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CHRISTMAS TREE CATARACT: A SCARCE VARIANT OF AGE-RELATED CATARACT - CASE REPORT

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ABSTRACT **Background:** Christmas Tree Cataract (CTC) is a rare morphological variant of age-related cataract characterised by brilliant polychromatic needle-shaped crystal deposits within the deep cortex and nucleus of the lens. The glistening, multicoloured refractile opacities resemble the decorative lights of a Christmas tree under slit-lamp biomicroscopy. While frequently an incidental finding, CTC can be associated with systemic conditions — most notably myotonic dystrophy — and may progress to visually significant lens opacification. **Case Presentation:** We report a 57-year-old hypertensive female who presented with a gradual, painless, progressive diminution of vision in the left eye. Slit-lamp examination revealed senile immature cataract (SIMC) in both eyes, with pathognomonic polychromatic crystalline deposits in the left lens consistent with Christmas Tree Cataract. Best corrected visual acuity (BCVA) was 6/12 in the right eye and 6/9p in the left. Intraocular pressure was within normal limits bilaterally. Posterior segment examination demonstrated bilateral vessel attenuation and dull foveal reflexes, consistent with her hypertensive background. **Management & Outcome:** The patient underwent phacoemulsification with hydrophobic acrylic intraocular lens (IOL) implantation in the left eye, followed by topical steroid and antibiotic therapy. Post- operative visual acuity recovered to 6/6p. Neurological evaluation excluded myotonic dystrophy. **Conclusion:** Christmas Tree Cataract, though rare, should be recognised as a distinct clinical entity by the examining ophthalmologist. Awareness of its characteristic slit-lamp appearance enables accurate diagnosis, guides surgical planning in view of potential capsular fragility and zonular weakness, and prompts appropriate systemic evaluation to exclude myotonic dystrophy.

KEYWORDS : Christmas Tree Cataract; Polychromatic Lens Deposits; Cysteine-Rich Crystallin; Slit-Lamp Biomicroscopy; Phacoemulsification; Myotonic Dystrophy; Age-Related Cataract; Rare Cataract

1. INTRODUCTION

Cataract is the leading cause of reversible blindness worldwide, accounting for approximately 51% of global blindness as estimated by the World Health Organisation. Among the many morphological subtypes of age-related lens opacification, Christmas Tree Cataract (CTC) — also referred to in the older literature as scintillating cataract, coronary cataract with crystal deposits, or polychromatic cataract — represents one of the rarest and most visually striking variants encountered in clinical ophthalmology.

Christmas Tree Cataract is characterised by brilliant, multicoloured, needle-shaped or spindle-shaped crystalline deposits located predominantly within the deep cortex and nucleus of the crystalline lens. Under slit-lamp biomicroscopy with diffuse illumination or retroillumination, these deposits produce a spectacular display of polychromatic refractile iridescence — a clinical appearance that has aptly inspired the eponymous designation.

The pathogenesis of CTC involves the accumulation of denatured cysteine-rich crystalline proteins within the lens fibres. These proteins undergo progressive oxidation and subsequent disulfide bond formation, leading to the precipitation of needle-shaped crystalline deposits composed primarily of cholesterol, calcium oxalate, and cystine. The highly organized crystalline lattice structure of these deposits enables them to refract incident light across the visible spectrum, producing the characteristic multicoloured shimmer.

Christmas Tree Cataract most commonly presents as an incidental slit-lamp finding in older individuals, with bilateral or unilateral distribution. While it is typically considered a variant of age-related lens change, a well-established systemic association exists with myotonic dystrophy (Steinert's disease) — an autosomal dominant neuromuscular condition caused by a trinucleotide CTG repeat expansion in the DMPK gene. Patients with myotonic dystrophy may develop CTC as early as the third decade of life. Other reported associations include hypocalcaemia, galactosaemia, atopic dermatitis, and prolonged corticosteroid use, although these are less consistently documented.

The clinical significance of CTC extends beyond its remarkable appearance. Progressive enlargement of the crystalline deposits can lead to visually significant lens opacification. Furthermore, the associated structural alterations within lens fibres — including capsular fragility and zonular weakness — impose unique surgical challenges during phacoemulsification, including an elevated risk of capsular rupture and vitreous prolapse. We present a case of Christmas Tree Cataract in a 57-year-old hypertensive female, discuss its clinical features, management, and outcome, and provide a concise review of the current literature.

2. Case Presentation

2.1 Presenting History

A 57-year-old female resident of Kamothe, Navi Mumbai, Maharashtra, presented to the Ophthalmology Outpatient Department at MGM Medical College & Hospital with a chief complaint of gradual, painless, progressive diminution of vision in the left eye of insidious onset. She had been using distance spectacles for the preceding ten years, with the last refraction and spectacle correction having been updated one year prior to presentation, and she reported full compliance with spectacle use.

There was no history of ocular trauma, prior ocular surgery, or any intraocular procedure. She had a known history of hypertension for ten years, for which she was on regular antihypertensive medication. She denied any drug allergy and had no history of tobacco, alcohol, or substance use. There was no personal or family history of myotonic dystrophy, neuromuscular disease, or other systemic condition.

2.2 General Examination

General examination revealed a well-built, well-nourished female who was conscious, alert, and oriented to time, place, and person. Her vital signs were as follows: pulse rate 86 beats per minute (regular, good volume); blood pressure 140/90 mmHg; respiratory rate 16 breaths per minute; and temperature afebrile. Systemic examination was unremarkable.

2.3 Ophthalmic Examination — Anterior Segment

A detailed ophthalmic examination was performed. Findings are summarized in Table 1.

Table 1. Anterior Segment Examination Findings (Both Eyes).

Parameter	Right Eye (RE)	Left Eye (LE)
Visual Acuity – Distance (Unaided)	FC at 2 m → 6/12	6/24 → 6/12p
Visual Acuity – Near (Unaided)	N12	N8
Best Corrected Visual Acuity (BCVA)	6/12	6/9p
Colour Vision (Ishihara)	17/17 plates	17/17 plates
Amsler Grid	Normal	Normal

Extra-Ocular Movements (EOM)	Free, full, painless in all gazes	Free, full, painless in all gazes
Lid and Adnexa	Normal	Normal
Conjunctiva	Normal	Normal
Cornea	Clear	Clear
Corneal Sensations	Present	Present
Sclera	Normal	Normal
Anterior Chamber Depth	Normal depth	Normal depth
Pupil	3 mm, round, regular, reactive; RAPD absent	3 mm, round, regular, reactive; RAPD absent
Lens	SIMC	SIMC with Christmas Tree deposits
IOP (Goldmann Applanation Tonometry)	14 mmHg	16 mmHg

The cardinal finding was in the left eye: slit-lamp biomicroscopy revealed, in addition to the background senile immature cortical changes (SIMC), a remarkable display of brilliant polychromatic, needle-shaped crystalline deposits distributed within the deep cortex and nucleus of the crystalline lens. These deposits exhibited vivid multicoloured iridescence under slit-lamp illumination — blue, green, red, and gold reflections — producing an appearance strikingly reminiscent of the glistening decorations of a Christmas tree. This appearance was pathognomonic for Christmas Tree Cataract. The right eye demonstrated senile immature cortical and mixed cataract (SIMC) without the characteristic crystalline deposits. Intraocular pressure was within normal limits in both eyes on Goldmann Applanation Tonometry.

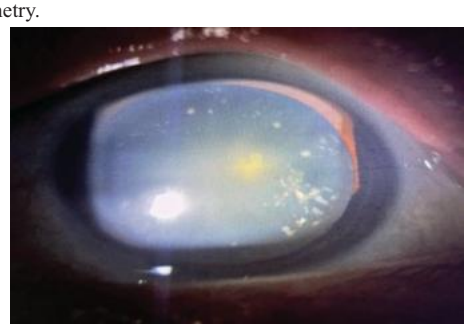

Figure 1: Slit Lamp Image showing Christmas Tree Cataract

2.4 Ophthalmic Examination — Posterior Segment

Posterior segment examination findings are summarized in Table 2.

Table 2. Posterior Segment Examination Findings (Both Eyes).

Parameter	Right Eye (RE)	Left Eye (LE)
Media	Clear	Clear
Optic Disc – Colour	Orange	Orange
Optic Disc – Margins	Well-defined	Well-defined
Cup: Disc Ratio	0.6:1	0.6:1
Blood Vessels	Attenuated	Attenuated
Foveal Reflex	Dull	Dull
Macula	Normal	Normal

Fundus examination was possible despite the lens opacities. Bilateral findings of attenuated blood vessels and dull foveal reflexes were noted, consistent with chronic hypertensive retinopathy in the context of her decade-long history of hypertension. The optic disc was orange with well defined margins and a cup-to-disc ratio of 0.6:1 bilaterally. The macula appeared normal in both eyes.

3. MANAGEMENT

3.1 Pre-operative Planning

Following clinical diagnosis of Christmas Tree Cataract in the left eye with associated visually significant lens opacification, surgical intervention was planned. Pre-operative evaluation included biometry for IOL power calculation. The surgical team was briefed regarding the potential intraoperative challenges specific to CTC, including the possibility of increased capsular fragility and zonular instability, which necessitate heightened vigilance during capsulorhexis, hydrodissection, and lens removal.

Informed consent was obtained from the patient after thorough counselling regarding the diagnosis, surgical procedure, potential intraoperative complications, and expected post-operative outcomes. Anaesthetic fitness was confirmed. Neurological referral was initiated pre-operatively to evaluate for any features of myotonic dystrophy, given its well-established association with Christmas Tree Cataract.

3.2 Surgical Intervention

The patient underwent phacoemulsification with hydrophobic acrylic intraocular lens (IOL) implantation in the left eye under local anaesthesia. Phacoemulsification — the gold standard surgical technique for cataract extraction — employs ultrasonic energy to emulsify the crystalline lens, which is then aspirated via a coaxial irrigation-aspiration system through a small self-sealing corneal incision (typically 2.2–2.8 mm), with subsequent implantation of a foldable IOL into the capsular bag.

A hydrophobic acrylic IOL was selected in preference to hydrophilic acrylic (HEMA- based) IOL, as hydrophobic designs carry a lower risk of posterior capsule opacification (PCO) and are less susceptible to calcification — a consideration of relevance given the inherent propensity for crystalline deposition in this condition. Intra-operatively, careful attention was paid to maintaining an intact continuous curvilinear capsulorhexis (CCC) and gentle hydrodissection to account for the potential capsular fragility associated with Christmas Tree Cataract. The procedure was completed without intraoperative complications.

3.3 Post-operative Course

Post-operatively, the patient was commenced on topical antibiotic-steroid combination eye drops to prevent infection and suppress post-operative inflammation, along with topical non- steroidal anti-inflammatory drops for macular protection. Post-operative visual acuity in the left eye recovered to 6/6p — near-complete restoration of visual function — confirming a successful surgical outcome.

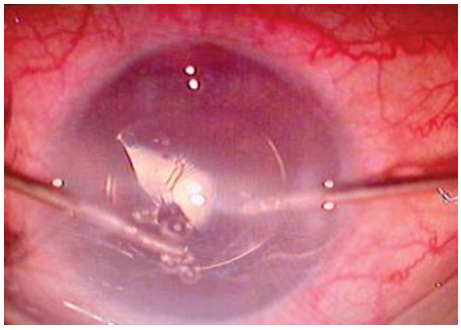

Figure 2: Image Showing Intraoperative Hydrophobic IOL implantation.

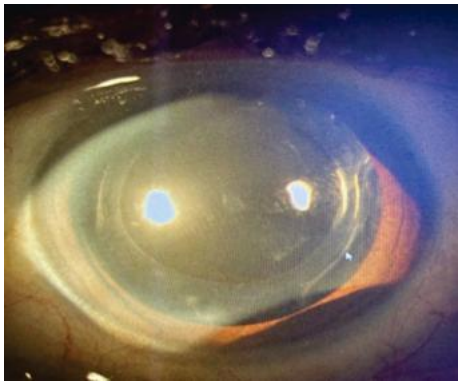

Figure 3: Slit Lamp Image Showing 2 weeks Post-Cataract Surgery

3.4 Systemic Evaluation

Neurological consultation was obtained to evaluate for myotonic dystrophy. Clinical neurological examination was unremarkable, with no features of myotonia, facial weakness, ptosis, distal muscle wasting, or percussion myotonia. No family history of myotonic dystrophy was elicited. Electromyography (EMG) was not required clinically. The neurologist's assessment concluded that the systemic association of myotonic dystrophy could be confidently excluded in this patient. The cataract was attributed to an age-related crystallin protein alteration without an identifiable underlying systemic aetiology.

4 DISCUSSION

Christmas Tree Cataract constitutes one of the rarest and most morphologically distinctive subtypes of lens opacification documented in ophthalmic literature. The first detailed clinical descriptions of polychromatic crystalline lens deposits appeared in the early twentieth century, and the condition has since been described in isolated case reports and small case series, underscoring its rarity. A systematic review of published literature reveals fewer than one hundred well- documented cases, reflecting the limited collective clinical experience with this entity.

The pathophysiological hallmark of CTC is the precipitation of cysteine-rich crystallin protein complexes within the lens fibre cells. Under physiological conditions, crystallin proteins — primarily α-, β-, and γ-crystallins — are maintained in a state of soluble transparency by molecular chaperone activity, particularly that of α-crystallin. With advancing age, cumulative oxidative stress, ultraviolet exposure, and metabolic alterations disrupt this homeostatic balance. In CTC, the specific predisposition to form needle-shaped crystalline precipitates — as opposed to the more common granular opacities of cortical or nuclear cataract — is attributed to the preferential oxidation and disulfide-bond crosslinking of cysteine residues within γ-crystallins, a process that favours the formation of ordered crystalline lattice structures from cholesterol, calcium oxalate, and cystine.

The classical slit-lamp appearance — polychromatic, brilliantly refractile, needle-shaped deposits within the deep cortex and nucleus — is pathognomonic and permits clinical diagnosis without the need for ancillary investigations. The glistening multicoloured display arises because the highly ordered crystal lattice diffracts and disperses white light across its spectral components, producing vivid blue, green, red, and gold iridescence. This appearance is most strikingly demonstrated under retroillumination or broad-beam diffuse illumination, and it is entirely distinct from the granular white or yellowish opacities of conventional cortical or nuclear sclerotic cataracts.

The most clinically significant systemic association of CTC is myotonic dystrophy type 1 (DM1 / Steinert's disease). DM1 is caused by an unstable CTG trinucleotide repeat expansion in the 3' untranslated region of the dystrophia myotonica protein kinase (DMPK) gene on chromosome 19q13.3. The lens is one of the earliest organs affected in DM1, and bilateral Christmas Tree or stellate posterior subcapsular cataracts may be the presenting feature — occasionally preceding overt neuromuscular manifestations by years. This makes CTC a potentially sentinel ocular finding warranting active neurological screening. In our patient, a comprehensive neurological evaluation excluded DM1, and the CTC was attributed to idiopathic age-related crystallin deposition.

From a surgical perspective, CTC presents unique intraoperative considerations. The same pathological processes that lead to crystalline deposit formation are associated with structural weakening of the lens capsule (capsular fragility) and zonular apparatus (zonular weakness or laxity). These alterations increase the risk of capsular tear — including posterior capsular rupture — and vitreous prolapse during phacoemulsification. Surgeons should therefore adopt a cautious technique: a well-centred continuous curvilinear capsulorhexis of adequate size, gentle and complete hydrodissection with careful attention to fluid dynamics, reduced phaco energy settings during nuclear disassembly to minimise capsular stress, and careful cortical clean-up. Pre-operative informed consent should specifically address this elevated surgical risk. The choice of hydrophobic acrylic IOL, as employed in our case, is clinically appropriate given the superior PCO prophylaxis and resistance to late in-the-bag calcification offered by this material class.

Our patient's posterior segment findings of bilateral arteriolar attenuation and dull foveal reflexes are consistent with hypertensive retinopathy — an expected finding in a patient with a decade-long history of inadequately controlled hypertension. These changes did not contribute to the visual impairment, and the excellent post-operative visual acuity of 6/6p confirms that the primary driver of visual loss was the crystalline lens opacification. This outcome underscores theimportance of early surgical intervention in CTC before the progression of associated complications — including lens-induced glaucoma from phacolytic or phacomorphic mechanisms, or increasing zonular instability — renders surgery technically more complex.

The present case adds to the small but growing body of evidence that Christmas Tree Cataract, though rare, can occur in the absence of systemic disease as a primary age-related lens phenomenon, and that phacoemulsification with careful technique and appropriate IOL selection yields excellent visual outcomes. It also highlights the critical importance of systemic evaluation — specifically for myotonic dystrophy — in every confirmed case of CTC.

5 CONCLUSION

Christmas Tree Cataract is a rare but clinically distinctive morphological variant of age- related cataract whose pathognomonic polychromatic needle-shaped crystalline deposits permit a confident clinical diagnosis on slit-lamp biomicroscopy alone. Several key lessons emerge from this case:

- Awareness of the characteristic slit-lamp appearance of Christmas Tree Cataract is essential for every practising ophthalmologist, as it is frequently an incidental finding that may be missed or misclassified as conventional nuclear sclerosis.
- Every confirmed or suspected case of CTC mandates neurological referral to exclude myotonic dystrophy, which may present with CTC as an early or isolated ocular manifestation preceding systemic features.
- Surgical planning must account for the capsular fragility and potential zonular weakness intrinsic to CTC, requiring meticulous intraoperative technique and appropriate surgeon preparedness.
- Hydrophobic acrylic IOL implantation is the preferred surgical choice, offering superior PCO prophylaxis and resistance to late calcification in the context of a lens predisposed to crystalline deposition.
- Timely surgical intervention, as demonstrated in this case, yields excellent visual rehabilitation with post-operative acuity recovering to 6/6p.

Increased reporting of well-documented cases will contribute to a better understanding of the epidemiology, natural history, and surgical nuances of this fascinating but enigmatic cataract variant.

Patient Consent

Written informed consent was obtained from the patient for publication of this case report and associated clinical data. All patient identifiers have been withheld to preserve confidentiality in accordance with institutional policy.

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