Acta Scientiae Veterinariae, 2024. 52(Suppl 1): 996.

CASE REPORT
Pub. 996

ISSN 1679-9216

Dogs with Lens Subluxation: Managing Vitreous Wick-Like Syndrome after Phacoemulsification

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ABSTRACT

***Background*:** Etiologies for lens luxation in dogs include congenital, primary, and secondary. When performing cataract surgery on dogs with lens subluxation, several complications can arise, making it imperative to explore strategies for their prevention. This case report is the 1st to describe zonular fiber and vitreous strand prolapse through the incision site, a vitreous wick-like syndrome in human, as a potential complication of phacoemulsification with lens subluxation in dogs. It also introduces methods to prevent this complication. The procedures were performed on 2 dogs with lens subluxation at the Veterinary Medical Teaching Hospital of the Chungbuk National University (CBNU), Republic of South Korea.

***Cases*:** *Case 1.* A 7-year-old Maltese dog that exhibited signs of discomfort on the 1st day after undergoing phacoemulsification. This discomfort was due to a single severed zonular fiber with a vitreal strand protruding from the unsutured 2nd incision site, which tightly constricted the iris. Consequently, on the following day, a revision surgical procedure was necessitated to remove and reposition the protruding zonular and vitreal fibers that were constricting the iris. This corrective surgery effectively alleviated the dog's pain. *Case 2.* A 8-year-old Yorkshire Terrier with a similar issue was observed during phacoemulsification near the 2nd incision port. A zonular fiber with a vitreal strand had detached and protruded into the anterior chamber. Prompt and proactive measures were taken to preempt potential complications. The zonular fiber and vitreous were meticulously trimmed and removed, and the 2nd incision port was securely sutured. Unlike in the case 1, this proactive approach successfully prevented any postoperative complications for the dog of case 2. During the surgery to correct lens subluxation in both patients, a capsular tension ring was applied. In the case 1, the vitreous wick-like syndrome induced significant pain and intraocular inflammation. However, by suturing the 2nd incision port and removing the vitreous-zonule complex, the surgical complications were minimized in the dog of case 2.

***Discussion*:** Common complications associated with phacoemulsification for cataracts include corneal edema, uveitis, elevated intraocular pressure (IOP), posterior capsule opacification, and retinal detachment. Additionally, there is a rare but significant risk of vitreous wick syndrome. This syndrome is typically reported in human cases where the vitreous prolapses into the anterior chamber through a microscopic wound, subsequently forming a vitreous wick on the extraocular surface. It is most reported following intracapsular cataract extraction, though there are rare instances after posterior capsulotomies, corneal relaxation incisions, and intravitreal injections. The presence of a vitreous wick facilitates potential intraocular infections from normal superficial ocular bacterial flora, which may include serious conditions such as endophthalmitis and iris incarceration and can cause significant pain. Based on this case report, we recommend that when a severed vitreous-zonule complex is encountered in the anterior chamber during surgery, it should be excised as thoroughly as possible by micro scissors or vitrectomy device, especially when it is located near the incision site. Additionally, we suggest suturing the incision area as a precautionary measure.

Keywords: canine, lens subluxation, phacoemulsification, capsular tension ring, vitreous wick syndrome, intraocular surgery.

DOI: 10.22456/1679-9216.140524

Received: 18 June 2024 Accepted: 10 October 2024 Published: 3 November 2024

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INTRODUCTION

Cataract surgery is commonly performed not only in humans but also increasingly in dogs. Unlike in humans, where the surgery often occurs at an earlier stage of cataract development, in dogs it is typically performed at a more advanced stage. A mature cataract in dogs can damage to the lens zonules [13]. This damage can lead to lens luxation, which is caused by factors such as cataracts, senile nuclear sclerosis, zonular degeneration, and trauma. As a result, the vitreous may move into the anterior chamber [2,14]. The lens dislocates from its anatomical position within the pupil area, which can cause hyperopia, retinal detachment, and acute glaucoma through obstruction of the pupil or the filtration angle [4,15]. Vitreous wick syndrome can occur following intraocular surgeries such as cataract surgery, posterior capsulotomy, and intravitreal injections. In this condition, the vitreous prolapses into the anterior chamber and forms a vitreous wick along a microscopic wound on the iris and external surface, leading to intraocular infections and inflammation [6,24,25].

This case report demonstrates unreported surgical challenges in veterinary medicine, particularly a peaked pupil associated with zonular complications during lens subluxation in phacoemulsification procedures. The practice of suturing previously unsutured surgical sites not only addresses the risk of vitreous wick syndrome, a phenomenon well-documented within human ophthalmology, but is also crucial in the preventing postoperative pain and infection. This contributes to the advancement of surgical protocols in veterinary ophthalmology.

CASES

Two canine patients were referred to the Veterinary Medical Teaching Hospital of the Chungbuk National University (CBNU), Cheongju, Republic of South Korea for cataract surgery. The dogs were examined using routine ophthalmic examination including Schirmer Tear Test, rebound tonometry[1] (TonoVet plus), slit-lamp biomicroscopy[2] and binocular indirect ophthalmoscopy[3]. Vision status was evaluated based on the menace response, dazzle reflex, pupillary light reflex (PLR) and photopic electroretinography[4]. Additionally, we examined the eyes using specular microscopy and ocular ultrasound before the operation.

Case 1. A 7-year-old castrated male Maltese dog weighing 3.5 kg, suffering from diabetes mellitus, visited for diabetic cataract with a history of OD (right eye) blepharospasm, severe hyperemia, and ciliary flush on the cornea. The dog had an intumescent cataract [lens anteroposterior diameter: OD 8.53 mm, OS (left eye) 8.62 mm] causing lens material leakage, leading to evident uveitis in OD along with keratic precipitates and corneal edema. Additionally, secondary glaucoma had developed. Elevated intraocular pressure (IOP) was 96 mmHg in OD and 14 mmHg in OS. Upon visiting the hospital, OD was not suitable for immediate surgery due to severe inflammation causing corneal edema and high IOP (Figure 1). The PLR (pupillary light reflex) was diminished in OD compared to OS, and there was an absence of menace response in both eyes, with only the dazzle reflex present bilaterally. A paracentesis of the anterior chamber was performed, followed by a subconjunctival injection of dexamethasone[5] to manage inflammation. Atropine[6] [OD q24h] was administered topically to paralyze the ciliary muscle and stabilize the blood-aqueous barrier. Preoperative medications included ofloxacin[7] [both eyes (OU) q6h], loteprednol[8] [OU q6h], dexamethasone with neomycin and polymyxin B[7] [OU q6h], and dorzolamide and timolol combination drug[9] [OD q12h]. Oral preoperative medication included prednisone[9] [0.5 mg/kg] to reduce inflammation and prepare for surgery. The patients were sedated with butorphanol[9] [0.2 mg/kg, i.v.] and anesthesized with propofol[10] [4 mg/kg, i.v.]. Atracurim besylate[11] [0.05 mg/kg i.v.] was administered as the neuromuscular blocking agent for muscle relaxation. The patients underwent 2-handed phacoemulsification using Stellaris PC[12] with a capsular tension ring[13] for lens subluxation and intraocular lens[8] [IOL] placement for each eye. While performing ultrasound on the cataractous material, the lens bag was unstable due to lens subluxation, and the lens margin could be observed. Also during irrigation/aspiration (I/A), a zonular fiber and vitreous strand prolapsed (Figure 2) from the ciliary body were observed in the anterior chamber. After surgery, the menace response in both eyes returned, and no pain response or ocular symptoms occurred. The day after surgery, both vision status and IOP were within normal range, however, zonular fiber with vitreous material was observed near the unsealed 2nd port incision. The iris was constricted by the zonular fiber and vitreal strand, forming a peaked

shape in the direction of the sutureless incision, and the patient continued to complain of pain (Figure 3A). The white mucous vitreous-zonule complex that had prolapsed to the outside were excised using Vannas scissor, but it had already adhered to the iris and did not return to its original position. The peaked shape of the iris did not change even when tissue plasminogen activator was used. As a result, revision surgery was considered. The vitreous-zonule complex was separated and cut using a Nagahara chopper and Vannas scissors, relieving the iris constriction. After removing the vitreous- zonule complex adhered to iris, the 2nd port incision was sutured with 8-0 vicryl to prevent additional pupil peak (Figure 3B). There was slight iris bleeding during the procedure, but it was controlled by I/A the entire anterior chamber with balanced salt solution[14] mixed with 0.01 % epinephrine[8]. When observed with the slit lamp biomicroscopy, there was no additional bleeding, vireous-zonule complex protrusion and the intraocular hemorrhage was disappeared the next day (Figure 4A). Currently, this patient followed up for 10 months since the surgery, and vision is maintained well with no complications such as infection or pain (Figure 4B). One week postoperatively, the patient was diagnosed with glaucoma and underwent Ahmed valve implantation. The patient has since remained stable without any ophthalmic clinical symptoms.

Case 2. A 8-year-old intact Yorkshier Terrier bitch, weighing 2.7 kg, presented with OS blindness and a mature cataract with slight vitreous prolapse and lens subluxation. Upon Slit-lamp examination, it was observed that the anterior chamber depth was inconsistent, and there were vitreous prolapse and zonules in OU [both eyes] (Figure 5). There were no peculiarities during the surgical procedure apart from subluxation of the lens. Like the *case 1* mentioned above, a zonular fiber and vitreous strand were observed in the anterior chamber, and a CTR was applied in the bag of the lens. After phacoemulsification, a protruding zonule and vitreous were cut using Vannas scissors, and the 2nd port closure was performed using 8-0 vicryl to prevent surgical complications such as pupil constriction and peak (Figure 6). There was a temporary postoperative ocular hypertension. During follow-up, IOP remained within the normal range. In this patient, the shortly trimmed zonular fiber and vitreous strand complex adhered to iris near the 2nd port, but there were no symptoms of pupil peak and pain. There have been no significant issues during the 3-month follow-up period (Figure 7).

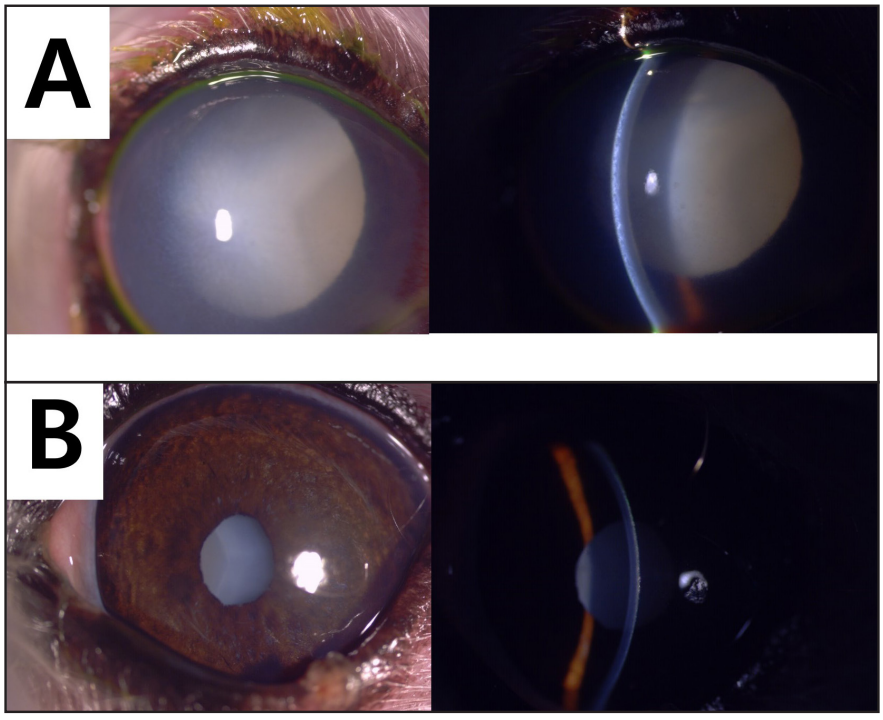

Figure 1. *Case 1.* Preoperative slit lamp examination of the patient (7-year-old castrated male Maltese dog) with an intumescent cataract due to diabetes mellitus. A- Preoperative photography of OD. The patient visited the hospital due to inflammation and glaucoma caused by intumescent cataract. This right eye shows corneal edema and glaucoma due to lens-induced uveitis. B- Preoperative photography of OS. This left eye shows no other issues apart from the cataract (10x magnification).

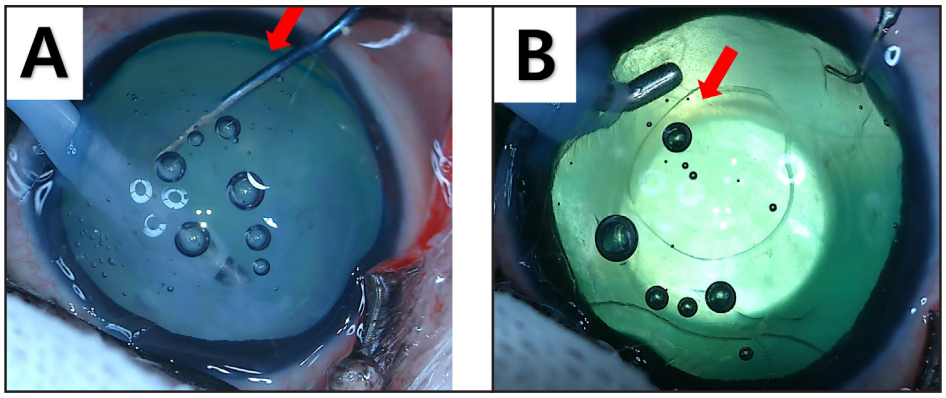

Figure 2. *Case 1.* In-operative photography. A- The margin of the lens equator was visible during the phacoemulsification, and this was more clearly observed due to the application of capsular tension ring, which helped manage the lens subluxation. B- The lens zonule engages with the surgical tip during I/A.

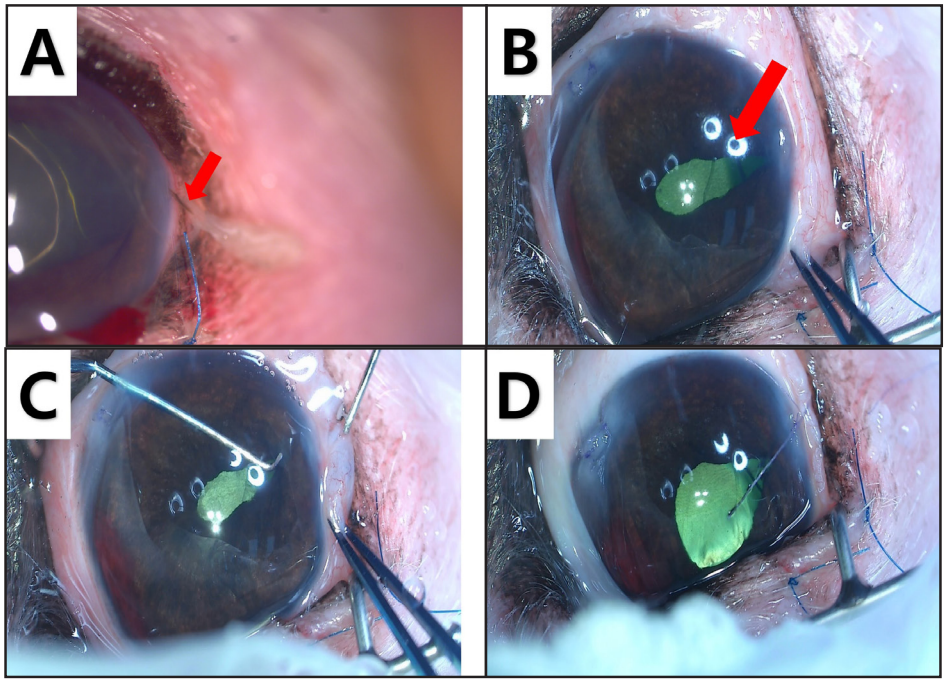

Figure 3. *Case 1.* A- The day after surgery, a white, mucinous, vitreous-zonule complex protruded out of the eyeball through a 2nd port. A revision surgery was performed to remove the protruding vitreous-zonule complex and to alleviate the iris peak. B- The iris is peaked toward the 2nd port, causing pain. C- Stitching out the main incision and releasing the protruding vitreous using a Nahagara chopper. D- Suturing the 2nd port to prevent the flow of the aqueous humor.

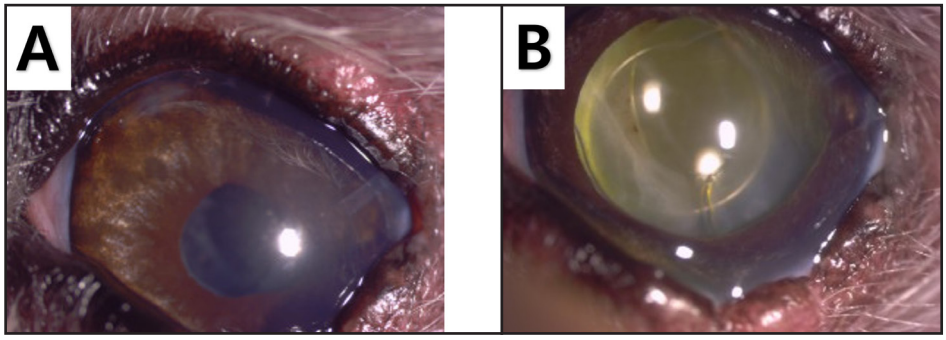

Figure 4. *Case 1.* Postoperative photography. A- The day after revision surgery. There was no additional intraocular bleeding and iris peak was alleviated. B- After 10 months of the surgery. The vision is maintained well without pain and inflammation.

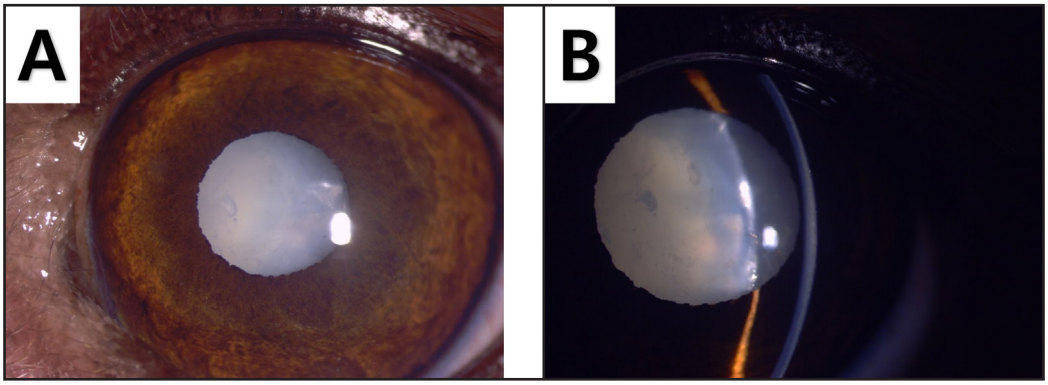

Figure 5. *Case 2.* Preoperative slit lamp examination of the patient (8-year-old intact Yorkshier Terrier bitch). The vitreous protruded into the anterior chamber. It means there is subluxation of the lens.

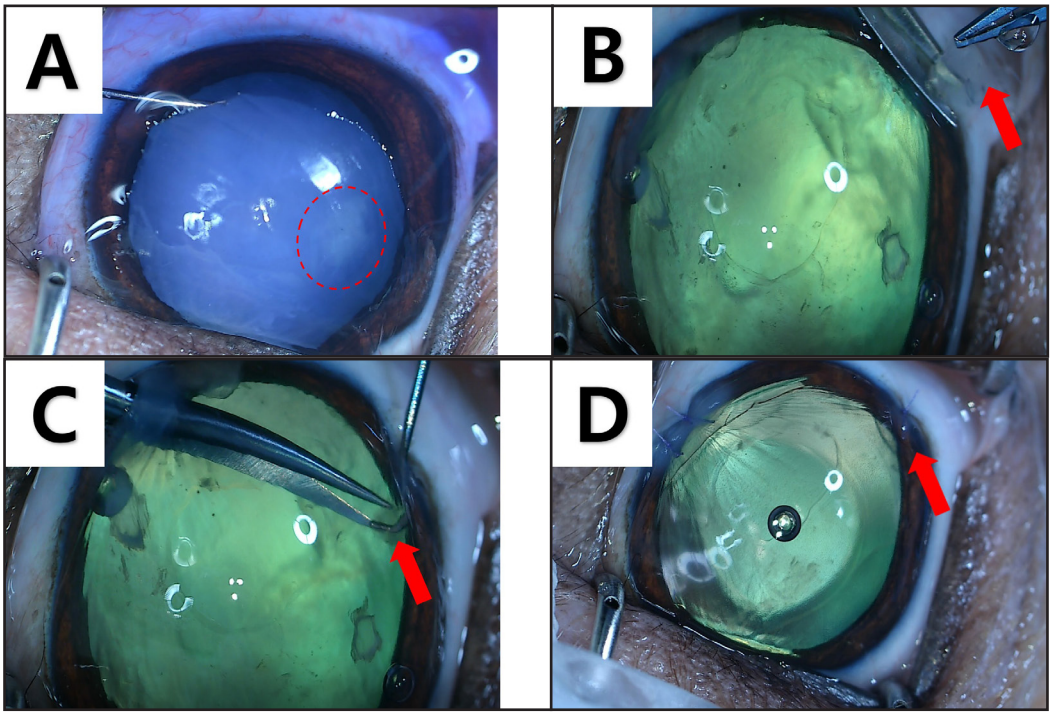

Figure 6. *Case 2.* In-operative photography. A- In the process of dyeing the anterior capsule, the vitreous protruding toward the anterior chamber was not dyed. B- The vitreous protruded into the 2nd port during the surgery were removed. C- The vitreous-zonule complex in the anterior chamber was also removed by Vannas scissor. D- The 2nd port was sutured like the revision surgery in case 1.

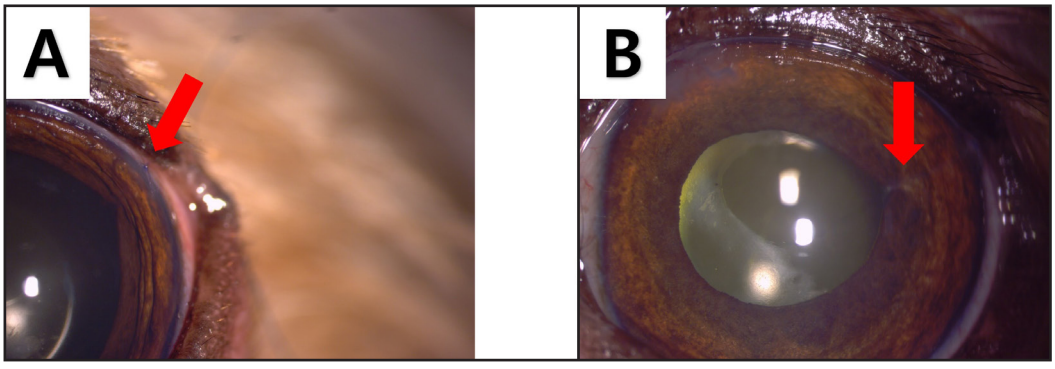

Figure 7. *Case 2.* Postoperative photography. A- The picture of the day after surgery without complaining of pain or inflammation. B- The picture of the 3 months postoperative surgery. The vision was maintained well without side effects.

DISCUSSION

This case report presents 2 canine patients with lens subluxation, where part of the lens zonules with vitreous escaped through the surgical incision, causing iris constriction and pain. Similar to vitreous wick syndrome in humans, the protrusion of the lens zonules through the unsutured surgical window, leading to pain and inflammation, has not been previously reported in veterinary medicine [24,25]. The report also covers the surgical procedures implemented thereafter to prevent such occurrences.

Lens subluxation is a condition where the zonules, which hold the lens in place, are partially disrupted. In humans, lens subluxation can be either congenital or developmental. For congenital cases, Marfan syndrome and homocystinuria are common examples. Developmental cases of lens subluxation can occur due to the progression of eye diseases or following trauma [4,11,20]. Subluxation can be diagnosed through iridodonesis, phacodonesis, vitreal prolapse, and the presence of aphakic crescent. A complete absence of lens zonules may cause an anterior lens luxation or luxation into the vitreous cavity [12]. In veterinary medicine, the causes of lens subluxations are similarly classified as either primary or secondary. Primary lens luxation, which is breed specific, involves an inherited zonular defect that results in lens instability, typically manifesting between 3 and 6 years of age. Breeds with a reported predisposition include the terrier breeds, Tibetan Terrier, Shar Pei, Cairn Terrier, Jack Russell Terrier, and Miniature Bull Terrier. Secondary lens luxation is based on pathological conditions and can be caused by glaucoma, intumescent and hypermature cataracts, blunt trauma, uveal tumors, and uveitis. Lens luxation is less common in cats and usually occurs as a secondary condition later in life [9,10,12,18,22].

In human patients with lens luxation, vision impairment can occur due to changes in the optical axis, and secondary angle closure can arise due to lens displacement, leading to severe ocular pain, redness, blurred vision, unilateral headaches, nausea, and an increase in IOP. Lens removal is being used to improve these symptoms [17]. The treatment of lens subluxation using miotics to prevent displacement of the lens into the anterior chamber and prevent elevation of IOP, as well as surgical correction such as lensectomy to remove displaced lens and scleral fixation with intraocular lens to ensure clear vision. Reported surgical techniques for lens extraction include intracapsular lens extraction (ICLE) for anterior lens luxation well as 2-handed phacoemulsification (with or without removal of the lens capsular bag) and the CTR for mild to severe lens instability. Ciliary sulcus lens implantation, endoscopic laser cycloablation, and prophylactic laser retinopexy can also be performed at the time of surgery [16,18,21,24,27,28].

In typical cataract surgery, the ciliary zonules effectively hold the lens capsule, allowing the I/A fluid to perfuse within the lens capsule during surgery. The countertraction of the normal ciliary body stabilizes the surgical field, ensuring the in-the-bag IOL remains well positioned postoperatively. However, in cases of lens subluxation, the lens bag wobbles during surgery, making it challenging to perform a continuous curvilinear capsulorhexis and fragment the nucleus due to the instability of the surgical field and the manipulation of surgical instruments [28]. In human medicine, tools like the femtosecond laser are employed to address these issues. The instruments used vary depending on the extent of zonular damage and its progression [4,5]. When performing phacoemulsification cataract surgery in patients with subluxation, the lens capsule itself is unstable, increasing the risk of posterior capsule rupture and the likelihood of the nucleus dropping into the vitreous cavity or vitreous prolapse [19,28].

Such zonular weakness necessitates the use of various supportive devices during cataract surgery. In such cases, the CTR or capsule retractors can be used to enhance surgical visibility and stability. In humans, with zonular weakness, when the subluxation is less than 90 degrees, the CTR is inserted into the lens capsule before implanting the intraocular lens. There are also sclera fixated CTRs available, like the Cionni ring, which can be anchored to the sclera to prevent IOL displacement [1,11,21]. For subluxations between 90 and 180 degrees, if a posterior capsule bag is present, the intraocular lens is inserted into the ciliary sulcus. For subluxations greater than 180 degrees, ICLE and capsular bag removal are followed by pars plana vitrectomy and a sclera-fixated intraocular lens implantation [3,7,16].

Despite the surgical treatment, if the vitreous escapes into the anterior chamber, there is a high probability of vitreous wick syndrome occurring, and immediate anterior vitrectomy should be performed to remove the vitreous wick, cover the protruded area

with a flap, and apply local antibiotics [23]. Complications of this syndrome include endophthalmitis, cystoid macular edema, and pupillary block glaucoma. The protruding vitreous not only keeps the wound site open but also acts as a conveyor for pathogens to enter the interior of the eye. In this process, it can create tractional force on the retina, and the vitreous protruding into the anterior chamber can block the pupil, causing glaucoma [24,25].

The case 1 patient is likely to have lens subluxation secondary to a disease. It could be due to intumescent cataracts, which are common in diabetes, or glaucoma, as the patient presented with IOP of 96 in the OD and corneal edema at the time of presentation [2,8,26]. However, it is difficult to definitively determine the exact cause of lens subluxation, as it might also be a primary trait inherent to the patient. No signs of anterior chamber changes or phacodonesis were observed during slit-lamp examination after dilation, but instability was noted during continuous curvilinear capsulorhexis in surgery. The case 2 patient, a Yorkshire terrier, exhibited vitreous prolapse into the anterior chamber during slit-lamp examination after dilation pre-surgery with no other ocular diseases observed besides cataracts. The cause of luxation could be due to the mature cataracts or a breed-specific anomaly in the development of the ciliary zonules. In papers relating the ADAMTS17 mutation to primary lens luxation in terrier breeds, it is noted that Yorkshire terriers account for 3.3% of emergency cases for lens luxation, with patients undergoing ICLE due to complete luxation into the anterior chamber [14]. However, since the Yorkshire Terrier patient in our study did not undergo genetic mutation testing, we can only discuss the potential causes of lens subluxation.

This report is the 1st to describe vitreous wick-like syndrome in veterinary medicine, highlighting the formation of pupil peak due to the prolapse of zonular fibers and vitreous strands in dogs. It shows how surgical techniques from human ophthalmology can be adapted for veterinary use, providing valuable insights for managing similar cases as cataract surgeries become more common in veterinary practice

In conclusion, in patients with vitreous or lens zonule prolapse, it is recommended to excise the vitreous-zonule complex and suture the micro incision to prevent it from following the flow of the aqueous humor and prolapsing through the incision.

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Acknowledgements. This study was supported by "Regional Innovation Strategy (RIS)" through the National Research Foundation of Korea (NRF) funded by the Ministry of Education (MOE) (2021 RIS-001). This work was also supported by the Basic Research Lab Program (2022R1A4A1025557) funded by the Ministry of Science and ICT and the Korean Fund for Regenerative Medicine (KFRM) grant (the Ministry of Science and ICT, the Ministry of Health & Welfare) No. 22A0101L1-11.

Declaration of interest. The authors declare no conflicts of interest. The authors alone are responsible for the contents of this study.

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