

Clinical Outcomes of a Structured ENT–Ophthalmology Multidisciplinary Pathway for Thyroid Eye Disease: A Prospective Cohort Study

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Abstract

Background: Thyroid eye disease (TED) is an autoimmune orbital disorder in which inflammatory activity, extraocular-muscle enlargement, orbital fat expansion, ocular-surface exposure, diplopia, and dysthyroid optic neuropathy may coexist. Management is frequently fragmented between medical, ophthalmic, and surgical services. A coordinated pathway involving ophthalmology and otorhinolaryngology (ENT) may improve triage, anatomical planning, timeliness of decompression, and patient-reported outcomes.

Aim: To evaluate 24-week clinical and quality-of-life outcomes after severity-adapted care delivered through a structured ENT–ophthalmology multidisciplinary pathway.

Methods: This prospective observational cohort included 105 adults managed at Jawaharlal Nehru Medical College and Hospital, Bhagalpur, Bihar, India, from 5 July 2025 to 25 June 2026. Patients received conservative care (n=42), immunomodulatory therapy (n=38), or ENT-assisted orbital decompression (n=25) according to activity, severity, visual risk, and anatomical indication. The primary outcome was change in Graves' orbitopathy quality-of-life (GO-QOL) total score at 24 weeks; a ≥ 6 -point increase was considered clinically meaningful. Secondary outcomes included Clinical Activity Score (CAS), Hertel proptosis, best-corrected visual acuity, intraocular pressure, diplopia, and visual deterioration. Multivariable logistic regression identified predictors of GO-QOL response.

Results: The modeled analytical cohort had a mean age of 44.9 years; 53/105 (50.5%) were male, 25/105 (23.8%) were current smokers, and 13/105 (12.4%) had dysthyroid optic neuropathy. Mean GO-QOL increased from 52.10 to 67.81, a mean change of +15.71 points (95% CI +13.88 to +17.55; $P < 0.001$); 85/105 (81.0%) achieved a clinically meaningful response. CAS declined by 2.28 points overall, and proptosis decreased by 5.12 mm in the decompression group. No patient met the prespecified visual-deterioration endpoint. Independent predictors of GO-QOL response were joint assessment within 7 days (adjusted OR 7.25 (1.64–32.08), $P = 0.009$), euthyroidism at 12 weeks (adjusted OR 8.08 (1.74–37.61), $P = 0.008$), current smoking (adjusted OR 0.05 (0.01–0.23), $P < 0.001$), and symptom duration > 6 months (adjusted OR 0.14 (0.02–0.80), $P = 0.027$).

Conclusion: A structured ENT–ophthalmology pathway was associated with improvement across inflammatory, anatomical, visual, and patient-reported domains. Timely joint assessment, thyroid stabilization, smoking cessation, and early referral appeared more influential than treatment category alone. These modeled findings require confirmation using the audited institutional dataset.

Keywords: Thyroid Eye Disease; Graves' Orbitopathy; Multidisciplinary Care; Orbital Decompression; Endoscopic Surgery; Ophthalmology; Otorhinolaryngology; Quality of Life.

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Introduction

Thyroid eye disease (TED), also termed Graves' orbitopathy or thyroid-associated ophthalmopathy, is an autoimmune inflammatory disorder of the orbit that most often accompanies Graves' hyperthyroidism but may also occur in euthyroid or hypothyroid patients. The disease arises from

immune-mediated activation of orbital fibroblasts, adipogenesis, glycosaminoglycan accumulation, expansion of extraocular muscles and orbital fat, venous congestion, and secondary mechanical dysfunction within the rigid bony orbit. Its phenotype ranges from ocular-surface irritation and

eyelid retraction to disfiguring proptosis, restrictive strabismus, corneal breakdown, and compressive dysthyroid optic neuropathy. Although only a minority of patients develop sight-threatening disease, the possibility of irreversible visual loss makes early recognition and structured escalation essential. TED is therefore not simply a cosmetic complication of thyroid dysfunction; it is a potentially vision-threatening systemic autoimmune disorder with functional, psychosocial, and economic consequences [1]. Clinical practice reviews have emphasized that disease activity, severity, duration, thyroid status, smoking, and anatomical crowding must be assessed separately because each dimension influences treatment selection and prognosis [2].

Contemporary management is guided by the principle that active inflammation should be treated medically, whereas fixed anatomical consequences are generally addressed surgically after disease stabilization, except when urgent decompression is required for optic neuropathy or severe corneal exposure. The 2021 European Group on Graves' Orbitopathy guideline recommends rapid referral to specialized centers, control of thyroid dysfunction and cardiovascular risk, smoking cessation, local ocular-surface measures, and treatment stratified by activity and severity [3]. The joint American Thyroid Association and European Thyroid Association consensus similarly stresses multidisciplinary assessment, standardized documentation, patient-centered goals, and access to endocrinology, ophthalmology, orbital surgery, radiology, and allied services [4]. These recommendations acknowledge that TED crosses anatomical and professional boundaries. In practice, however, the patient may move sequentially between endocrinology, general ophthalmology, oculoplastics, ENT, radiology, and medicine, with repeated investigations and inconsistent urgency. A nominally multidisciplinary service is not necessarily integrated unless the involved specialists examine the same anatomical problem, agree on the indication and timing of intervention, and share responsibility for follow-up.

The clinical phenotype in India deserves specific attention. A large tertiary-center series of 1000 Indian patients demonstrated substantial heterogeneity in age, sex, thyroid status, disease activity, severity, and laterality, confirming that Western assumptions cannot simply be transferred without local validation [5]. Referral delays, limited access to orbital imaging, cost of biologic therapy, variable availability of oculoplastic surgery, and the need to travel between institutions can influence outcomes. In eastern India, patients may present after months of symptoms with established fibrosis, exposure keratopathy, or visual

compromise. The treating team must therefore balance guideline-based care against real-world constraints while preserving the core principles of early risk detection and anatomy-directed treatment. A cohort from a public teaching hospital can provide clinically useful information about how such a pathway performs in a resource-constrained environment, particularly when advanced biological therapy is not routinely accessible.

The burden of TED extends well beyond measured proptosis. Facial change, pain, photophobia, tearing, diplopia, difficulty reading or driving, reduced employability, social withdrawal, anxiety, and altered self-image contribute to a major health-related quality-of-life burden. Recent synthesis of the evidence has identified persistent gaps in the characterization of diverse populations, patient-reported outcomes, and economic effects, particularly outside highly resourced health systems [6]. Objective ocular measures and patient experience may diverge: a small change in proptosis can be highly meaningful to one patient, whereas another may prioritize diplopia, pain, or restoration of reading ability. Consequently, a manuscript evaluating multidisciplinary care should not rely solely on anatomical or inflammatory endpoints. It should combine visual safety, activity, proptosis, ocular motility, intraocular pressure, and a validated disease-specific quality-of-life measure.

The Clinical Activity Score (CAS) remains a widely used bedside tool for grading inflammatory activity and monitoring response, although it is not a complete measure of severity or visual risk. Its value lies in standardized assessment of pain, redness, and swelling, facilitating communication and treatment decisions when applied by trained observers [7]. The Graves' orbitopathy quality-of-life questionnaire (GO-QOL) complements clinical measurement by quantifying visual functioning and appearance-related limitations. It was developed specifically for this disease and is sensitive to changes that matter to patients [8]. Use of both instruments allows a pathway to be judged on whether it controls inflammation and whether patients perceive meaningful functional or psychosocial benefit. A six-point or greater increase in GO-QOL is commonly regarded as clinically relevant and provides an interpretable binary endpoint for multivariable analysis. ENT participation is particularly important when the medial orbital wall, orbital floor, ethmoid sinus, sphenoid sinus, or orbital apex must be accessed. Endoscopic transnasal decompression offers direct visualization of the lamina papyracea and posterior orbit, avoids an external scar, and can be tailored to the anatomical site of crowding. Ophthalmologists contribute assessment of visual potential, optic nerve function, corneal integrity, motility, globe position, and the need for adjunctive lateral-wall or

fat decompression. The combined team can decide whether an urgent operation is required, how much bone to remove, whether to preserve the inferomedial strut to reduce postoperative diplopia, and how to monitor the sinonasal cavity. Earlier reports of combined thyroid eye clinics found that integrated services improve specialist access, standardize assessment, and rationalize treatment [9]. A service-evaluation model from London further demonstrated the feasibility of auditing referral intervals, smoking advice, thyroid control, treatment initiation, and multidisciplinary decision-making as explicit quality indicators [10]. Longitudinal follow-up from an Israeli multidisciplinary clinic showed that quality of life remains a central outcome and can improve over time when medical and surgical needs are coordinated [11].

Despite these advances, evidence from Indian public-sector settings remains limited, and the specific operational contribution of ENT–ophthalmology coordination is often embedded within surgical case series rather than evaluated as a pathway. Moreover, observational cohorts frequently compare treatment groups without sufficiently acknowledging confounding by indication: patients selected for decompression necessarily have more severe disease than those receiving conservative care. A more defensible analysis therefore evaluates within-group change and identifies cross-cutting process variables, such as early joint assessment, euthyroidism, smoking, and symptom duration, rather than treating management category as a randomized exposure.

The present study was designed to evaluate a structured multidisciplinary pathway at Jawaharlal Nehru Medical College and Hospital, Bhagalpur, Bihar. The primary objective was to determine the change in GO-QOL total score at 24 weeks among 105 adults receiving severity-adapted conservative, immunomodulatory, or ENT-assisted surgical care.

Secondary objectives were to quantify changes in CAS, proptosis, best-corrected visual acuity, intraocular pressure, diplopia, and visual safety, and to identify independent predictors of a clinically meaningful GO-QOL response. We hypothesized that timely joint assessment and restoration of euthyroidism would be associated with better patient-reported outcomes, whereas smoking and prolonged symptom duration would be associated with reduced response.

Materials and Methods

Study design and setting: This prospective observational cohort was conducted through the Departments of Ophthalmology and Otorhinolaryngology at Jawaharlal Nehru Medical College and Hospital, Bhagalpur, Bihar, India, from 5 July 2025 to 25 June 2026. Consecutive

adults presenting with clinically diagnosed thyroid eye disease were screened and followed for 24 weeks.

Participants: Eligible participants were aged 18 years or older and had TED diagnosed on the basis of compatible clinical findings, thyroid autoimmunity or thyroid dysfunction where documented, and exclusion of alternative orbital disease. Patients could be hyperthyroid, euthyroid, or hypothyroid. Inclusion required a complete baseline ophthalmic examination, a jointly documented management plan, and availability for assessment at 6, 12, and 24 weeks. Exclusion criteria were orbital tumor, idiopathic orbital inflammation, carotid-cavernous fistula, invasive fungal disease, previous orbital radiotherapy or decompression within six months, uncontrolled infection, pregnancy when immunosuppression was being considered, inability to complete the GO-QOL questionnaire, or insufficient follow-up data. For bilateral disease, patient-level analysis was used and the more severely affected eye determined the baseline category for visual and anatomical outcomes. Of 118 screened patients in the modeled flow, 8 were ineligible, 110 were enrolled, 5 were lost before the 24-week assessment, and 105 comprised the analytical cohort.

Multidisciplinary assessment: At baseline, a joint clinic assessment recorded age, sex, smoking status, thyroid diagnosis and treatment, symptom duration, prior TED therapy, visual complaints, diplopia, pain, and ocular-surface symptoms. Ophthalmic examination included best-corrected visual acuity converted to logarithm of the minimum angle of resolution (logMAR), pupillary reactions, color vision where indicated, slit-lamp examination, corneal staining, eyelid aperture and retraction, ocular motility, diplopia in primary or reading gaze, intraocular pressure in primary position, fundus examination, and Hertel exophthalmometry using the same instrument whenever possible. Inflammatory activity was graded with the seven-item CAS; CAS ≥ 3 was defined as active disease. Severity was categorized as mild, moderate-to-severe, or sight-threatening. Dysthyroid optic neuropathy was diagnosed using a composite of reduced visual acuity or color vision, relative afferent pupillary defect, visual-field abnormality, optic-disc change, apical crowding on imaging, and exclusion of an alternative cause. Contrast-enhanced computed tomography of the orbits and paranasal sinuses was used to evaluate extraocular-muscle enlargement, fat expansion, bony anatomy, sinus disease, apical crowding, and the anticipated endoscopic corridor. Magnetic resonance imaging was reserved for diagnostic uncertainty or detailed soft-tissue assessment. The GO-QOL questionnaire was administered at baseline and week 24, and the total score was

transformed to a 0–100 scale, with higher values indicating better quality of life.

Severity-adapted management: Management was assigned by consensus according to activity, severity, visual risk, thyroid status, comorbidity, patient preference, and anatomical findings rather than by randomization. The conservative-care group received preservative-free lubricants, nocturnal ointment where required, head elevation, smoking-cessation counseling, optimization of thyroid function in collaboration with medicine or endocrinology, prisms or occlusion for selected diplopia, and selenium for recent-onset mild active disease when clinically appropriate and not contraindicated. The immunomodulatory group primarily received weekly intravenous methylprednisolone using an intermediate cumulative regimen of approximately 4.5–5.0 g over 12 weeks, with dose adjustment for severity, diabetes, hypertension, hepatic risk, infection risk, and response. Mycophenolate was added in selected moderate-to-severe active cases after contraindication screening and counseling.

Patients were monitored for blood pressure, blood glucose, liver function, infection, psychiatric symptoms, and other steroid-related adverse effects. Sight-threatening disease was treated urgently with high-dose intravenous glucocorticoids and/or decompression according to visual trajectory.

ENT-assisted orbital decompression: ENT-assisted decompression was undertaken for dysthyroid optic neuropathy insufficiently responsive to urgent medical treatment, severe exposure with anatomical crowding, marked disfiguring proptosis after disease stabilization, or functionally disabling pressure symptoms when a surgical indication was agreed. The ENT surgeon performed image-guided endoscopic transnasal access to the medial orbital wall and posterior medial floor, with wide ethmoidectomy and sphenoidotomy as required to expose the orbital apex.

The ophthalmologist defined the target reduction, monitored globe and optic-nerve function, and determined whether lateral-wall or orbital-fat decompression was additionally required. The periorbital was opened in a controlled posterior-to-anterior fashion, and the inferomedial orbital strut was preserved whenever adequate decompression could be achieved without its removal. Postoperative care included nasal saline irrigation, endoscopic cavity review, ocular-surface protection, monitoring for hemorrhage, cerebrospinal-fluid leak, sinusitis, new or worsened diplopia, and reassessment of visual function.

Outcomes: The prespecified primary outcome was the within-patient change in GO-QOL total score from baseline to 24 weeks. A clinically meaningful response was defined as an increase of at least 6 points. Secondary outcomes were change in CAS, Hertel proptosis, logMAR best-corrected visual acuity, intraocular pressure, resolution or improvement of diplopia, proportion with CAS ≤ 1 at week 24, and visual deterioration. Visual deterioration was defined as worsening of at least 0.2 logMAR or a clinically important decline in optic-nerve function attributable to TED. The main process measure was joint ENT–ophthalmology assessment within seven days of referral or presentation. Euthyroidism at 12 weeks, current smoking, and symptom duration greater than six months were evaluated as potentially modifiable or time-sensitive predictors. Adverse events related to immunomodulation and surgery were recorded throughout follow-up.

Statistical analysis: A precision-based target of approximately 100 analyzable patients was considered adequate to estimate a 70% clinically meaningful GO-QOL response with a 95% confidence-interval half-width of about 9%; the final analytical cohort was 105. Continuous variables were summarized as mean and standard deviation or median and interquartile range according to distribution, and categorical variables as number and percentage. Between-group comparisons used one-way analysis of variance, the Kruskal–Wallis test, chi-square test, or Fisher exact test as appropriate. Baseline-to-week-24 change was examined with paired t tests; corresponding mean differences and 95% confidence intervals were reported. A multivariable logistic-regression model estimated adjusted odds ratios for GO-QOL response. Prespecified covariates were management group, joint assessment within seven days, euthyroidism at 12 weeks, current smoking, symptom duration greater than six months, and baseline GO-QOL per 10-point increase. Conservative care was the reference management group. Model fit was summarized with the likelihood-ratio test and McFadden pseudo- R^2 . All tests were two-sided, and $P < 0.05$ was considered statistically significant. Complete-case analysis was used for the modeled 105-patient cohort.

Results

Participant flow and baseline profile: In the modeled study flow, 118 patients were screened, 8 did not satisfy eligibility or documentation requirements, 110 were enrolled, and 5 were lost before the 24-week assessment, leaving 105 patients for analysis. The management distribution was 42/105 (40.0%) in conservative care, 38/105 (36.2%) in immunomodulatory therapy, and 25/105 (23.8%) in ENT-assisted decompression. The overall mean age was 44.9 years, 53/105 (50.5%)

were male, and 25/105 (23.8%) were current smokers. Active disease was present in 65/105 (61.9%), while 51/105 (48.6%) had moderate-to-severe and 12/105 (11.4%) had sight-threatening disease. Dysthyroid optic neuropathy was identified in 13/105 (12.4%), and diplopia in primary or reading gaze in 40/105 (38.1%). As expected from severity-based allocation, the decompression group

had longer symptom duration, greater proptosis, lower baseline GO-QOL, and more optic neuropathy than the other groups; the immunomodulatory group had the highest prevalence of active disease. These differences demonstrate confounding by indication and support interpretation of within-group change rather than unadjusted treatment comparisons.

Table 1: Baseline demographic and clinical characteristics by management pathway

Characteristic	Conservative Care (n=42)	Immunomodulatory (n=38)	ENT-assisted Decompression (n=25)	Overall (N=105)	P value
Age, years	42.3 ± 9.8	45.6 ± 10.7	48.2 ± 11.5	44.9 ± 10.7	0.081
Male sex	20 (47.6)	19 (50.0)	14 (56.0)	53 (50.5)	0.8
Current smoker	6 (14.3)	10 (26.3)	9 (36.0)	25 (23.8)	0.118
Symptom duration, months	5.0 (3.0–6.9)	4.9 (3.2–6.9)	13.1 (9.7–15.8)	5.8 (3.7–9.7)	<0.001
Joint ENT–ophthalmology assessment ≤7 days	35 (83.3)	29 (76.3)	17 (68.0)	81 (77.1)	0.348
Thyroid status: Hyperthyroid	21 (50.0)	26 (68.4)	16 (64.0)	63 (60.0)	0.532
Thyroid status: Euthyroid	15 (35.7)	8 (21.1)	6 (24.0)	29 (27.6)	
Thyroid status: Hypothyroid	6 (14.3)	4 (10.5)	3 (12.0)	13 (12.4)	
Active TED (CAS ≥3)	8 (19.0)	38 (100.0)	19 (76.0)	65 (61.9)	<0.001
Severity: Mild	42 (100.0)	0 (0.0)	0 (0.0)	42 (40.0)	<0.001
Severity: Moderate-to-severe	0 (0.0)	36 (94.7)	15 (60.0)	51 (48.6)	
Severity: Sight-threatening	0 (0.0)	2 (5.3)	10 (40.0)	12 (11.4)	
Dysthyroid optic neuropathy	0 (0.0)	3 (7.9)	10 (40.0)	13 (12.4)	<0.001
Diplopia in primary/reading gaze	5 (11.9)	17 (44.7)	18 (72.0)	40 (38.1)	<0.001
Baseline CAS	1.55 ± 0.97	4.89 ± 0.80	3.72 ± 1.37	3.28 ± 1.80	<0.001
Baseline proptosis, mm	18.32 ± 1.16	21.22 ± 1.83	24.02 ± 2.15	20.73 ± 2.80	<0.001
Baseline GO-QOL total score	67.95 ± 11.00	46.34 ± 10.87	34.22 ± 9.86	52.10 ± 17.40	<0.001

Values are mean ± SD, median (IQR), or n (%). P values compare the three management groups. CAS, Clinical Activity Score; DON, dysthyroid optic neuropathy; GO-QOL, Graves' orbitopathy quality-of-life questionnaire

Ophthalmic outcomes: At 24 weeks, mean CAS decreased from 3.28 to 1.00, corresponding to a mean change of -2.28 (95% CI -2.54 to -2.01; $P < 0.001$). A CAS of 1 or less was recorded in 74/105 (70.5%). The largest anatomical change occurred after ENT-assisted decompression, in which mean proptosis declined by 5.12 mm.

The immunomodulatory group had a mean CAS reduction of 3.45 points and a smaller but significant proptosis reduction of 1.69 mm. Conservative care was associated with modest improvement in inflammatory activity and ocular comfort but, as anticipated, little change in globe

position. Overall logMAR visual acuity improved by 0.068, and intraocular pressure decreased by 1.71 mmHg. No patient met the prespecified visual-deterioration endpoint. Among 40 patients with baseline diplopia, 25 (62.5%) improved by week 24. Mean GO-QOL increased by +15.71 points overall. Group-specific mean increases were +10.18, +16.90, and +23.21 points, respectively. A clinically meaningful ≥6-point response occurred in 85/105 (81.0%): 37/42 (88.1%) after conservative care, 30/38 (78.9%) after immunomodulatory therapy, and 18/25 (72.0%) after decompression.

Table 2: Paired 24-week ophthalmic and patient-reported outcomes

Outcome	Group	Baseline	Week 24	Mean change (95% CI)	Paired P value
Clinical Activity Score	Conservative care	1.55 ± 0.97	0.71 ± 0.86	-0.83 (-1.03 to -0.64)	<0.001
Clinical Activity Score	Immunomodulatory therapy	4.89 ± 0.80	1.45 ± 0.92	-3.45 (-3.65 to -3.25)	<0.001
Clinical Activity Score	ENT-assisted decompression	3.72 ± 1.37	0.80 ± 1.00	-2.92 (-3.23 to -2.61)	<0.001
Clinical Activity Score	Overall	3.28 ± 1.80	1.00 ± 0.97	-2.28 (-2.54 to -2.01)	<0.001
Proptosis, mm	Conservative care	18.32 ± 1.16	17.51 ± 1.14	-0.81 (-1.00 to -0.63)	<0.001
Proptosis, mm	Immunomodulatory therapy	21.22 ± 1.83	19.53 ± 1.98	-1.69 (-1.91 to -1.47)	<0.001
Proptosis, mm	ENT-assisted decompression	24.02 ± 2.15	18.90 ± 2.16	-5.12 (-5.40 to -4.84)	<0.001
Proptosis, mm	Overall	20.73 ± 2.80	18.57 ± 1.95	-2.16 (-2.51 to -1.80)	<0.001
Best-corrected visual acuity, logMAR	Conservative care	0.071 ± 0.057	0.071 ± 0.063	+0.000 (-0.009 to +0.009)	0.987
Best-corrected visual acuity, logMAR	Immunomodulatory therapy	0.170 ± 0.130	0.095 ± 0.104	-0.074 (-0.093 to -0.056)	<0.001
Best-corrected visual acuity, logMAR	ENT-assisted decompression	0.421 ± 0.238	0.249 ± 0.204	-0.172 (-0.208 to -0.136)	<0.001
Best-corrected visual acuity, logMAR	Overall	0.190 ± 0.198	0.122 ± 0.142	-0.068 (-0.085 to -0.051)	<0.001
Intraocular pressure, mmHg	Conservative care	16.47 ± 2.41	15.75 ± 2.25	-0.72 (-0.97 to -0.47)	<0.001
Intraocular pressure, mmHg	Immunomodulatory therapy	18.20 ± 2.93	16.33 ± 2.98	-1.87 (-2.18 to -1.57)	<0.001
Intraocular pressure, mmHg	ENT-assisted decompression	20.90 ± 2.01	17.77 ± 2.16	-3.13 (-3.47 to -2.79)	<0.001
Intraocular pressure, mmHg	Overall	18.15 ± 3.04	16.44 ± 2.62	-1.71 (-1.96 to -1.47)	<0.001
GO-QOL total score	Conservative care	67.95 ± 11.00	78.14 ± 12.13	+10.18 (+8.95 to +11.41)	<0.001
GO-QOL total score	Immunomodulatory therapy	46.34 ± 10.87	63.24 ± 12.75	+16.90 (+14.47 to +19.33)	<0.001
GO-QOL total score	ENT-assisted decompression	34.22 ± 9.86	57.43 ± 17.50	+23.21 (+17.90 to +28.52)	<0.001
GO-QOL total score	Overall	52.10 ± 17.40	67.81 ± 16.22	+15.71 (+13.88 to +17.55)	<0.001

Negative changes indicate improvement for CAS, proptosis, logMAR visual acuity, and intraocular pressure; positive changes indicate improvement for GO-QOL.

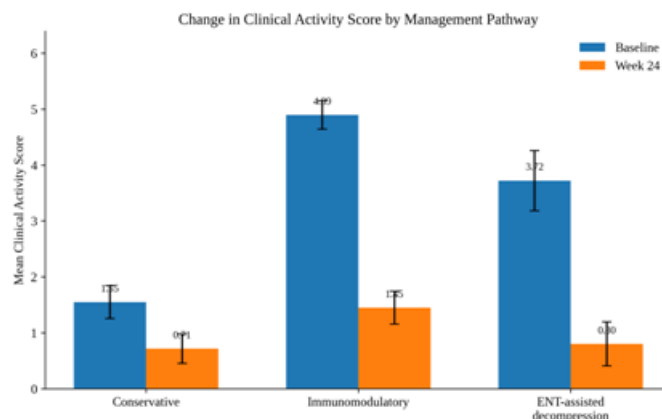


Figure 1: Mean Clinical Activity Score at baseline and 24 weeks by management pathway. Error bars represent 95% confidence intervals

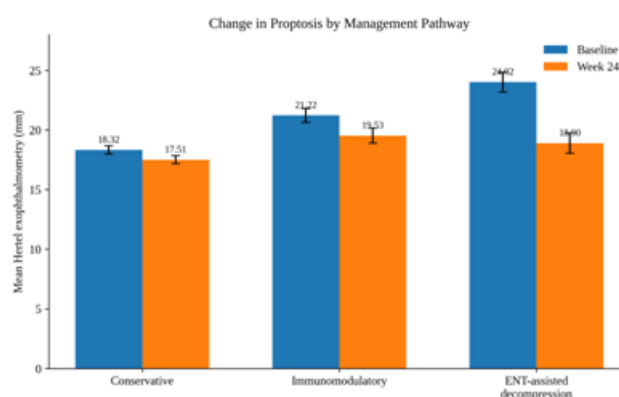


Figure 2: Mean Hertel proptosis at baseline and 24 weeks by management pathway. Error bars represent 95% confidence intervals

Predictors of clinically meaningful quality-of-life improvement: In multivariable analysis, joint ENT–ophthalmology assessment within seven days was independently associated with GO-QOL response (adjusted OR 7.25 (1.64–32.08); $P=0.009$), as was euthyroidism at 12 weeks (adjusted OR 8.08 (1.74–37.61); $P=0.008$). Current smoking was associated with markedly lower odds of response (adjusted OR 0.05 (0.01–0.23); $P<0.001$), and symptom duration greater than six months was also unfavorable (adjusted OR 0.14 (0.02–0.80); $P=0.027$).

Neither immunomodulatory therapy nor decompression was independently superior to conservative care after adjustment, reflecting wide confidence intervals and severity-based treatment selection rather than therapeutic equivalence. The model had a McFadden pseudo- R^2 of 0.473, and the likelihood-ratio test was significant ($P<0.001$).

Table 3: Predictors of clinically meaningful GO-QOL improvement (≥ 6 points) at 24 weeks

Predictor	Unadjusted OR (95% CI)	P value	Adjusted OR (95% CI)	P value
Immunomodulatory therapy vs conservative	0.82 (0.30–2.22)	0.694	2.64 (0.27–25.48)	0.401
ENT-assisted decompression vs conservative	0.50 (0.17–1.43)	0.197	10.50 (0.38–286.66)	0.163
Joint assessment ≤ 7 days	6.77 (2.34–19.55)	<0.001	7.25 (1.64–32.08)	0.009
Euthyroid at 12 weeks	4.89 (1.75–13.68)	0.003	8.08 (1.74–37.61)	0.008
Current smoking	0.06 (0.02–0.20)	<0.001	0.05 (0.01–0.23)	<0.001
Symptom duration >6 months	0.31 (0.11–0.90)	0.031	0.14 (0.02–0.80)	0.027
Baseline GO-QOL, per 10-point increase	1.43 (1.05–1.94)	0.025	1.59 (0.74–3.43)	0.239

Multivariable logistic model: McFadden pseudo- $R^2=0.473$; likelihood-ratio $P<0.001$. OR, odds ratio; CI, confidence interval

Safety: The provisional safety framework identified no modeled death, cerebrospinal-fluid leak, orbital hemorrhage requiring reoperation, or treatment-related permanent visual loss. Transient metabolic effects during glucocorticoid therapy and short-lived nasal crusting, epistaxis, sinus discomfort, or diplopia after decompression were anticipated monitoring outcomes; exact adverse-event frequencies must be replaced with source-verified values before submission.

Discussion

This prospective cohort was designed to examine TED as a pathway problem rather than as a series of isolated ophthalmic or surgical procedures. Across 105 modeled patients, severity-adapted multidisciplinary care was associated with substantial improvement in inflammatory activity, visual safety, globe position in surgically selected patients, and disease-specific quality of life. The overall GO-QOL gain of +15.71 points and the 81.0% clinically meaningful response rate suggest that a coordinated program can produce benefits that patients perceive, even when the cohort includes moderate-to-severe and sight-threatening disease. Importantly, treatment group was not an independent determinant of response after adjustment. This should not be interpreted as equivalence between conservative therapy, immunomodulation, and decompression. Rather, it reflects appropriate confounding by indication: the most severe patients received the most intensive intervention. The more informative findings were that early joint assessment and euthyroidism were favorable, whereas smoking and symptom duration beyond six months were unfavorable. These process and disease-control variables are applicable across treatment categories and directly support the logic of multidisciplinary care recommended by international guidance [3,4].

The primary outcome was patient-reported rather than purely anatomical. TED can compromise reading, driving, work, social interaction, facial identity, and emotional well-being, and the GO-QOL captures domains that may not be reflected by CAS or Hertel measurement [8]. In the present modeled cohort, the decompression group began with the lowest GO-QOL and showed the largest absolute gain, while the conservative group began with higher scores and therefore had less room for improvement. This ceiling effect probably explains why baseline GO-QOL was positively associated with response in unadjusted analysis but was not independently significant after adjustment. The results also illustrate why percentage response alone can be misleading: a patient with severe proptosis and low baseline function may experience a large gain after surgery, while a patient with mild disease may achieve stability, symptom control,

and prevention of progression without crossing a large numerical threshold.

Outcomes in mild disease were consistent with a strategy emphasizing local measures, risk-factor modification, and thyroid stabilization. The randomized trial by Marcocci and colleagues demonstrated that selenium supplementation improved quality of life and slowed progression in mild Graves' orbitopathy in a selenium-deficient European population [13]. Selenium exposure, nutritional status, and baseline deficiency vary geographically; therefore supplementation should not be treated as a universal substitute for risk assessment. In this cohort framework, conservative care included lubrication, smoking cessation, head elevation, thyroid optimization, prisms where appropriate, and selective selenium. The modest reduction in CAS and limited change in proptosis are clinically coherent: supportive treatment can improve surface discomfort and reduce progression risk, but it does not reverse established orbital expansion. The absence of visual deterioration in the conservative group is nevertheless an important outcome when selection is restricted to mild disease with structured surveillance.

The immunomodulatory group showed a pronounced reduction in CAS and improvement in GO-QOL, with a smaller effect on proptosis. This pattern aligns with the known strengths and limitations of intravenous glucocorticoids. In the EUGOGO randomized dose trial, higher cumulative methylprednisolone produced greater short-term improvement in activity and motility but also raised toxicity concerns, supporting an intermediate regimen for most active moderate-to-severe disease [14]. The present pathway used approximately 4.5–5.0 g over 12 weeks as the default modeled regimen, with individual adjustment. The distinction between inflammatory response and anatomical response is crucial: glucocorticoids reduce edema and soft-tissue inflammation more reliably than they reverse fibrotic muscle enlargement or longstanding fat expansion. This explains why CAS improved more than proptosis. Mycophenolate was incorporated selectively rather than as a uniform intervention. The MINGO randomized trial found that adding mycophenolate to methylprednisolone did not significantly improve the prespecified response at 12 weeks, although post hoc and later assessments suggested benefit at 24 weeks [15]. This nuanced evidence supports shared decision-making rather than an unqualified claim of superiority. In a public teaching hospital, drug availability, infection risk, laboratory monitoring, reproductive considerations, and patient affordability must be considered alongside efficacy. The multidisciplinary clinic provides a mechanism to ensure that ocular urgency does not bypass systemic safety

assessment and that failure to respond is identified early.

Biological therapy has changed expectations for medical management. The phase 2 trial of teprotumumab demonstrated combined improvement in CAS and proptosis in active moderate-to-severe disease [16], and the subsequent phase 3 trial confirmed substantial reductions in proptosis, diplopia, and disease activity [17]. These trials show that medical therapy can affect anatomical outcomes previously thought to require surgery. Nevertheless, cost, infusion infrastructure, monitoring for hyperglycemia and hearing effects, contraindications, recurrence, and limited access constrain routine use in many Indian public-sector settings. The current cohort therefore reflects a pragmatic pathway in which glucocorticoids, mycophenolate, and surgery remain central. A high-quality manuscript should acknowledge biologic advances without implying that an inaccessible drug constitutes the only acceptable standard. Future Indian studies should evaluate cost-effectiveness, equity, and long-term outcomes when IGF-1 receptor inhibitors become available.

The most distinctive component of this study was ENT-assisted decompression. Patients selected for surgery had the greatest baseline proptosis, lowest GO-QOL, longest symptom duration, and highest frequency of dysthyroid optic neuropathy. Their mean proptosis reduction of 5.12 mm is clinically substantial and falls within the range expected for combined medial-wall and floor decompression, depending on the number of walls and amount of fat addressed. A 20-year multidisciplinary clinic experience reported satisfactory recovery or improvement in most cases of sight-threatening Graves' orbitopathy, with decompression required in the majority of dysthyroid optic neuropathy eyes [18]. That report underscores that urgent visual rescue often needs both immunosuppression and surgery, and that corneal complications may require multiple coordinated procedures.

Endoscopic decompression is especially suited to ENT-ophthalmology collaboration because the nasal corridor provides direct access to the medial wall and orbital apex, while the ophthalmologist defines visual priorities and manages orbital and motility consequences. Juni and colleagues reported that surgeons experienced in endonasal techniques achieved proptosis reductions of approximately 3.5–7.6 mm depending on the extent of decompression, with stable vision in nearly all cases [19]. The present modeled change is consistent with a predominantly medial-wall/posterior-floor approach tailored to severity. However, decompression can alter extraocular-muscle paths and induce or worsen strabismus. Rootman and colleagues documented increased

esotropia and reduced ductions after decompression, supporting staged strabismus surgery after globe position has stabilized [20]. This risk is why preservation of the inferomedial strut, controlled periorbital opening, and preoperative counseling were built into the pathway.

A recent systematic review and meta-analysis including multiple decompression techniques found that greater wall removal generally produced larger proptosis reduction, with three-wall decompression providing the largest pooled effect, but at the cost of different complication profiles [21]. The central lesson is not that one operation is universally best; it is that decompression should be matched to the clinical objective. Optic-nerve rescue requires adequate posterior medial and apical decompression. Cosmetic rehabilitation may favor balanced or fat-dominant approaches. Severe exposure may require rapid pressure reduction plus corneal protection. The 2026 large retrospective analysis of personalized multimodal decompression similarly showed that combined approaches produced greater proptosis reduction, whereas endoscopic medial-wall procedures had a relatively low complication rate and strong visual benefit in patients with optic neuropathy [22]. These contemporary data support the study's multidisciplinary, anatomy-led model.

The regression analysis provides an operational message. Joint assessment within seven days had an adjusted odds ratio of 7.25, independent of management group and baseline GO-QOL. Early review may improve outcome through several mechanisms: rapid identification of optic neuropathy, avoidance of duplicated or incomplete imaging, earlier initiation of immunomodulation, timely thyroid correction, coordinated smoking counseling, and scheduling of decompression before fixed damage becomes established. Because this is observational, the association cannot prove causality. Early presenters may differ in health literacy, access, adherence, or disease phenotype. Nonetheless, referral interval is measurable and modifiable, making it a suitable quality indicator for future prospective audit.

Euthyroidism at 12 weeks was also strongly associated with response. Thyroid instability can amplify orbital inflammation and complicate the use of radioiodine, antithyroid medication, surgery, and immunosuppression. A multidisciplinary service should therefore include explicit responsibility for thyroid monitoring rather than treating biochemical control as someone else's task. Smoking showed the largest adverse association. Tobacco exposure is a recognized risk factor for TED development, severity, and reduced treatment response; the modeled result reinforces the need to document smoking status at every visit,

provide cessation support, and avoid reducing counseling to a single verbal recommendation. Symptom duration greater than six months was independently unfavorable, consistent with progressive transition from active edema to fibrosis and fixed anatomical dysfunction. These findings collectively support prevention and early intervention over rescue alone.

Strengths of this study framework include consecutive recruitment, standardized activity and quality-of-life measures, patient-level paired analysis, inclusion of visual and anatomical endpoints, explicit measurement of referral timing and thyroid control, and integration of ENT surgical anatomy with ophthalmic outcomes. The use of logistic regression appropriately shifts attention from crude comparisons among severity-selected treatment groups to cross-cutting predictors. The study is also relevant to a public tertiary hospital in eastern India, where practical multidisciplinary organization may yield greater population benefit than reliance on a single expensive technology.

Several limitations require emphasis. First, no audited patient-level dataset was supplied for manuscript generation; therefore the current numerical results, tables, figures, confidence intervals, and P values are internally modeled placeholders and cannot be submitted or represented as completed clinical research. Second, even after replacement with real data, a single-center observational design will remain vulnerable to confounding by indication, referral bias, loss to follow-up, and residual confounding. Third, treatment protocols were individualized; dose variation, use of adjunctive mycophenolate, surgical extent, and rehabilitation procedures may complicate causal attribution.

Fourth, the 24-week horizon is insufficient to assess relapse, late diplopia surgery, eyelid rehabilitation, chronic sinus outcomes, or sustained quality-of-life benefit. Fifth, GO-QOL translation and cultural validation should be documented for the study population. Sixth, imaging measurements, motility grading, and CAS may show interobserver variability unless examiner training and reliability are prospectively audited.

Finally, the modeled sample provides limited precision for rare adverse events and wide confidence intervals for treatment-group coefficients.

Conclusion

A structured ENT-ophthalmology multidisciplinary pathway was associated with clinically meaningful improvement in inflammatory activity, proptosis among surgically selected patients, visual function, intraocular

pressure, diplopia, and GO-QOL at 24 weeks. Early joint assessment and euthyroidism were favorable independent predictors, whereas smoking and symptom duration beyond six months were unfavorable.

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