



Arygrosis in Lens Capsule: A Case Report

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Abstract

To report a case of long-standing occupational ocular argyrosis with histopathological confirmation during cataract surgery. A 57-year-old male silver worker with a 16-year history of ocular argyrosis and progressive visual deterioration underwent comprehensive ophthalmological examination and phacoemulsification with intraocular lens implantation. The anterior lens capsule obtained during capsulorhexis was submitted for histopathological examination. Clinical examination revealed bilateral diffuse corneal deposits, periocular pigmentation, and characteristic findings consistent with chronic silver deposition patterns. The right eye demonstrated a mature cataract with complete cortical opacity. Phacoemulsification was performed successfully without complications. Histopathological analysis confirmed characteristic silver deposits within the capsular matrix, providing a definitive diagnosis of ocular argyrosis. Postoperative visual acuity improved from hand motion to 0.9. This case demonstrates successful cataract surgery outcomes in a patient with long-standing occupational ocular argyrosis. Histopathological examination of surgical specimens provides invaluable diagnostic confirmation and demonstrates the systemic nature of silver deposition. The case emphasizes the importance of long-term monitoring in patients with occupational silver exposure and confirms that cataract surgery can be performed safely with excellent visual outcomes in patients with concurrent ocular argyrosis.

Keywords: Argyria, cataract, lens, ocular argyrosis, phacoemulsification

Introduction

Silver exposure in occupational settings has emerged as a significant health concern, particularly in industries involving jewelry manufacturing, photography, and metallurgy (1).

Argyria is a rare systemic disorder characterized by the pathological deposition of silver particles in various tissues following chronic exposure to silver compounds (2). The condition develops through multiple exposure routes, including ingestion, inhalation, and dermal absorption, with occupational exposure representing the most frequent etiology in contemporary clinical practice (3). The pathophysiological mechanism involves the reduction of absorbed silver ions to insoluble metallic silver particles, which are subsequent-

ly sequestered in tissues rich in elastic fibers and basement membranes (2).

Ocular argyrosis represents the most frequently encountered form of localized argyria, characterized by pathognomonic gray discoloration of ocular structures (4). The deposition of silver salts results in skin discoloration around the eyes; the affected area becomes gray or bluish-gray. Silver precipitates are distributed in the elastic fibers of the connective tissue and basement membranes, including the eyelids, conjunctiva, lacrimal sac, lens, ciliary body and Bruch's membrane, and are also noted within Bowman's membrane, corneal stroma, Descemet's membrane, and lens capsule, causing characteristic tissue discoloration (5). While the majority of patients remain asymptomatic, some individuals

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may experience nyctalopia or visual field abnormalities (2). Ocular argyrosis diagnosed during a thorough ophthalmic examination may be the first sign of generalized argyria. The disease may also develop following the use of silver-containing eye drops, certain eyelash and eyebrow dyes (6). Diagnosis is primarily established through clinical examination and occupational history (3). Histopathological examination remains the gold standard for definitive diagnosis when tissue samples are available (7). Herein a case of ocular argyrosis in a patient who underwent cataract surgery with histopathological analysis of the anterior lens capsule confirming silver deposition is reported.

Case Report

A 57-year-old male patient presented with a 4-year history of progressive visual deterioration in the right eye. The patient was a long-standing silver worker who had been diagnosed with ocular argyrosis 16 years earlier. His past medical history was significant for hypertension and myocardial infarction. Current medications included antidepressant therapy and acetylsalicylic acid.

Best-corrected visual acuity measured with the Snellen chart was hand motion in the right eye and 0.6 in the left eye with optical correction. Slit-lamp examination revealed characteristic findings of ocular argyrosis bilaterally. The periocular skin and ocular surface displayed diffuse black-gray pigmentation in both eyes. Corneal examination showed patchy pigmentation in the stroma and Descemet's membrane bilaterally, with highly reflective punctiform deposits extending from the anterior to mid-stroma and increasing in density toward the corneal endothelium (Fig. 1a). Due to the intense stromal silver deposits, proper evaluation of the corneal endothelium was not possible. The right eye demonstrated a mature cataract with complete cortical opacity, while the left eye showed nuclear sclerosis (Fig. 1b). The anterior segment optical coherence tomography (AS-OCT) also demonstrated silver accumulation in the cornea (Fig. 1c). Fundus examination was not possible in the right eye due to the dense cataract. However, the left eye fundus appeared normal with no pigmentation. Intraocular pressure was within normal limits in both eyes. Ocular ultrasonography of the right eye confirmed no retinal detachment and revealed normal posterior segment anatomy. Based on the clinical findings of corneal silver deposits and visually significant cataract, the patient was scheduled for phacoemulsification with intraocular lens implantation (IOL) in the right eye. The biometry was performed using optical coherence biometry, showing axial length: 24.02 mm, K1: 43.49 D, K2: 45.06 D, and anterior chamber depth: 3.51 mm. The IOL was 18.5 D.

The patient underwent uncomplicated phacoemulsification with posterior chamber intraocular lens implantation

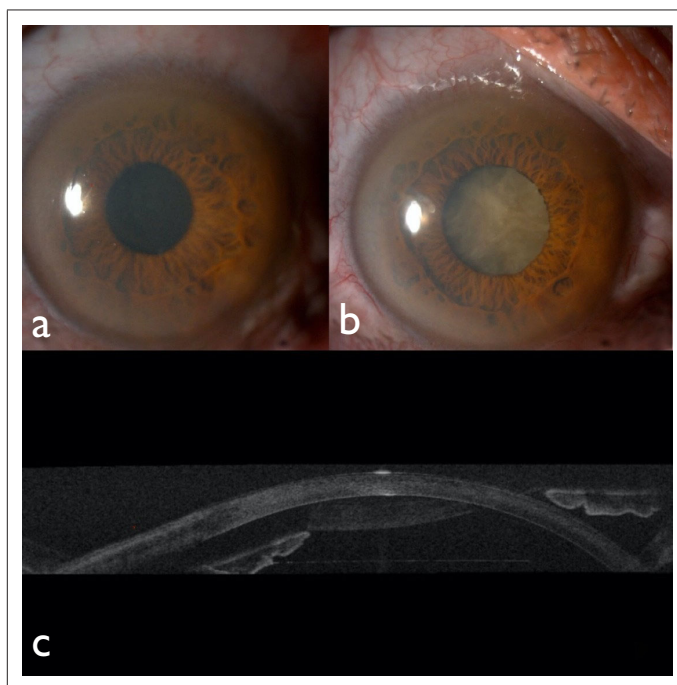


Figure 1. (a) Corneal examination showing patchy pigmentation in the stroma and Descemet's membrane, with highly reflective punctiform deposits extending from the anterior to mid-stroma and increasing in density toward the corneal endothelium. (b) Right eye showing mature cataract with complete cortical opacity. (c) Anterior segment optical coherence tomography demonstrating silver accumulation in the cornea.

under topical anesthesia. During the capsulorhexis procedure, the anterior lens capsule tissue was carefully collected and submitted for histopathological examination. The surgical procedure was completed with no complications. Postoperatively, the patient was treated with routine topical antibiotic and corticosteroid therapy. The recovery was uneventful with no signs of inflammation or other complications during the follow-up period. Histopathological analysis of the anterior lens capsule revealed characteristic silver deposits consistent with ocular argyrosis, confirming the clinical diagnosis (Fig. 2). The silver particles were identified within the capsular matrix, providing definitive evidence of silver accumulation in the ocular tissues.

The patient demonstrated excellent visual recovery following cataract surgery, with best-corrected visual acuity improving to 0.9 with optical correction (+0.75 -1.25 100), and no postoperative complication was observed.

Informed consent was obtained from all individual participants included in the study.

Discussion

Ocular argyrosis constitutes a rare ophthalmic manifestation of systemic silver toxicity, characterized by pathological silver accumulation within diverse ocular structures. The incidence has markedly decreased due to enhanced industrial safety

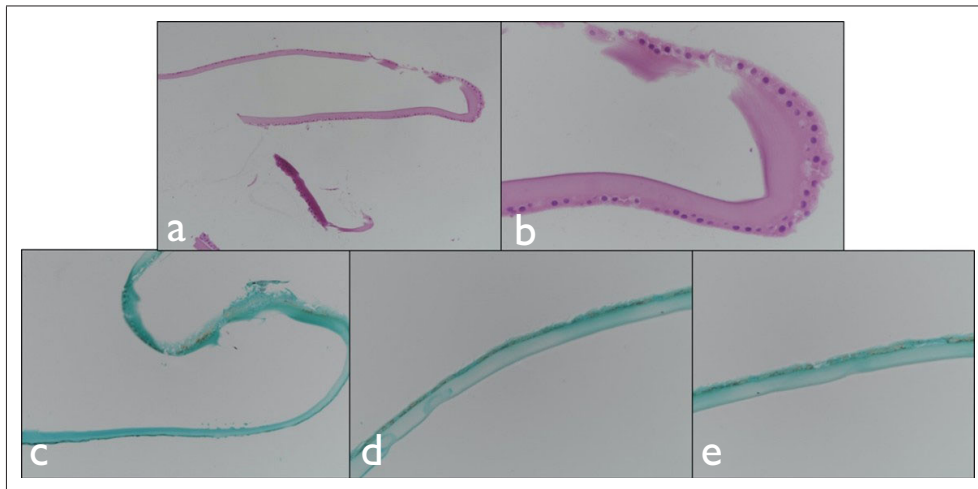


Figure 2. Histopathological examination of the anterior lens capsule. **(a, b)** Hematoxylin and eosin (H&E) staining showing the anterior lens capsule with single-layered endothelial cells at low magnification (a, $\times 40$) and higher magnification (b, $\times 200$). **(c-e)** Methenamine silver staining demonstrating fine granular pigmented silver particles within the capsular matrix and endothelial cells. (c, $\times 40$; d, $\times 100$; e, $\times 100$).

measures and discontinuation of silver-containing medications (8). Despite these preventive measures, silver compounds maintain widespread industrial applications across metallurgical processes, photographic technologies, jewelry manufacturing, and specialized medical devices, perpetuating potential occupational exposure (9). This case highlights the importance of histopathological confirmation in cases of suspected ocular argyrosis and demonstrates successful surgical outcomes in patients with this rare condition.

The pathophysiological mechanisms involve systemic uptake of silver particles, which form stable molecular complexes with endogenous proteins, DNA and RNA structures (3). These silver-protein conjugates demonstrate selective tissue tropism, accumulating preferentially in highly vascularized ocular tissues, particularly the choroidal vasculature and ciliary body. In contrast to systemic exposure, topical silver exposure typically results in localized ocular argyrosis with predominant intracellular accumulation within conjunctival epithelial cells and extracellular precipitation at the Descemet's membrane level (10). Silver deposits selectively accumulate within elastic fibers of connective tissue and basement membrane structures, involving the eyelids, conjunctiva, lacrimal sac, crystalline lens, ciliary body, and Bruch's membrane. Corneal deposition occurs across multiple anatomical layers, involving Bowman's membrane, corneal stroma, and Descemet's membrane, resulting in characteristic tissue discoloration (1,7,9). Clinical studies demonstrate a direct correlation between exposure duration and corneal deposit density (11,12).

The clinical spectrum demonstrates considerable phenotypic heterogeneity, with numerous patients exhibiting asymptomatic corneal silver deposition (13). However, Sta-

feeva et al. (4) reported that some individuals may develop nyctalopia secondary to photoreceptor cellular dysfunction. Sarnat-Kucharczyk et al. (2) described additional manifestations including visual field deficits and decreased visual acuity, though these complications are relatively infrequent. Additionally, Palamar et al. (14) reported in their case report that bilateral ocular surface pigmentation and black tears were observed in a case of argyrosis due to occupational silver exposure. The most frequent finding consists of conjunctival hyperpigmentation, particularly in the nasal region and caruncle (8).

The current case presents a scenario of occupational ocular argyrosis in a long-standing silver worker with 16 years of known disease progression. This case demonstrates the chronic, progressive nature of silver deposition and highlights the importance of long-term monitoring in patients with occupational exposure. Bilateral corneal deposits, periocular pigmentation, and systemic tissue involvement were consistent with characteristic silver deposition patterns as described in the literature (7,13,15).

Contemporary imaging technologies have fundamentally transformed diagnostic paradigm and morphological characterization. AS-OCT emerged as a valuable non-invasive tool, identifying silver deposits as hyperreflective bands at Bowman's layer and Descemet's membrane levels (10,12,16). Dudeja et al. (12) demonstrated novel AS-OCT application in a 67-year-old photographic film manufacturer with chronic silver-halide exposure, revealing distinct hyperreflective bands that distinguish ocular argyrosis from other metallic deposition diseases such as Wilson's disease or drug-induced corneal verticillata. In vivo confocal microscopy has proven invaluable in characterizing corneal silver accumulation, re-

vealing distinctive hyperreflective precipitates with granular morphological patterns (11,15). Mora et al. (16), utilizing in vivo confocal microscopy, demonstrated that argyrosis typically does not stimulate corneal inflammatory reactions, with most patients remaining asymptomatic, consistently showing absence of activated keratocytes and dendritic cells.

Surgical management of cataract in ocular argyrosis patients requires careful consideration. Our patient underwent successful phacoemulsification with IOL implantation, achieving excellent visual outcomes with best-corrected visual acuity improving to 0.9 postoperatively. This demonstrates concordance with previously published reports advocating safety and efficacy of cataract extraction in argyrosis patients (17). Dudeja et al. (12) reported a 56-year-old silversmith with bilateral ocular argyrosis who underwent cataract surgery with histopathological confirmation of silver deposits in the lens nucleus, raising important questions regarding whether silver deposits occur in senile cataracts or if cataracts are induced by silver deposition itself. Agarwal et al. (17) highlighted challenges in IOL power calculation, noting that Scheimpflug imaging results may be erroneous due to light blockage by silver deposits, while optical and ultrasonic biometry remain reliable, with recommendations for monofocal IOLs until long-term results of premium IOLs are established. Nevertheless, theoretical concerns warrant consideration, including potential bioactivity of silver particles within aqueous humor, possible mobilization of corneal silver deposits during surgical manipulation, and unknown long-term biocompatibility interactions between silver compounds and IOL biomaterials. Histopathological validation of silver deposits within our patient's anterior lens capsule provided definitive diagnostic confirmation. This approach has been emphasized as the gold diagnostic standard, particularly in ambiguous or atypical presentations (8). Microscopic identification of silver particles within the capsular matrix confirms the systemic nature of silver deposition.

Differential diagnostic considerations encompass alternative metallic deposition disorders, including Wilson's disease with pathognomonic copper accumulation, ocular chrysiasis characterized by gold particle deposition, and siderosis involving iron precipitation (10). Conditions associated with abnormal ocular pigmentation, including primary acquired melanosis and malignant melanoma, require systematic exclusion (18). Pharmacologically-induced corneal deposits secondary to medications such as amiodarone and antimalarial agents may demonstrate morphologically similar presentations (1). This case emphasizes the critical importance of comprehensive ophthalmological evaluation and long-term monitoring in patients with occupational silver exposure. The successful surgical outcome demonstrates that cataract extraction can be performed safely in

patients with concurrent ocular argyrosis. Histopathological examination of surgically obtained specimens provides invaluable diagnostic information and should be considered when clinically feasible.

The long-term visual prognosis remains generally favorable, particularly when future silver exposure is effectively prevented. However, existing metallic deposits are considered irreversible and permanent, emphasizing the paramount importance of early clinical recognition and appropriate occupational counseling when applicable (2). Comprehensive long-term studies evaluating potential interactions between silver deposits and intraocular lens materials following cataract surgery remain absent in current literature, highlighting an important area for future research.

Conclusion

This case demonstrates successful cataract surgery in a patient with chronic occupational ocular argyrosis, with histopathological confirmation of silver deposits in the anterior lens capsule, providing a definitive diagnosis. The excellent visual outcome (BCVA 0.9) confirms that phacoemulsification can be safely performed in patients with silver deposition. Early recognition of occupational silver exposure and appropriate monitoring remain crucial, as existing deposits are irreversible despite a favorable long-term visual prognosis when further exposure is prevented.

Disclosures

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