Thyrotoxicosis and Keratoconus

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REPORT

Bilateral Keratoconus Induced by Secondary Hypothyroidism After Radioactive Iodine Therapy

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ABSTRACT

PURPOSE: To present a case of new-onset, bilateral, rapidly progressive keratoconus induced by radioactive iodine therapy during the sixth decade of life that was successfully treated with corneal cross-linking.

METHODS: Case report and literature review.

RESULTS: A 63-year-old woman with no ocular complaints but with a history of Graves’ disease and thyrotoxicosis was treated with radioactive iodine therapy and oral levothyroxine for secondary acquired hypothyroidism. Initially, uncorrected distance visual acuity (UDVA) was 20/40 and corrected distance visual acuity (CDVA) was 20/25 in both eyes. Over the following 3 years, the patient developed worsening UDVA and CDVA, with increasing manifest astigmatism of greater than 7.00 diopters (D) in the right eye and 4.75 D in the left eye, with corneal thinning and foci steepening and was diagnosed as having bilateral progressive keratoconus. The patient underwent sequential corneal cross-linking with postoperative CDVA of 20/20 and reduced maximum keratometry and manifest astigmatism in both eyes. The patient’s thyroid levels were within normal limits throughout the clinical course.

CONCLUSIONS: This case provides evidence of the relationship between keratoconus exacerbation and thyroid gland dysfunction. The pathophysiology of this relationship has yet to be completely elucidated, but elevated levels of thyroid hormone in the aqueous humor and tear film and thyroxine receptors in the cornea likely play a role. Screening topographies for patients with thyroid gland dysfunction may be of value for these higher risk patients.

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Thyroid gland dysfunction induced Keratoconus*

- 53 year old female with late onset and progression of bilateral keratoconus
  - Previous keratoconus?
  - Post-refractive ectasia?
  - Severe eye rubbing?
  - Trauma?
  - Pellucid marginal degeneration?
  - Something else?

*Quoted from J Bradley Randleman, MD, Ramon Lee, MD*
At Presentation

- Visual acuity:
  - CDVA 20/60 OD, 20/50 OS
- SLE
  - LLL: blepharitis OU
  - K: inferior corneal thinning without scarring OU
  - L: 1+ NSC OU

Quoted from

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The Thyroid Disease
(1994)
• 17-year-old female presented in 1994 with a history of Graves’ disease and who underwent partial thyroidectomy.

• She was euthyroid for the period of post-operative follow up.

• Her baseline ophthalmic examination prior to the partial thyroidectomy was normal and with a corrected distance visual acuity (CDVA) of 20/20 in both eyes with a manifest refraction of +1.00D sphere in both eyes.
The Right eye Affection

(2007)

13 years of regular follow up for Blepharitis and Recurrent chalazia
• She represented in 2007 (13 years later) at the age of 29 years with decreased visual acuity in the right eye.

• CDVA was 20/30 in the right eye and 20/20 in the left eye.

• Manifest **astigmatism** increased from no astigmatism in either eye to +2.50D in the right eye and +1.50 in the left eye.
Right Keratoconus  left normal
Right Corneal Cross Linking
(2007)

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**Dresden Protocol:**

Parameter for First Eye *(RIGHT)* CXL:

- **Target:** Keratoconus
- **Fluence:** (total) \((\text{mJ/cm}^2)\) 5.4
- **Soak Time** *(minutes)*: 30
- **Intensity** *(mW)*: 3
- **Treatment time** *(minutes)*: 30
- **Epithelium status:** Off – 9mm removal.
- **Chromophore:** 0.15% Riboflavin (Peschke D).
- **Light Source:** UV-X1000 (IROC).
- **Irradiation mode:** Continuous.
(2009)

OD

OS

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In 2016, at the age of 39 years, routine follow up evaluation revealed CDVA of 20/20 in both eyes and mild changes in manifest refraction with +2.00 +1.75 x155 in the right eye and +3.00 +2.50 x30 in the left eye.

Corneal Tomography was stable in the right eye, however there was mild steepening and corneal thinning in the left eye that was worse than the 2011 examination. No intervention was pursued due to the mild nature in the change in refraction and tomography.
2016
• A year later (2017), the patient obtained serum thyroid hormone levels in anticipation of surgical removal of bilateral ovarian cysts and was found to have free T3 (3.950 pg/mL) and free T4 (1.610 ng/dL) that were within the normal range;

• However, TSH level was markedly decreased (0.014 ulu/mL), reference range of 0.400-4.200 ulu/mL).

• She was evaluated by her endocrinologist, and U/S Showed bilateral enlargement of thyroid lobes that was causing her hyperthyroid state. She was subsequently started on oral Carbimazole 5mg daily and radioactive iodine.
• Her ophthalmic examination at that time showed CDVA of 20/30 in the right eye and 20/60 in the left eye.

• With increase in manifest astigmatism to 2.50D in the right eye and 5.00D in the left eye.

• Pentacam imaging demonstrated stable findings in the right eye but progressed inferior steeping (Kmax 45.5D) and inferior corneal thinning of 482 microns in the left eye.
(2017)
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RIGHT EYE

Waveform #1 (1:34:47 PM)

IOPg : 11.2  IOPcc : 14.3  CCT : 0

CH : 8.6  CRF : 7.6  WS : 3.3 *

LEFT EYE

Waveform #1 (1:34:58 PM)

IOPg : 11.5  IOPcc : 10.0  CCT : 0

CH : 4.4  CRF : 4.1  WS : 1.6 *
Left Eye Accelerated Epi-Off CXL
(2017)
Accelerated Epi-Off Corneal Cross-Linking

- **Parameter Variable for Second Eye (Left)**
- **Target**: Keratoconus
- **Fluence**: (total) \((\text{mJ/cm}^2)\) 5.4
- **Soak Time**: (minutes) 30
- **Intensity**: (mW) 18
- **Treatment time**: (minutes) 5
- **Epithelium status**: Off – 9mm removal
- **Chromophore**: 0.10% Riboflavin (Peschke D)
- **Light Source**: CCL-VARIO (Peschke)
- **Irradiation mode**: Continuous.
Review of literature:

• Relation between thyroid eye diseases and Keratoconus:

Pathophysiology

Patients with thyroid gland dysfunction have elevated levels of thyroxine in both the tear film and the aqueous humor which may cause biomechanical changes in the corneal stroma due to thyroxine-receptor interactions.*

• Tear film thyroxine levels are elevated regardless of blood thyroxine levels.

• Inadequate use of tear thyroxine by the cornea of keratoconus patients is suggested either by changes in the transformation of thyroxine to tri-iodothyronine or ineffective binding of thyroxine by receptors.*

• Direct effect of **Thyroxine** on **normal keratocyte** metabolism is to inhibit inflammatory process and stimulation of keratocytes proliferation in vitro.*

• That effect is **reversed in keratoconus keratocyte**, and was suggested to be due to modified expression of thyroxine receptors by corneal keratocytes.*

• **Thyroid dysfunction** prevalence among patients with KC is 13.6%, which is higher than its prevalence in the general population (about 2%).

• Tear T4 was higher in KC, and *keratocyte thyroxine receptors were elevated in KC* compared with controls.

• **Collagen and cytokeratins** were equally altered both in KC and in the cultured corneas substituted with T4.*

Role of Thyroxine in the Development of Keratoconus

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Conclusions: Our data implicate a crucial role of T4 in KC pathophysiology, which is most likely mediated by T4Rs.

Key Words: cornea, thyroid hormones, thyroid hormone receptors, immunoassay, immunohistochemistry, keratoconus

(Cornea 2016;35:1338–1346)
Additional Case Reports

- 10 year old boy with Hashimoto’s disease
- 12 year old boy with Down syndrome and hypothyroidism
- 33 year old pregnant woman with hypothyroxinemia

1. “Quoted from J B Randeleman, R lee”


Bilateral, Asymmetric Keratoconus Induced by Thyrotoxicosis with Long-Term Stability after Corneal Cross-Linking*
Conclusions:

- Keratoconus is a bilateral disease.

- There is an Association between thyrotoxicosis and keratoconus.

- **Order** T3, T4 & TSH for all cases of KC (13.4% of KC have elevated T3, T4, TSH).

- Asymmetric presentation of Thyroid-induced keratoconus.

- CXL had a long-term Stabilizing effect over 10 years despite the ongoing effects of thyroid gland dysfunction.*

Preferable to Avoid Refractive Surgery in Patients with THYROID DISEASES
Thank you

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