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Original Research Article

THYROID HORMONES AND OCULAR PHYSIOLOGY: EFFECTS ON EXTRAOCULAR MUSCLES AND VISION – A CLINICAL STUDY OF 150 CASES

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ABSTRACT

Background: Thyroid hormones play a crucial role in maintaining ocular physiology. Thyroid dysfunction, particularly hyperthyroidism and hypothyroidism, can significantly affect extraocular muscles and visual function, leading to conditions such as thyroid eye disease (TED). **Objectives:** To evaluate the effect of thyroid hormone imbalance on extraocular muscles and to assess the impact of thyroid dysfunction on visual function.

Materials and Methods: A hospital-based observational study was conducted on 150 patients with diagnosed thyroid disorders. Detailed ophthalmic examination including visual acuity, ocular motility, exophthalmometry, and fundoscopy was performed. Thyroid profile (T3, T4, TSH) was correlated with ocular findin`gs.

Results: Among 150 patients, 60% had hyperthyroidism and 40% had hypothyroidism. Extraocular muscle involvement was observed in 48% cases, with inferior rectus being most commonly affected. Proptosis was seen in 36% of patients. Visual impairment was noted in 28% cases. Significant association was found between abnormal thyroid hormone levels and ocular manifestations ($p < 0.05$).

Conclusion: Thyroid dysfunction significantly affects extraocular muscles and visual function. Early ophthalmic evaluation is essential in thyroid patients to prevent vision-threatening complications.

Keywords: Thyroid hormones, Extraocular muscles, Thyroid eye disease, Proptosis, Vision.

INTRODUCTION

Thyroid hormones, namely triiodothyronine (T3) and thyroxine (T4), play a vital role in regulating metabolic processes and maintaining normal physiological function across multiple organ systems, including the eye. Ocular manifestations of thyroid dysfunction are most commonly associated with autoimmune thyroid disorders, particularly Graves' disease, and are collectively referred to as thyroid eye disease (TED).[1] TED is characterized by inflammation and remodeling of orbital tissues, including enlargement of extraocular muscles, increased orbital fat volume, and deposition of glycosaminoglycans, leading to proptosis, eyelid retraction, and restrictive myopathy.[2] The extraocular muscles are especially susceptible due to autoimmune-mediated fibroblast activation and cytokine release, resulting in muscle edema followed by fibrosis and impaired motility.[3] Among the extraocular muscles, the inferior rectus is most frequently involved, contributing to vertical diplopia and limitation of upward gaze.[4] In addition to mechanical effects, severe cases may lead to compressive optic neuropathy, which can result in irreversible visual loss if not detected early.[5] The prevalence and severity of ocular involvement vary widely, with studies reporting clinically significant ophthalmopathy in approximately 25–50% of patients with Graves' disease.[6] Thyroid dysfunction

can also affect visual function indirectly through exposure keratopathy, tear film instability, and corneal involvement due to lagophthalmos and lid retraction.[7] Despite the clinical significance of these manifestations, there is limited data correlating thyroid hormone levels with the extent of extraocular muscle involvement and visual impairment, particularly in the Indian population. Therefore, this study aims to evaluate the effects of thyroid hormone imbalance on extraocular muscles and assess its impact on vision.

Objectives

Primary Objective

- To evaluate the effects of thyroid hormones on extraocular muscles.

Secondary Objective

- To assess the impact of thyroid dysfunction on vision.

MATERIALS AND METHODS

Study Design: Hospital-based observational cross-sectional study

Study Setting: The study was conducted in the Department of Ophthalmology and Physiology at Navodaya Medical College Hospital and Research Centre, Raichur, Karnataka, India.

Study Duration: 12 months (January to December 2025)

Sample Size: 150 patients

Inclusion Criteria

- Patients diagnosed with thyroid disorders (hyperthyroidism/hypothyroidism)
- Age >18 years
- Willing to participate

Exclusion Criteria

- Pre-existing ocular diseases unrelated to thyroid
- History of orbital trauma or surgery
- Neurological causes of ocular motility disorders

Methodology

This hospital-based observational cross-sectional study was conducted at Department of Ophthalmology and Physiology at Navodaya Medical College Hospital and Research Centre, Raichur, Karnataka, India over a period of 12 months and included a total of 150 patients diagnosed with thyroid disorders. Adult patients aged above 18 years with confirmed hyperthyroidism or hypothyroidism based on clinical evaluation and laboratory investigations were included in the study. Patients with pre-existing ocular diseases unrelated to thyroid dysfunction, history of orbital trauma or surgery, and neurological causes of ocular motility disorders were excluded. After obtaining informed written consent, a detailed history was recorded including duration of thyroid disease, treatment status, and associated systemic conditions. All participants underwent a comprehensive ophthalmic evaluation, which included assessment of visual acuity using Snellen's chart, anterior segment examination using slit-lamp biomicroscopy, and fundus examination. Extraocular muscle function was assessed by evaluating ocular movements in all gazes, and diplopia was documented where present. Proptosis was measured using Hertel exophthalmometer. Clinical signs such as lid retraction, lid lag, conjunctival congestion, and exposure keratopathy were noted. Thyroid function tests, including serum triiodothyronine (T3), thyroxine (T4), and thyroid-stimulating hormone (TSH), were recorded for all patients. The severity of thyroid eye disease was assessed clinically based on standard activity parameters.

Statistical analysis

The collected data were entered into Microsoft Excel and analyzed using Statistical Package for the Social Sciences (SPSS) software version 25.0. Descriptive statistics were used to summarize the data, with categorical variables expressed as frequencies and percentages, and continuous variables presented as mean ± standard deviation. The association between thyroid status and ocular manifestations, including extraocular muscle involvement, proptosis, and visual impairment, was evaluated using the Chi-square test. A p-value of less than 0.05 was considered statistically significant. Appropriate tables were constructed to present the distribution and relationships of variables in a clear and concise manner.

RESULTS

Table 1: Age and Gender Distribution of Study Participants (n = 150)

Age Group (years)	Male (n)	Female (n)	Total (n)	Percent
18–30	12	18	30	20
31–40	15	25	40	26.7
41–50	10	30	40	26.7
51–60	8	20	28	18.7
>60	4	8	12	8
Total	**49**	**101**	**150**	**100**

The age and gender distribution of the study participants showed that the majority of cases were concentrated in the middle age groups. The highest proportion of participants was observed in the 31–40 years and 41–50 years age groups, each accounting for 40 cases (26.7%). This was followed by the 18–30 years age group with 30 cases (20%), and the 51–60 years group with 28 cases (18.7%). The least number of participants was seen in the age group above 60 years, comprising 12 cases (8%). Gender-wise distribution revealed a clear female predominance, with 101 females (67.3%) compared

to 49 males (32.7%). Across all age groups, females outnumbered males, particularly in the 41–50

Table 2: Distribution of Thyroid Disorders

Type of Disorder	Number	Percent
Hyperthyroidism	90	60
Hypothyroidism	60	40

Out of a total of 150 cases, hyperthyroidism was observed in 90 individuals, accounting for 60 of the study population, while hypothyroidism was present in 60 individuals, comprising 40 of the cases. These findings indicate that hyperthyroidism was more prevalent than hypothyroidism among the participants in this study.

Table 3: Extraocular Muscle Involvement

Muscle Involved	Number	Percent
Inferior rectus	36	24
Medial rectus	24	16
Superior rectus	12	8
Lateral rectus	6	4
No involvement	72	48

The distribution of extraocular muscle involvement among the study participants showed that nearly half of the patients did not have any muscle involvement, accounting for 72 cases (48%). Among those with involvement, the inferior rectus muscle was the most commonly affected, seen in 36 cases (24%). This was followed by the medial rectus muscle, involved in 24 cases (16%). The superior rectus muscle was affected in 12 cases (8%), while the lateral rectus muscle was the least commonly involved, seen in only 6 cases (4%). Overall, the findings indicate a predominance of inferior rectus muscle involvement among patients with thyroid-related ocular manifestations, reflecting the characteristic pattern of restrictive myopathy seen in thyroid eye disease.

Table 4: Ocular Manifestations

Manifestation	Number	Percent
Proptosis	54	36
Diplopia	45	30
Lid retraction	60	40
Conjunctival congestion	42	28

The distribution of ocular manifestations among the study participants revealed that lid retraction was the most common clinical finding, observed in 60 cases (40%). Proptosis was present in 54 cases (36%), making it the second most frequent manifestation. Diplopia was noted in 45 cases (30%), indicating significant extraocular muscle involvement in a considerable proportion of patients. Conjunctival congestion was seen in 42 cases (28%), reflecting underlying inflammatory activity in thyroid eye disease. Overall, the findings demonstrate that eyelid abnormalities and proptosis are the predominant features, with a substantial number of patients also exhibiting functional disturbances such as diplopia, highlighting the multifaceted ocular involvement associated with thyroid dysfunction.

Table 5: Visual Acuity Status

Visual Status	Number	Percent
Normal vision	108	72
Impaired vision	42	28

The assessment of visual status among the study participants showed that the majority had normal vision, accounting for 108 cases (72%), while 42 patients (28%) exhibited impaired vision. The relatively high proportion of patients with normal visual acuity suggests that although thyroid-related ocular manifestations are common, significant visual impairment occurs in a smaller subset of patients. However, the presence of impaired vision in over one-fourth of the cases indicates a considerable burden of disease, likely attributable to factors such as extraocular muscle involvement, exposure keratopathy, or compressive optic neuropathy. These findings emphasize the importance of early ophthalmic evaluation and timely intervention to prevent progression to vision-threatening complications.

Table 6: Association between Thyroid Status and Ocular Findings

Parameter	p-value	Significance
Extraocular muscle involvement	0.021	Significant
Proptosis	0.034	Significant
Visual impairment	0.041	Significant

The analysis of the association between thyroid status and ocular manifestations demonstrated statistically significant relationships across multiple parameters. Extraocular muscle involvement showed a significant association with thyroid dysfunction ($p = 0.021$), indicating that abnormalities in thyroid hormone levels are closely linked to muscle pathology. Similarly, proptosis was found to be significantly associated ($p = 0.034$), reflecting the role of thyroid-related orbital changes in the development of forward displacement of the eyeball. Visual impairment also showed a statistically significant association ($p = 0.041$), suggesting that alterations in thyroid function can have a measurable impact on visual outcomes. Overall, these findings highlight that thyroid dysfunction is significantly correlated with both structural and functional ocular changes, reinforcing the importance of early detection and integrated management to prevent progression of ocular morbidity.

DISCUSSION

The present study demonstrated that the majority of patients were in the 31–50 years age group, with peak distribution in the 31–40 and 41–50 years categories (26.7% each). This finding is consistent with the epidemiological pattern of thyroid eye disease reported in previous studies (table 1). Bartalena et al[1] observed that thyroid-associated ophthalmopathy commonly presents in the middle-aged population, particularly between the third and fifth decades of life. Similarly, Wiersinga et al,[4] also reported a higher prevalence of thyroid eye disease in patients aged 30–50 years, which aligns closely with the current study findings.

In terms of gender distribution, the present study showed a marked female predominance, with females accounting for 67.3% of cases compared to 32.7% males. This is in agreement with earlier studies, where autoimmune thyroid disorders are known to be more common in women. Perros et al,[6] reported a significantly higher female-to-male ratio in thyroid eye disease, which is comparable to the findings of this study. Likewise, Bahn et al[2] also emphasized the higher prevalence of thyroid dysfunction and its ocular manifestations among females, although males may present with relatively more severe disease.

Furthermore, Bartley et al,[5] also documented that thyroid-associated ophthalmopathy is more frequent in females and typically occurs in middle age, reinforcing the trends observed in the present study. Thus, the age and gender distribution in this study are consistent with established literature, confirming that thyroid-related ocular manifestations predominantly affect middle-aged females.

The present study demonstrated that extraocular muscle involvement was observed in 52% of patients, while 48% showed no muscle involvement. Among the affected muscles, the inferior rectus was the most commonly involved (24%), followed by the medial rectus (16%), superior rectus (8%), and lateral rectus (4%). This pattern of muscle involvement is consistent with the classical description of thyroid eye disease (table 3).

Similar findings have been reported in previous studies. Wiersinga et al,[4] described that the inferior rectus is most frequently involved in thyroid eye disease, followed by the medial rectus, due to their anatomical susceptibility to autoimmune inflammation and glycosaminoglycan deposition. Likewise, Bartalena et al,[1] also reported a predominance of inferior rectus involvement, contributing significantly to restrictive myopathy and vertical diplopia.

Smith et al,[3] further explained that the enlargement and fibrosis of extraocular muscles, particularly the inferior and medial recti, are characteristic features of thyroid eye disease, which aligns with the distribution observed in the present study. Additionally, Rootman et al,[7] emphasized that inferior rectus involvement is most common and often leads to limitation of upward gaze and diplopia, consistent with the clinical implications seen in this study.

The relatively lower involvement of superior and lateral rectus muscles in the present study is also supported by existing literature, where these muscles are less frequently affected. Thus, the pattern of extraocular muscle involvement observed in this study closely parallels established findings, reinforcing the typical sequence of muscle involvement in thyroid eye disease.

The present study demonstrated statistically significant associations between thyroid dysfunction and key ocular manifestations, including extraocular muscle involvement ($p = 0.021$), proptosis ($p = 0.034$), and visual impairment ($p = 0.041$) (table 6). These findings are consistent with established literature highlighting the strong correlation between thyroid hormone imbalance and orbital as well as visual changes.

Wiersinga et al,[4] reported that thyroid eye disease is closely linked to autoimmune-mediated inflammation affecting extraocular muscles and orbital tissues, leading to significant muscle involvement and proptosis, which supports the findings of the present study. Similarly, Bartalena et al,[1] emphasized that the severity of orbital manifestations is significantly associated with

thyroid dysfunction, particularly in active disease phases.

Smith et al,[3] also described that alterations in thyroid hormone levels contribute to orbital fibroblast activation, resulting in tissue expansion and muscle enlargement, thereby explaining the significant association with extraocular muscle involvement and proptosis observed in this study. Furthermore, Bahn et al,[2] highlighted that thyroid dysfunction plays a crucial role in the development of clinically significant ophthalmopathy, including visual impairment in severe cases.

In addition, Bartley et al,[5] reported that visual impairment in thyroid eye disease is often related to compressive optic neuropathy and exposure keratopathy, both of which are consequences of progressive orbital involvement, thereby supporting the statistically significant association observed in the present study. Thus, the findings of this study are in agreement with previous research, confirming that thyroid dysfunction is significantly associated with both structural and functional ocular changes.

CONCLUSION

The present study demonstrates that thyroid hormone imbalance has a significant impact on ocular physiology, particularly affecting the extraocular muscles and visual function. With respect to the primary objective, a substantial proportion of patients exhibited extraocular muscle involvement, most commonly involving the inferior rectus, reflecting the characteristic pattern of thyroid eye disease. Regarding the secondary objective, visual function was found to be affected in a notable number of patients, with a significant association between thyroid dysfunction and visual impairment.

Overall, the study establishes that abnormalities in thyroid hormone levels are closely associated with both structural changes in extraocular muscles and functional visual disturbances. These findings highlight the importance of early ophthalmic evaluation and regular monitoring in patients with thyroid disorders to facilitate timely intervention and prevent vision-threatening complications.

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REFERENCES

1. Bartalena L, Baldeschi L, Dickinson AJ, Eckstein A, Kendall-Taylor P, Marcocci C, et al. Consensus statement of the European Group on Graves' orbitopathy. Eur J Endocrinol. 2008;158(3):273–285.
2. Bahn RS. Graves' ophthalmopathy. N Engl J Med. 2010;362(8):726–738.
3. Smith TJ, Hegedüs L. Graves' disease. N Engl J Med. 2016;375(16):1552–1565.
4. Wiersinga WM, Kahaly GJ. Graves' orbitopathy: A multidisciplinary approach. Endocr Rev. 2012;33(2):154–192.
5. Bartley GB. The epidemiologic characteristics and clinical course of ophthalmopathy associated with autoimmune thyroid disease. Trans Am Ophthalmol Soc. 1994;92:477–588.
6. Perros P, Crombie AL, Matthews JNS, Kendall-Taylor P. Age and gender influence the severity of thyroid-associated ophthalmopathy. Clin Endocrinol (Oxf). 1993;38(4):367–372.
7. Rootman DB, Dolman PJ. Thyroid eye disease: Clinical features and management. Clin Exp Ophthalmol. 2014;42(3):284–292.