Management of intrascleral chestnut burr spines under ultrasound biomicroscopy guidance

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Purpose: To explore the efficacy of ultrasound biomicroscopy (UBM) as a tool for detecting and localizing intrascleral chestnut burr spines. Methods: Individuals who were diagnosed with definitive or suspected intrascleral chestnut burr injuries between 2019 and 2020 were retrospectively reviewed. All patients underwent UBM to detect potential intrascleral spines. UBM imaging features were recorded and analyzed. Intrascleral spines were removed based upon UBM-guided localization. Patient clinical profiles, management, and treatment outcomes were recorded. Results: A total of 10 eyes (10 patients; 6 males, 4 females) were diagnosed with intrascleral spines over the study period, with an average patient age of 55 years (range: 39–71). Three of these 10 eyes exhibited involvement of the palpebrae and cornea, whereas three exhibited corneal involvement, and the remaining four patients exhibited only intrascleral spine injuries owing to their having undergone previous intracorneal spine extraction procedures. UBM features consistent with chestnut burr spines manifest a hyperechoic spot with a shadow. UBM enabled the precise localization of these spines and thus ensured their successful removal via a single surgery. During follow-up, two patients experienced vitreous hemorrhage due to a penetrating injury into the ciliary body that was gradually absorbed. All patients with eye irritation and red eyes progressed favorably, and no surgical complications were recorded. Conclusion: A retained scleral chestnut burr spine should be suspected if a patient complains of persistent eye irritation following intracorneal spine removal. UBM may be a valuable tool for detecting spines retained in the sclera, enabling the successful removal thereof.

Key words: Intrascleral chestnut burr spines, management, UBM

Chestnut burr spines primarily cause eye injuries affecting the palpebral, conjunctival, or cornea, with scleral involvement being less common. These foreign bodies can be readily detected and removed from the cornea. Although the surgical removal of larger spines in an obvious location and with sufficient exposure from the sclera is often a relatively straightforward process, the removal of smaller intrascleral spines inserted into the scleral stroma is much more challenging as they are often not detectable upon microscopic examination.\cite{1,2} We report UBM as an efficacious means of detecting and localizing small chestnut burr spines retained within the scleral stroma.

Methods

We retrospectively analyzed patients with suspected or definitive diagnoses of intrascleral chestnut burr spine injuries treated in our hospital during the chestnut harvesting seasons in 2019 and 2020. Cases exhibiting corneal perforation or infectious keratitis were excluded. In total, 11 patients were ultimately included in this study. The Institutional Ethics Committee approved the present study, which was consistent with the Declaration of Helsinki. All patients provided informed consent to participate in this study.

During their initial visit, all 11 patients underwent exhaustive slit-lamp examinations, and spines were localized and recorded. Four patients were definitively diagnosed with intrascleral spines using slit lamp, whereas seven patients without classical typical clinical presentations of such intrascleral spines were suspected of harboring these spines and were recommended to undergo UBM (SW-3200L, Suoer Electronic Technology Co., Ltd, Tianjin, China). All 11 patients were examined by an experienced UBM technician along with a primary ophthalmologist. The injured eye, including the cornea and anterior sclera, was analyzed in detail in a clockwise direction. Enhancing scans of regions exhibiting marked conjunctival congestion were performed, as these areas were considered more likely to harbor a retained chestnut burr spine.

Medical records, patient demographics, previous treatments, and duration from the onset of injury to diagnosis were retrospectively reviewed. Best-corrected visual acuity,
intraocular pressure, anterior and posterior segment examinations, pre- and intra-operative findings regarding spine localization and number, and treatment outcomes were additionally recorded. Corneal and scleral UBM imaging features were also assessed.

Prior to surgery, all patients underwent topical antibiotic (0.5% levofloxacin) and topical steroid (0.5% loteprednol etabonate) treatment four times per day. In addition, six patients exhibiting corneal involvement underwent topical antifungal treatment (0.2% fluconazole) four times per day. All surgical procedures were performed by a single experienced surgeon (Dr TX) for those patients exhibiting intracorneal or intrascleral chestnut burr spines injury in the operating room.

Intracorneal spines were removed under topical anesthesia (proparacaine hydrochloride eye drops), using a 26-gauge needle to reach deep below the spine and thereafter extract it. Intrascleral spines were removed under local infiltrative anesthesia via the conjunctival injection of 2% lidocaine. A pair of scissors was then used to open the bulbar conjunctiva, after which a small lamellar sclerotomy was made based upon the spine location as detected via UBM. Following the exposure of the tail of the brown spine, it was carefully extracted with a needle or forceps.

Postoperatively, patients were administered topical antibiotics for up to 1 month. Topical antifungals were continued for 2 weeks if no corneal infections developed. Topic steroids were gradually tapered from four times daily to once per day over a 1-month period. In this current study, the complications of chestnut burr injuries included stromal inflammation, anterior chamber reaction, and vitreous hemorrhage were managed using appropriate treatment strategies. The follow-up period ranged from 6 to 12 months, with follow-up intervals of 0.5, 1, 3, 6, and 12 months. Patient reexamination consisted of routine ophthalmologic examinations in conjunction with slit-lamp, anterior segment, and fundus examinations, or B scans, with UBM being performed if appropriate. A minimum follow-up of 6 months post-surgery was considered for inclusion in the present analysis.

Results
All chestnut burr injuries occurred between September and October during the chestnut harvesting period. Of these 11 patients, 9 were injured while picking chestnuts, whereas the remaining 2 were bystanders. None of these patients wore any form of eye protection. The primary symptoms and clinical manifestations of these patients included red, irritated eyes, accompanied by bulbar conjunctival congestion or subconjunctival hemorrhage [Fig. 1].

UBM was used to definitively diagnose intrascleral chestnut burr spines in 11 examined eyes. One (Case 9) of the 4 patients (Cases 5, 6, 8, 9) who had been definitively diagnosed with intrascleral spines via slit-lamp evaluation was found to have an additional tiny spine lodged in his sclera via UBM imaging. Of the seven patients who were suspected of harboring intrascleral spines by slit lamp, one was excluded as no spine was detected, whereas the other six patients (Cases 1–4, 7, 10) were all diagnosed with tiny spines embedded in the scleral stroma as detected using UBM guidance. Therefore, the remaining 10 patients (10 eyes; 6 males, 4 females) were diagnosed with intrascleral spines, with an average age of 55 years (range: 39–71).

Three of these 10 eyes (Cases 1, 7, 8) exhibited both palpebrae and corneal involvement, whereas three (Cases 5, 6, 9) exhibited corneal involvement, and the remaining four (Cases 2, 3, 4, 10) did not exhibit residual spines in the palpebrae or cornea as three of these patients had undergone one round of surgical treatment to intracorneal spines, and one had experienced two previous surgical procedures including an intracorneal spine removal operation and exploration for the presence of remaining intrascleral spines, in their local hospital during their initial visit [Tables 1 and 2]. Although intracorneal spines had been completely removed in these four patients, they nonetheless experienced persistent discomfort and red eyes. As such, the duration between injury onset and final diagnosis was an average of 31.5 days (range: 15–53 days), owing to previous misdiagnosis or delayed diagnosis.

A shadow underneath a hyperechoic region was found to be the UBM imaging feature characteristic of a chestnut burr spine retained in the cornea or sclera. The hyperechoic spot

| Table 1: General information of 10 patients with intrascleral chestnut burr injuries |
|----------------------------------|------------------|------------------|------------------|
| Age/ Sex | OD/OS | Previous surgeries | Duration of symptom (days) |
|----------|-------|----------------------|------------------------|
| 54/F | OS | No | 5 |
| 39/M | OS | Intrascleral spine removal | 15 |
| 46/M | OS | Intrascleral spine removal | 53 |
| 47/F | OD | Intrascleral spine removal-intrascleral spine exploration | 28 |
| 57/F | OD | No | 3 |
| 71/F | OD | No | 10 |
| 64/M | OS | No | 1 |
| 67/M | OS | No | 8 |
| 67/F | OS | No | 12 |
| 40/F | OD | Intrascleral spine removal | 30 |

| Table 2: Clinical characteristics of 10 patients with intrascleral chestnut burr injuries |
|----------------------------------|------------------|------------------|
| Locations and numbers of spines | Total surgeries | Complications |
| eyelid | cornea | Scleral (UBM (SL)) | | |
| 3 | 2 | 2 (0) | 1 |
| 3 | 0 | 2 (0) | 2 | VH |
| 1 | 2 | 2 (0) | 2 | VH |
| 3 | 1 | 1 (1) | 3 |
| 1 | 1 | 2 (0) | 1 |
| 1 | 7 | 1 (1) | 1 |
| 1 | 3 | 3 (2) | 1 |
| 3 | 0 | 2 |

VH: vitreous hemorrhage; SL: slit lamp
corresponds to a strong acoustic echo from the spine, whereas the acoustic shadow is associated with signal loss due to the influence of the foreign body [Fig. 1].

All patients with chestnut burr-related ocular injuries had their remaining spines removed completely through a single microsurgical operation under our treatment. Surgeries were performed for 10 eyes, with quick and accurate removal having been achieved under UBM guidance. In particular, cases 3 and 4 [Figs. 2 and 3] corresponded to the four patients who had undergone previous surgeries, with Case 3 having undergone corneal foreign body removal, and Case 4 having undergone corneal foreign body removal and a failed intrascleral foreign body extraction. The spines retained in the sclera of these patients were too small to detect upon microscopic examination, and the removal of these spines was successfully performed under UBM localization. These four patients were thus cured in a maximum of three spine extraction sessions. An intrascleral spine retention often coincides with an area of remarkable conjunctival congestion and edema [Fig. 1d]. Retained spines were found at these locations during surgery in the present patient cohort. In all patients, intraoperative localization and numbers of intrascleral spines were completely consistent with preoperative UBM imaging results. These data are summarized in Tables 1 and 2.

All patients exhibited complete symptom resolution and good visual acuity over the 6–12 month follow-up period without any evidence of keratitis, synechia formation, hypopyon, or infection. Two patients (case 3 and 6) experienced vitreous hemorrhage due to a penetrating injury into the ciliary body that was gradually absorbed over time.

**Discussion**

When individuals handle chestnuts without appropriate eye protection, the chestnut burr spines can easily lodge in exposed portions of the eye, including the eyelid, cornea, anterior sclera, or even intraocular tissues.[1,3] These stiff and sharp spines can cause severe ocular injuries including ocular contusion, corneal, scleral, and conjunctival foreign body-related damage with or without laceration, penetrating trauma, keratitis, traumatic cataract, and endophthalmitis, some of which have the potential to result in more serious visual impairment.[4,5]

Owing to their fragile, woody characteristics, chestnut burr spines tend to break easily and lodge in the corneal and scleral stroma or the eyelid, unlike more robust materials such as iron fragments that can readily penetrate into the vitreous humor or retina.[6] Although chestnut burr spines embedded within the cornea or eyelid can be readily localized via slit-lamp examination and subsequently removed under a surgical microscope, small pieces of these spines embedded in the scleral stroma can be difficult to detect owing to congestion of the surrounding tissues and conjunctival coverage. This may lead to patient misdiagnosis, delayed removal, or multiple removal operations performed in a clinical setting. Several studies have demonstrated that delayed chestnut burr spine removal can result in inflammation, infection, toxicity, and

![Figure 1: Intracorneal and intrascleral chestnut burr spines.](image-url)
granulomatous reactions, with multiple rounds of surgical removal exposing patients to a higher risk of iatrogenic injury.[1,2,4] It is thus essential that more reliable approaches to detecting and localizing intrascleral foreign bodies such as chestnut burr spines be identified.

**B** scans, anterior segment optical coherence tomography (AS-OCT), computed tomography (CT), and magnetic resonance imaging (MRI) can all be employed to detect foreign bodies such as intrascleral spines.[5,7] However, B scans cannot display images of the anterior segment. Although AS-OCT can be used in patients suffering from corneal perforation or infections, significant signals generally cannot be obtained owing to its low tissue penetration and resolution limit. CT and MRI approaches have not been used in this diagnostic context,[8] as they are costly and not well-suited to the localization of small wood-based foreign bodies in the eyes. Slit-lamp detection is effective as a means of localizing larger intracorneal and intrascleral spines with an obvious presentation. Owing to these limitations, detecting intrascleral spines in six eyes (Cases 1–4, 7, 10), in the present study was difficult upon initial evaluation as these spines were very small and thus largely unobservable.

Surgical exploration is another common technique employed to locate foreign bodies, using a conjunctival incision to search for evidence of small foreign bodies on the surface of the sclera. Unfortunately, such surgical exploration is often unsuccessful if the foreign body is not visible or is beneath the episcleral. This was likely what occurred in Case 4, in which the patient presented with intrascleral spines after having undergone failed exploratory surgery. This is consistent with a report from Zhang et al.,[4] who found that some patients had undergone multiple surgical interventions to remove burr spines.

UBM is a noninvasive approach to examining the anterior segment, and it is particularly valuable when assessing the cornea, anterior sclera, anterior chamber, anterior chamber angle, iris, and ciliary body. The high-frequency (50 MHz) and high-resolution characteristics of this approach offer excellent cross-sectional imaging of the anterior segment.[7,10,11]

Our results indicate that UBM can detect the existence of intracorneal or intrascleral chestnut burr spines, which are characterized by a shadow underneath a hyperechoic spot in UBM images. The hyperechoic spot corresponds to a strong acoustic echo from the spine, whereas the acoustic shadow is the signal loss due to the influence of the foreign body. When using UBM to detect intrascleral spines, intensive continuous cross-sectioning on the suspicious scleral site is critical owing to the potential for missing the positive signals. UBM may occasionally yield a similar false hypoechoic band, but this band is typically unstable and variable. Appropriate operator experience can ensure the reliable detection of an intrascleral foreign body via UBM. As UBM technicians may overlook or otherwise misinterpret a signal from an intrascleral spine, it is
important that a primary ophthalmologist and UBM technician examine and analyze UBM signals together. Detecting relationships between clinical symptoms and UBM data can guide the effective and successful use of this technology.

UBM can provide precise information regarding the location of intrascleral spines, including the accurate clock-hour location, depth, and distance from the corneal limbus. Such information is essential for successful surgical extraction. For example, in Case 3 in the present study [Fig. 2c], UBM imaging revealed a characteristic hyperechoic spot at the 3 o’clock position approximately 3 mm from the corneal limbus. After a conjunctival incision was made based upon these UBM scan results, the tail of a chestnut spine exposed on the scleral surface was located and a ~2 mm chestnut spine was readily removed. Similarly, the patient in Case 4 who had undergone two previous surgical procedures revealed a deeper intrascleral spine with a remarkable hyperechoic spot [Fig. 3c]. After the opening of the conjunctiva, no evidence regarding the location of spines on the scleral surface was evident other than iatrogenesis. Under UBM guidance, a small sclerotomy was made, permitting the location of a small ~1 mm brown spine that was deeply embedded within the scleral stroma at the 9 o’clock position approximately 6 mm from the corneal limbus. Such deeply embedded spines cannot be reliably located at present without UBM guidance. In this study, UBM guidance was sufficient to locate intrascleral chestnut Burr spines of varying sizes with ease, permitting their rapid surgical removal. As such, UBM can be effectively utilized to detect such spines from the scleral stroma, regardless of whether they are exposed or buried deep within the scleral stroma.

Herein, intrascleral spines were detected in six patients without clinical presentations typical of chestnut Burr spine injuries. Detection in these patients was thus attributable to the high accuracy of UBM-based spine localization. The retention of intrascleral chestnut Burr spines should be suspected when patients with signs in local bulbar conjunctiva or sclera, including peribulbar tissue congestion, subconjunctival hemorrhage, and conjunctival tear present in a clinical setting. Our data indicated that even in patients with suspected or definitive intrascleral spine diagnoses, UBM examination is appropriate to exclude the presence of retained spines that are otherwise undetectable via slit lamp. The treatment and clinical presentation of the four patients (Cases 2, 3, 4, and 10) in this study that had undergone previous surgical procedures to remove intracorneal or intrascleral spines further suggest that persistent ocular congestion and eye irritation following the removal of intracorneal spines, should be considered as potentially indicative of retained chestnut Burr spines somewhere within the sclera, likely in the area exhibiting conjunctival congestion. The symptoms of these four patients were in contrast to previous reports suggesting that chestnut Burr spines are often well tolerated and may spontaneously extrude.[2,12]

Conclusion
To the best of our knowledge, the application of UBM to localize intrascleral chestnut Burr spines and guide their removal has not been previously reported in the literature. As such, this study provides a detailed description of the characteristic UBM features of intracorneal and intrascleral Burr spines. Our results demonstrate that UBM is a very useful tool for detecting Burr spines retained in the sclera. Specific cross-sectional images can aid in identifying the exact location of these tiny intrascleral foreign bodies, thereby guiding their successful removal. This report may also guide the localization and management of the other types of anterior scleral foreign bodies that can be challenging to localize using standard clinical practices.

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Conflicts of interest
There are no conflicts of interest.

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