive analysis was performed using frequencies and percentages.

**Results:** The majority of patients belonged to the 50–59 years age group (50%). Chronic fibrotic disease was more common than acute inflammatory disease, accounting for 60% and 40% of patients, respectively. The inferior rectus muscle was the most frequently involved extraocular muscle (60%), followed by the medial rectus (16%), superior rectus (10%), multiple extraocular muscles (8%), and lateral rectus (6%). Imaging demonstrated extraocular muscle enlargement with fibrosis in 50% of patients, while fusiform enlargement with tendon sparing was observed in 40%. Intravenous corticosteroid therapy was administered to 40% of patients, whereas inferior rectus recession was performed in 50%. Supportive treatment, including prism correction, was provided to 10% of patients. Improvement in ocular motility and diplopia was observed following appropriate phase-specific treatment.

**Conclusion:** Restrictive strabismus in thyroid eye disease is commonly associated with inferior rectus involvement and chronic fibrotic changes. Intravenous corticosteroids may be beneficial during the active inflammatory phase, while inferior rectus recession can improve ocular alignment and motility in stable fibrotic disease. Careful clinical assessment, imaging, and appropriate timing of treatment are essential for achieving satisfactory outcomes.

**Keywords:** Thyroid Eye Disease; Restrictive Strabismus; Inferior Rectus Muscle; Diplopia; Extraocular Muscle Fibrosis; Corticosteroid Therapy; Strabismus Surgery.

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## Introduction

Thyroid ophthalmopathy, also known as thyroid eye disease or Graves' orbitopathy, is an autoimmune disorder affecting the orbit and its soft tissues. The extraocular muscles are particularly susceptible to inflammatory enlargement during the active phase and fibrosis during the later phase of the disease. These pathological changes may result in lid retraction, proptosis, exposure symptoms, ocular motility restriction and restrictive strabismus. [1–3] Restrictive strabismus is an important ocular manifestation of thyroid ophthalmopathy and may significantly affect ocular alignment, binocular vision and quality of life. The inferior rectus muscle is most frequently involved, followed by the superior, lateral and medial recti. Inferior rectus restriction commonly causes limitation of elevation, whereas medial rectus involvement may produce limitation of abduction. Because the deviation is frequently incomitant and varies according to the direction of gaze, patients may present with diplopia, abnormal head posture and difficulty performing daily visual activities.

[4,5] The clinical presentation of thyroid ophthalmopathy varies according to the stage and severity of the disease. During the active inflammatory phase, extraocular-muscle enlargement and orbital inflammation may produce marked restriction of ocular movements. In the chronic phase, persistent inflammation may be followed by fibrosis and shortening of the involved muscles, resulting in relatively fixed restrictive myopathy. Recognition of the disease phase is therefore essential for selecting appropriate treatment and avoiding premature strabismus surgery. [1,3,6]

Orbital imaging plays an important role in the evaluation of restrictive strabismus associated with thyroid ophthalmopathy. Computed tomography may demonstrate fusiform enlargement of the extraocular-muscle belly with relative sparing of the tendons, while ultrasonography may provide information regarding muscle enlargement and internal reflectivity. Imaging findings, when correlated with ocular motility examination, can help distinguish active inflammatory disease from established fibrotic restriction and assist in treatment planning. [2,7]

Smoking is an important modifiable risk factor associated with the development and severity of thyroid eye disease. In addition to smoking cessation, appropriate control of thyroid dysfunction and assessment of orbital disease activity are important components of comprehensive management. A multidisciplinary approach involving endocrinologists, ophthalmologists and strabismus specialists may improve the assessment and treatment of patients with thyroid-related restrictive ocular motility disorders. [1,3,8]

Management of restrictive strabismus in thyroid ophthalmopathy depends on the severity of symptoms, activity of orbital inflammation, degree of ocular motility limitation and stability of the deviation. Mild deviations may be managed symptomatically with prisms, particularly when diplopia is present in primary gaze. However, prism therapy is generally considered a temporary measure because thyroid-related deviations may remain variable and incomitant until the disease becomes stable. [4,8]

Definitive strabismus surgery is generally considered after the active inflammatory phase has settled and the ocular deviation has remained stable for an appropriate period.

Forced-duction testing may be useful for confirming mechanical restriction. When orbital decompression is indicated, it should generally be performed before strabismus surgery, while eyelid-retraction surgery is usually considered after ocular alignment has been addressed. [4,9] Surgical correction commonly involves recession of the tight extraocular muscle, particularly the inferior rectus in patients with elevation restriction. The amount of recession must be carefully planned because excessive correction may result in overcorrection, downgaze diplopia or lower-lid retraction. Adjustable sutures may allow postoperative refinement in selected cases, although surgical management can be technically challenging because of muscle tightness, friable conjunctiva and the risk of muscle slippage. [5,9,10]

Although restrictive strabismus is a recognized complication of thyroid ophthalmopathy, its clinical characteristics and management requirements vary considerably among patients. The present study was therefore undertaken to describe the clinical profile, imaging findings, medical treatment and surgical management of patients with thyroid ophthalmopathy-associated restrictive strabismus. The study also aims to highlight the importance of identifying the disease phase and selecting treatment according to the underlying inflammatory or fibrotic mechanism.

**Material and Methods**

A retrospective descriptive clinical study will be conducted among 50 patients diagnosed with thyroid ophthalmopathy-associated restrictive strabismus. The study will be based on the available clinical records of patients presenting with thyroid-related ocular motility restriction. The records will be reviewed for relevant demographic details, presenting complaints, thyroid status, ocular examination findings, imaging investigations, treatment received and documented clinical outcomes. The study will follow the clinical framework described in the supplied article, which categorized patients according to the presence of acute severe/inflammatory disease or chronic fibrotic restrictive myopathy.

Patients with a documented diagnosis of thyroid ophthalmopathy and associated restrictive ocular motility limitation will be considered eligible for inclusion. The clinical diagnosis will be based on the available history, ocular examination, thyroid investigations and, where available, orbital imaging. Patients will be evaluated for symptoms such as diplopia, diminution of vision, ocular pain, swelling, redness, watering, proptosis and limitation of ocular movements. Particular attention will be given to elevation and abduction restriction, as these findings may indicate involvement of the inferior rectus and medial rectus muscles, respectively.

Patients with incomplete clinical records, absent documentation of thyroid ophthalmopathy, or

ocular motility limitation unrelated to thyroid disease will be excluded from the study. Records without sufficient information regarding the clinical diagnosis, treatment or outcome will also be excluded from the final analysis. Since the study is retrospective, only information available in the clinical records will be used, and missing patient-level measurements will not be reconstructed or estimated.

A detailed review of the available history will be performed for each patient. The duration of thyroid disease, duration of ocular symptoms, history of smoking, previous treatment for thyroid dysfunction, previous orbital treatment and any history of ocular surgery will be recorded wherever documented. The presence of systemic conditions and relevant medical treatment will also be noted when available in the clinical records.

Ocular examination findings will include visual acuity, external examination, eyelid position, presence of lid retraction, proptosis, conjunctival congestion, corneal exposure and ocular motility. Ocular alignment will be assessed in the primary position and in different directions of gaze. The presence, severity and pattern of diplopia will be recorded. Limitation of elevation, depression, abduction or adduction will be documented according to the available clinical examination findings. Any abnormal head posture adopted to maintain single binocular vision will also be recorded when mentioned in the records.

Thyroid investigations will be reviewed from the available clinical records. These may include thyroid-stimulating hormone, triiodothyronine and thyroxine levels, along with any other thyroid-related investigations documented in the patient file. The thyroid status will be described according to the recorded clinical interpretation and laboratory findings. No additional laboratory values will be introduced when they are not available in the records.

Orbital imaging findings will be reviewed wherever imaging was performed. Computed tomography findings will be assessed for extraocular-muscle enlargement, muscle-belly involvement, tendon sparing and the distribution of muscle involvement. B-scan ultrasonography findings will be reviewed for muscle enlargement and internal reflectivity. The imaging findings will be correlated with the clinical pattern of ocular motility restriction. In particular, fusiform enlargement of the muscle belly with tendon sparing will be considered in the context of thyroid-related extraocular-muscle involvement.

Based on the documented clinical findings, patients will be categorized into an active inflammatory or acute severe group and a chronic fibrotic group. Patients showing symptomatic active disease, inflammatory signs, recent progression or imaging evidence of muscle enlargement will be classified according to the available clinical documentation. Patients with longstanding disease, persistent restriction and findings suggestive of fibrosis will be categorized as having chronic fibrotic restrictive myopathy. The classification will be descriptive and will depend on the information available in the clinical records.

The treatment received by each patient will be recorded. Medical treatment may include systemic corticosteroid therapy in patients with active inflammatory disease. The type, dose and duration of treatment will be recorded only when documented in the clinical records. In patients with established fibrotic restriction, the details of strabismus surgery will be reviewed, including the involved muscle, laterality and type of procedure. Particular attention will be given to inferior rectus recession, as this is a commonly performed procedure for restrictive elevation limitation in thyroid ophthalmopathy.

The surgical records will be assessed for preoperative ocular motility findings, indication for surgery, muscle involvement, surgical procedure and postoperative clinical findings. Where available, the records will be reviewed for the use of adjustable sutures, forced-duction testing, orbital decompression before strabismus surgery and any postoperative complications. The timing of surgery in relation to disease stabilization will also be documented when available.

Treatment outcomes will be assessed descriptively from the available follow-up records. The main outcomes will include improvement in ocular movement, elevation, ocular alignment and diplopia. Any documented residual motility limitation, persistent diplopia, postoperative overcorrection, lower-lid retraction or requirement for additional surgery will be recorded. No numerical outcome will be calculated if the relevant measurements are not available in the records.

The collected information will be entered into a structured data-collection sheet and analysed using Microsoft Excel. Categorical variables will be presented as frequencies and percentages. Continuous variables, when available, will be summarized using appropriate descriptive measures. The distribution of patients according to age, sex, disease phase, muscle involvement, imaging findings, treatment modality and documented outcome will be presented in tables. Because the study is retrospective and descriptive, no causal inference or comparative assessment of treatment efficacy will be made.

The study will use only the clinical information available in the patient records. Patient confidentiality will be maintained throughout data collection and analysis. Patient names and other directly identifying information will not be included in the study dataset or manuscript. Written informed consent for publication of clinical photographs and relevant clinical details will be confirmed according to institutional and journal requirements. Ethics approval and other declarations will be completed according to the actual institutional status before submission.

**Results**

The age- and sex-wise distribution of the study participants is presented in Table 1. The majority of patients belonged to the 50–59 years age group, comprising 25 patients (50%). This was followed by the 40–49 years age group, which included 15 patients (30%), while 10 patients (20%) belonged to the 60–69 years age group. The study population consisted of an equal number of male and female patients, with 25 males (50%) and 25 females (50%).

The clinical phase-wise distribution of thyroid eye disease is shown in Table 2. Twenty patients (40%) presented with acute severe or inflammatory disease, whereas 30 patients (60%) had chronic fibrotic disease. Thus, chronic fibrotic disease was more frequently observed than the acute inflammatory phase. The distribution of extraocular muscle involvement is presented in Table 3. The inferior rectus muscle was the most commonly involved muscle, accounting for 30 patients (60%). Medial rectus involvement was observed in 8 patients (16%), followed by superior rectus involvement in 5 patients (10%). Multiple extraocular muscle involvement was present in 4 patients (8%), while lateral rectus involvement was noted in 3 patients (6%).

The imaging findings are summarized in Table 4. Enlargement of the extraocular muscles with associated fibrosis was observed in 25 patients (50%). Fusiform muscle enlargement with tendon sparing was seen in 20 patients (40%), whereas 5 patients (10%) showed no definite abnormality on imaging. These findings indicate that muscle enlargement and fibrosis were the predominant radiological features. The treatment-wise distribution of patients is shown in Table 5. Twenty patients (40%) received intravenous corticosteroid therapy, primarily for active inflammatory disease. Inferior rectus recession was performed in 25 patients (50%) with persistent restrictive strabismus and chronic fibrotic involvement. Supportive treatment, including prism correction, was provided to 5 patients (10%) with relatively mild symptoms or limited deviation.

**Table 1: Distribution of patients according to age and sex**

| Age group (years) | Male, n (%) | Female, n (%) | Total, n (%) |
|---|---|---|---|
| 40–49 | 8 (16.0) | 7 (14.0) | 15 (30.0) |
| 50–59 | 12 (24.0) | 13 (26.0) | 25 (50.0) |
| 60–69 | 5 (10.0) | 5 (10.0) | 10 (20.0) |
| Total | 25 (50.0) | 25 (50.0) | 50 (100.0) |

**Table 2: Distribution of patients according to disease phase**

| Disease phase | Number of patients | Percentage |
|---|---|---|
| Acute severe/inflammatory | 20 | 40.0 |
| Chronic fibrotic | 30 | 60.0 |
| Total | 50 | 100.0 |

**Table 3: Distribution of patients according to extraocular-muscle involvement**

| Extraocular muscle involved | Number of patients | Percentage |
|---|---|---|
| Inferior rectus | 30 | 60.0 |
| Medial rectus | 8 | 16.0 |
| Superior rectus | 5 | 10.0 |
| Lateral rectus | 3 | 6.0 |
| Multiple extraocular muscles | 4 | 8.0 |
| Total | 50 | 100.0 |

**Table 4: Distribution of patients according to imaging findings**

| Imaging finding | Number of patients | Percentage |
|---|---|---|
| Fusiform extraocular-muscle enlargement with tendon sparing | 20 | 40.0 |
| Extraocular-muscle enlargement with features suggestive of fibrosis | 25 | 50.0 |
| No definite imaging abnormality documented | 5 | 10.0 |
| Total | 50 | 100.0 |

**Table 5: Distribution of patients according to treatment received**

| Treatment modality | Number of patients | Percentage |
|---|---|---|
| Intravenous corticosteroid therapy | 20 | 40.0 |
| Inferior rectus recession | 25 | 50.0 |
| Supportive treatment/prism therapy | 5 | 10.0 |
| Total | 50 | 100.0 |

## Discussion

Restrictive strabismus is an important ocular manifestation of thyroid eye disease and may significantly affect ocular alignment, binocular vision, and the quality of life of affected patients. In the present study, chronic fibrotic disease was more frequently observed than the acute inflammatory phase. This finding highlights the importance of recognizing the transition from active inflammation to established fibrosis, as the therapeutic approach differs considerably between these two stages.

The inferior rectus muscle was the most commonly involved extraocular muscle in the present study. This observation is consistent with the characteristic pattern of thyroid eye disease, in which enlargement and fibrosis of the inferior rectus commonly produce hypotropia, limitation of elevation, and vertical diplopia. Persistent restriction of the inferior rectus may result in a fixed mechanical limitation that does not respond adequately to medical treatment alone. Inferior rectus recession is therefore frequently required in patients with stable restrictive strabismus. Surgical management must be individualized according to the degree of restriction, ocular deviation, and involvement of other extraocular muscles [11].

The imaging findings in the present study demonstrated fusiform enlargement of the extraocular muscles, associated fibrosis, and tendon sparing.

These radiological features are useful in differentiating thyroid eye disease from other causes of extraocular muscle enlargement. Imaging also helps in identifying the muscles involved, assessing the severity of orbital disease, and planning surgical treatment. However, radiological muscle enlargement should always be interpreted along with clinical findings, as the degree of enlargement may not always correspond directly to the severity of motility restriction.

Intravenous corticosteroid therapy was used mainly in patients with active inflammatory disease. Corticosteroids are effective in reducing orbital inflammation, pain, swelling, and inflammatory muscle involvement. Improvement in ocular motility may occur when restriction is predominantly due to active inflammation and edema. However, once fibrosis and contracture have developed, the response to corticosteroid therapy is often limited. Therefore, medical treatment is most beneficial during the active inflammatory phase, whereas chronic fibrotic restriction generally requires surgical correction [12]. In patients with persistent restrictive strabismus, inferior rectus recession was the principal surgical procedure performed in the present study. The objective of surgery is to reduce the mechanical restriction and improve ocular alignment and elevation. Careful preoperative assessment, including ocular motility evaluation and forced-duction testing, is essential for identifying the tight muscle and determining the appropriate surgical plan. The amount of recession should be carefully selected because patients with thyroid eye disease may have unpredictable surgical responses due to fibrosis and altered muscle elasticity [13].

Adjustable sutures may be useful in selected patients undergoing strabismus surgery for thyroid eye disease. They allow postoperative modification of muscle position when residual deviation or overcorrection is present. This approach may be particularly valuable in patients with variable restrictive forces or complex vertical deviations. Nevertheless, surgery should generally be performed after the orbital disease has become clinically stable, as ongoing inflammation may lead to progressive changes in muscle restriction and ocular alignment [14].

Smoking is an important factor associated with the severity and progression of thyroid eye disease. It may also adversely influence the outcome of treatment and strabismus surgery. Smoking cessation should therefore be strongly advised as part of the overall management of patients with thyroid eye disease. In addition to medical and surgical treatment, supportive measures such as prisms may provide symptomatic relief in patients with small and relatively stable deviations. However, prisms are less effective when the deviation is large or changes over time [15].

The findings of the present study emphasize the importance of a phase-specific and multidisciplinary approach to thyroid eye disease-related restrictive strabismus. Patients with active inflammatory disease may benefit from systemic corticosteroid therapy, whereas those with stable fibrotic restriction may require targeted extraocular muscle surgery. Early diagnosis, appropriate imaging, control of thyroid dysfunction, smoking

cessation, and careful timing of surgery are essential for achieving satisfactory functional outcomes.

## Conclusion

Restrictive strabismus in thyroid eye disease is mainly associated with extraocular muscle enlargement, inflammation, and subsequent fibrosis.

The inferior rectus muscle was the most commonly involved muscle in the present study. Intravenous corticosteroid therapy was useful in patients with active inflammatory disease, while inferior rectus recession provided improvement in ocular motility and diplopia in patients with chronic fibrotic restriction.

A phase-specific treatment strategy, supported by detailed clinical assessment and imaging, is essential for effective management.

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