HARRAN ÜNİVERSİTESİ VETERİNER FAKÜLTESİ DERGİSİ

Capsular Tension Ring and Iris Hook Use in The Management of Cataract with Phacoemulsification Method in Dogs

Osman BULUT[1,a,*], Ayşe İpek AKYÜZ ÜNSAL[2,b], Ali BELGE[3,c]

[1]Mugla Sitki Kocman University, Faculty of Milas Veterinary Medicine, Department of Surgery, Mugla, Türkiye.

[2]Aydin Adnan Menderes University, Faculty of Medicine, Department of Ophthalmology, Aydin, Türkiye.

[3]Aydin Adnan Menderes University, Faculty of Veterinary Medicine, Department of Surgery, Aydin, Türkiye.

[a]ORCID: 0000-0003-2773-8243;

[b]ORCID: 0000-0001-5260-674X;

[c]ORCID: 0000-0003-3346-6926;

Received: 01.04.2024

Accepted: 06.05.2024

How to cite this article: Bulut O, Akyüz Ünsal AI, Belge B. (2024). Capsular Tension Ring and Iris Hook Use in The Management of Cataract with Phacoemulsification Method in Dogs. Harran Üniversitesi Veteriner Fakültesi Dergisi, 13(1): 68-75. DOI:10.31196/huvfd.1462824.

***Correspondence:** Osman BULUT

[1]Mugla Sitki Kocman University, Faculty of Milas Veterinary Medicine, Department of Surgery, Mugla, Türkiye.

e-mail: obulut@mu.edu.tr

Available on-line at: https://dergipark.org.tr/tr/pub/huvfd

Abstract: The purpose of this study is to evaluate the surgical outcome of capsular tension ring and iris hook use during phacoemulsification in dogs with zonular weakness and miotic pupils. This study includes nineteen dogs (29 eyes) that underwent phacoemulsification (15 dogs/25 eyes) and extracapsular cataract extraction surgery (4 dogs/4 eyes) between February 2014 and February 2015. Patients with any ophthalmic problem other than cataracts were not included in the study. Some dogs did not achieve pharmacologic pupil dilation. These dogs required the use of iris hooks or the insertion of capsular tension rings. The capsular tension ring insertion was used in dogs with zonular rupture in more than half of the zonules. Capsular tension rings were inserted in cases of zonular dialysis and iris hooks were placed to widen the pupil. Fifteen dogs (25 eyes) underwent phacoemulsification, while 4 (4 eyes) received extracapsular cataract extraction (ECCE) surgery due to the difficulty of phacoemulsification in hypermature cataracts. Iris hooks were used in four dogs (8 eyes) for drug-resistant miotic pupils. Capsular tension rings were inserted to stabilize the lens capsule during phacoemulsification and to centralize the intraocular lens (IOL) in the bag. Capsular tension rings in cases of zonular dialysis and iris hooks in drug-resistant miotic pupils improved the success of cataract operations with phacoemulsification. Both are safe and useful for zonular weakness and for maintaining mydriasis during surgery.

Keywords: *Canine, Extracapsular cataract extraction (ECCE), Intraocular lens, Mydriatics, Zonular weakness.*

Köpeklerde Fakoemülsifikasyon Tekniği ile Katarakt Cerrahisinde Kapsül Germe Halkası ve İris Kancası Kullanımı

Özet: Bu çalışmanın amacı, miyotik pupilla ve zonuler zayıflığa sahip köpeklerin fakoemülsifikasyon operasyonunda, kapsül germe halkası ve iris kancalarının kullanımının cerrahi sonuçlarını değerlendirmektir. Çalışmanın materyalini, Şubat 2014 ve Şubat 2015 tarihleri arasında, katarakt cerrahisi için fakoemülsifikasyon (15 köpek/25 göz) ve ekstrakapsüler katarakt ekstraksiyonu (EKKE) (4 köpek/4 göz) uygulanan toplam 19 köpek oluşturdu. Katarakt harici başka bir göz hastalığı olanlar çalışmaya dahil edilmedi. Operasyonlar sırasında pupillada miyosis şekillenen bazı köpeklere iris kancaları, zonüler zayıflığı olanlara ise kapsül germe halkası yerleştirildi. Kapsül germe halkaları aynı zamanda lens kapsülü stabil hale getirmek ve intraokuler lensi (İOL) kapsül içinde sentralize etmek için kullanıldı. Miyosis şekillenen toplam 4 köpekte (8 göz) iris kancaları kullanıldı. Fakoemülsifikasyon işlemi ile katarakt ekstrasksiyonu gerçekleşemeyen 4 köpekte EKKE uygulandı. Zonüler zayıflık için kapsül germe halkaları ile pupillar miyosise karşı iris kancaları kullanımının katarakt operasyonlarının başarısını arttırdığı tespit edildi.

Anahtar Kelimeler: *Ekstrakapsüler katarakt ekstraksiyonu (EKKE), İntraokuler lens, Köpek, Midriyatiks, Miyosis, Zonuler zayıflık.*

Introduction

Cataract is a frequent and common eye disease in canines as well as other animals and the leading cause of blindness (Chen et al., 2023). The most effective treatment is to remove the affected lens material and, if appropriate, replace it with an artificial intraocular lens (IOL) (Dowler et al., 2021). Phacoemulsification is the most popular method due to its high success rates, but it can be affected by drug-resistant miotic pupils, zonular weakness or dialysis, and postoperative posterior capsule opacification, which can impact the short and long-term success (Edelmann et al., 2022).

During phacoemulsification, miotic pupil size can affect lens visualization and cause complications like posterior capsule rupture, potentially leading to nuclear fragments falling into the vitreous (Newbold et al., 2015). If miotics are insufficient to enlarge the small pupil, simple iris dilating techniques, sphincterotomy, iris retractors, or pupil expanders are recommended to simplify the surgery (Sigle and Nasisse, 2006). The iris hooks are inserted into the iris and then gently pulled to stretch and hold the iris open, allowing the surgeon to access the lens. This can be especially helpful in cases where the pupil is too small or not responding to medication that would typically be used to dilate it (Alagoz et al., 2009).

Capsular tension rings (CTR) during phacoemulsification surgery help distribute the force received by the zonules evenly around the circumference. These rings help to stabilize the lens during phacoemulsification surgery. They also inhibit late-term lens epithelial cell migration and prevent decentration. CTR use during phacoemulsification in dog eyes is limited in the literature also (Santosh et al., 2019; Wilkie et al., 2015).

The present study aims to report the outcome of cases undergoing lens extraction surgery via phacoemulsification or extracapsular cataract extraction (ECCE) in dogs. This study conducted capsular tension ring and iris hook use in case of zonular weakness and miotic pupils that are resistant to pharmacologic dilation, respectively.

Materials and Methods

Ethical Statement: The ethical approval of the study was provided by Aydin Adnan Menderes University's Institutional Animal Care and Use Committee (approval number: 2014-075). In this study, a signed information confirmation form was obtained from the patient owners.

Animals: The study material consisted of nineteen dogs (29 eyes) of different ages (mean age 9.75±6.25 years), species, and genders (13 female, 6 male), which were referred to Aydin Adnan Menderes University, Faculty of Veterinary Medicine, Department of Surgery for cataract surgery. Phacoemulsification was performed on 25 eyes of 15 dogs. ECCE surgery was performed on 4 eyes of 4 dogs, due to the challenges of phacoemulsification in cases of hypermature cataracts. Therefore, a total of 29 eyes from nineteen dogs were included in the study.

Clinical Examinations and Anesthesia: An anamnesis, ophthalmoscopic inspection, and reflex examination were performed. Mydriatic was administered to the dogs, and the entire lens was examined with ophthalmoscopy, leading to a diagnosis of cataract. As mature and hypermature cataracts did not allow for retina examination, ultrasonography was performed to check for possible retinal detachment or vitreous hemorrhage. Ten dogs had senile, 8 had traumatic and 1 had metabolic (diabetic) cataracts. Three of them were immature, 7 of them were hypermature and 19 of them were mature morphologically in 29 eyes.

All animals diagnosed with cataracts and scheduled for operative intervention are recommended to use corticosteroid drops (1% prednisolone sodium phosphate, Norsol®, Mefar İlaç Sanayi A.Ş, Türkiye) and antibiotic drops (0.3% ofloxacin, Exocin®, Allergan AbbVie Company, Ireland) five times a day, two drops in each eye, starting seven days before the surgery to the day of the operation to prevent secondary uveitis. To achieve mydriasis, topical tropicamide 0.5% (Tropamid®, Mefar Ilac Sanayi A.Ş, Türkiye), phenylephrine HCl 2.5% (Mydfrin®, Alcon Laboratories Ticaret A.Ş, Türkiye), and cyclopentolate HCl 1% (Siklоplejin®, Abdi Ibrahim Ilac Sanayi ve Ticaret A.Ş, Türkiye) were applied at 10-minute intervals, respectively. After adequate mydriasis was achieved, the dogs were anesthetized. Induction of all cases was achieved by intramuscular injection of atropine sulfate 2% (Atropin® %2, Deva Holding A.Ş, Türkiye) at a dose of 0.045 mg/kg, xylazine hydrochloride 2% (Alfazyne® %2, Alfasan International, Holland) at a dose of 1-2 mg/kg, and ketamine hydrochloride 10% (Alfamine® 10%, Alfasan International, Holland) at a dose of 11 mg/kg. After induction, the patients were intubated and general anesthesia was maintained with 1-3% isoflurane (Isoflurane®, Piramal Critical Care, USA).

Surgery Technique: After intubation, the dogs were placed in a decubitus position on the operating table. The head, cornea, and eyeball were positioned under the operating microscope parallel to the ceiling (Fig. 1). The hair

Figure 1. The decubitus position of the patient under a microscope.

around the eyelids was shaved, and the skin was cleaned with a 5% povidone-iodine solution. The ocular surface was irrigated with physiological saline after the instillation of 0.5-

1% povidone-iodine (Poviodine®, Tosel İlac Sanayi A.S, Türkiye) solution. To manipulate the eyeball, 4/0 non-absorbable silk material was placed in the superior rectus as a sling.

The operation started with a 1.1 mm wide side-port incision from the limbus at the 3 and 9 o'clock positions (Fig. 2a). Trypan blue 0.06% (Ocublu®, Miray Medical, Türkiye) was directly applied onto the anterior capsule of the lens to stain it in mature cataracts after injecting an air bubble into the anterior chamber from the temporal side port, with a dosage ranging from 0.5 to 1.5 ml. (Fig. 2b). Three seconds later, the anterior chamber was irrigated with Ringer lactate solution (Polifleks Laktat Ringer®, Polifarma İlaç Sanayi ve Tic. A.Ş, Türkiye) to eliminate the toxic effect of Trypan blue on corneal endothelial cells. To maintain anterior chamber depth, viscoelastic material (Bio-Hyalur SV®, BioTech, India) was injected (Fig. 2c).

Following a 2.8 mm main entrance incision at 12 o'clock, a tear was created on the capsule with a cystotome (Fig 3a). A smooth 360-degree circular opening was created in the center of the anterior capsule by holding the edge of this tear with utrata forceps (Fig. 3b, 3c). Attention was paid to ensuring the diameter of the capsulorhexis was 1 mm smaller than the optic diameter of the IOL to be inserted. The capsule and the lens were separated from each other using a flat-ended 27G hydro dissection cannula. (Fig. 3d). The lens was rotated within the capsule to ensure that hydro dissection had occurred.

After hydro dissection, the phaco device (MTP 2000 phacoeumulsifer, USA) was operated at 30 joules of ultrasound energy, 50 watts of aspiration power, and 450 mmHg vacuum. The lens was dissected using the phaco-chop technique with the help of a phaco chopper and the nucleus was fragmented and emulsified (Fig. 4a, 4b, 4c). In 4 cases where there was a posterior capsule rupture and wide zonular dialysis extending to 180 degrees, the corneal incision was enlarged, and the cataract was extracted using the extracapsular cataract extraction (ECCE) technique (Fig. 5).

In cases with insufficient pupillary dilatation and zonule weakness (Fig. 6a), iris hooks (IrisCare, Madhu Instruments, India) were placed through both side ports. Additionally, new small side ports at 1, 4, and 5 o'clock positions to achieve pupil dilation. The plugs at the end of the iris hooks were pulled towards the free end and inserted through the incision. After the hook part was attached to the iris and the capsule, the plug was pushed towards the hook and placed in front of the cornea. The iris hooks were attached to the edge of the capsulorhexis to reduce the strain on the zonules and simultaneously dilate the pupil (Fig. 6b, 6c). Placement of the iris hooks in these positions allowed for the successful completion of the phacoemulsification stage by providing adequate pupil dilation.

In addition to iris hooks, a 13 mm capsular tension ring (CTR, Freedom Capsuler Tension Ring, India) was placed inside the capsule to support the zonules in cases of zonular weakness. The CTR was inserted after cortical aspiration and before IOL implantation, using tying forceps in both hands without a CTR injector. One open end of the CTR was slowly guided into the capsule. When inserting the CTR follow the curvature of the capsule bag. The y-tipped manipulator was inserted into the hole and supported the ring as the ring was placed into the correct position. The CTR was useful during the IOL implantation stage for the IOL stabilization and centralization (Fig. 7).

Residual cortical material was removed using irrigation/aspiration cannulas which were inserted from the side ports at 450-600 mmHg aspiration parameters (Fig. 8a). Once the stability of the anterior chamber was achieved, 1–1.5 ml of 1% Na-hyaluronate (Bio-Hyalur SV®, BioTech, India) was injected into the anterior chamber and a foldable 41 D hydrophilic-acrylic IOL (Eyecryl Plus, BioTech, India) was inserted through the 3.2 mm incision with an IOL injector (Fig. 8b). After the IOL implantation, the viscoelastic material was removed using an irrigation-aspiration procedure. The corneal incisions were closed by hydrating the corneal edges of the incisions for anterior chamber stabilization. Corticosteroid drops (%0.1 dexamethasone, Maxidex®, Alcon Couvreur N.V, Belgium) and antibiotic drops (0.3% ciprofloxacin, Ciloxan®, Rijksweg, Belgium) were injected into the anterior chamber at a dose of 0.3 mL to prevent possible infection and inflammation (Fig. 8).

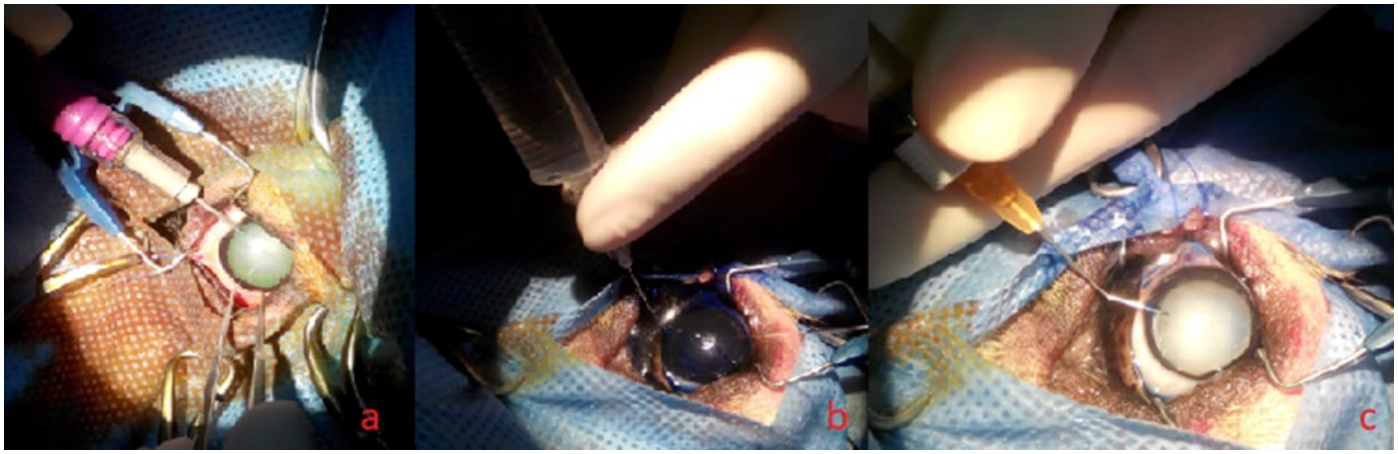

Figure 2. a: Side-ports at 3 and 9 o'clock, b: Trypan blue injection under air bubble, c: injection of viscoelastic material.

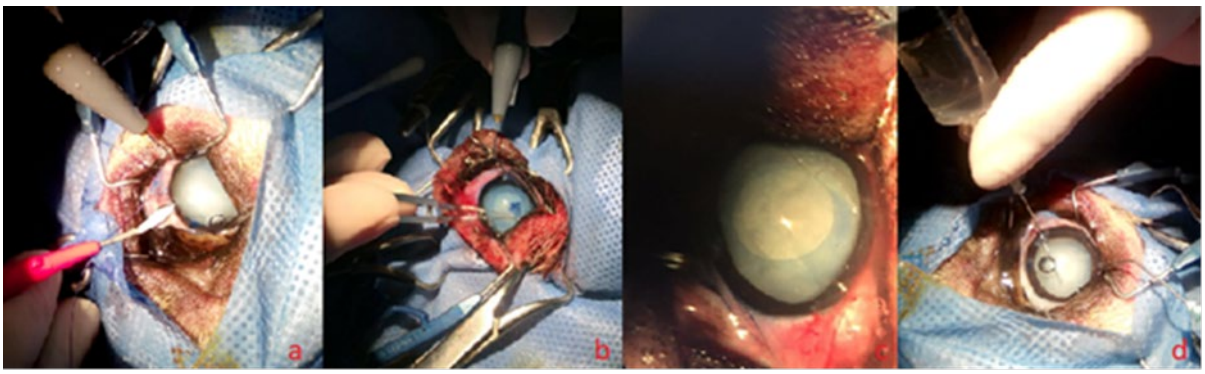

Figure 3. a: Main incision at 12 o'clock, b: Capsulorhexis procedure, c: Circumferential curvilinear capsulorhexis of the lens capsule, d: Hydrodisection of the lens from the capsule.

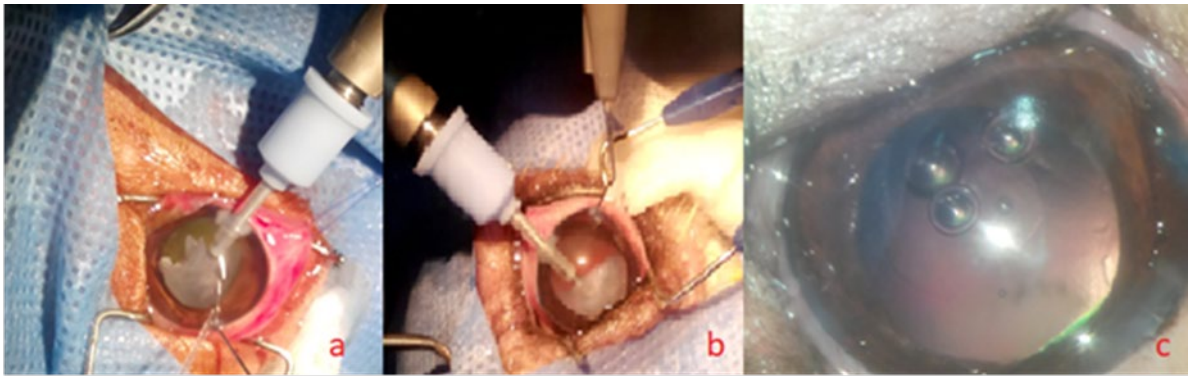

Figure 4. Steps of phacoemulsification (Phaco-chop technique).

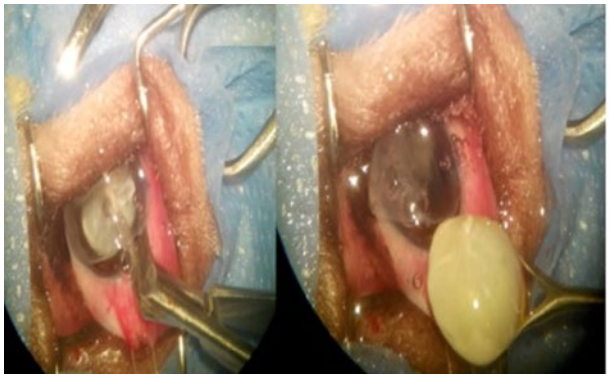

Figure 5. The stages of ECCE.

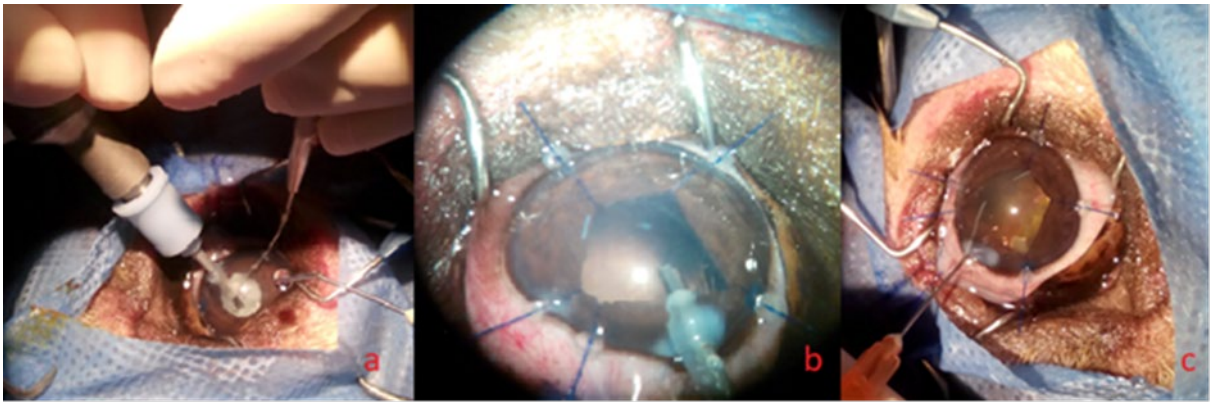

Figure 6. a: Pupillary miosis during phacoemulsification, b-c: İris hooks.

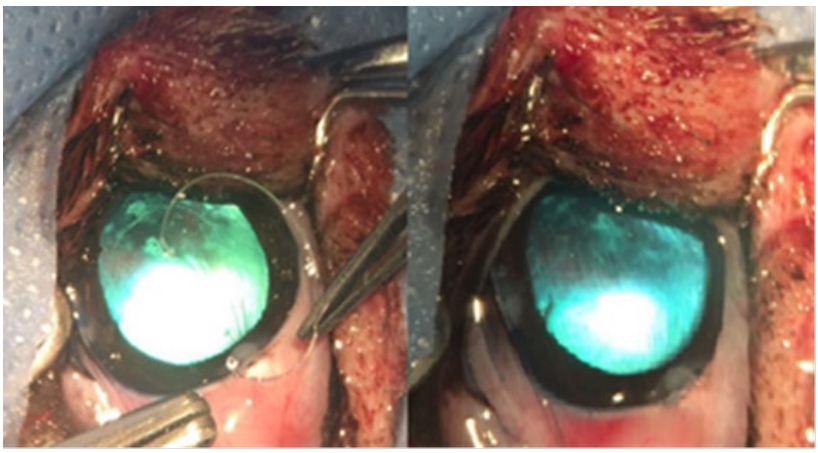

Figure 7. Implantation of CTR

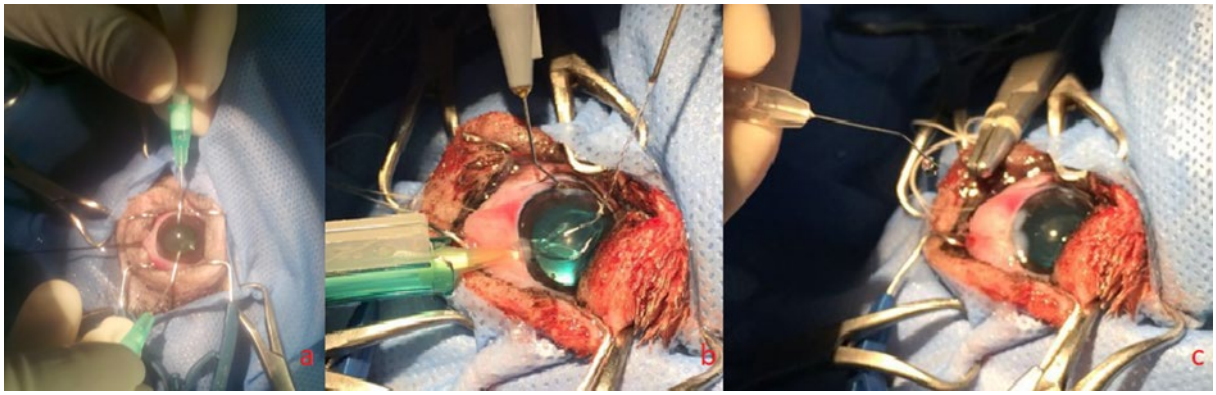

Figure 8. a: İrrigation aspiration of cortex materials, b: İmplantation of IOL, c: The closure of the incisions with corneal hydration.

Results

In our study, phacoemulsification was performed in 15 (25 eyes) cases and ECCE was performed in 4 cases (4 eyes) for cataract surgery. IOL was implanted in 13 cases (23 eyes) after phacoemulsification and in 1 case (1 eye) after ECCE, while 5 cases were left aphakic. The demographic data of the dogs are summarized in Table 1. Plausible improvement in vision was reported by the owners and confirmed by clinical examinations in 14 cases. However, in 5 cases, a slight improvement in vision was not achieved due to postoperative complications such as corneal edema, bullous keratopathy, anterior uveitis, formation of posterior pupillary membrane, anterior synechia, glaucoma, and posterior capsule opacification in the early postoperative period.

Intraoperative complications and management strategies: In four of our cases (8 eyes), mydriatic drugs were unable to achieve mydriasis. Therefore we placed iris hooks through the side ports at the edge of the iris and capsulorhexis borders to continue phacoemulsification. Iris hooks supported the capsule and dilated the pupil, allowing us to perform phacoemulsification safely.

In 14 cases (24 eyes), the capsulorhexis was performed in a circular shape and desired size, while in 5 cases (5 eyes), it was small and asymmetric due to zonular weakness. In those cases, we implanted CTR to support lens zonules and avoid anterior chamber collapse during high vacuum. After lens removal, CTR was implanted in the capsule bag to centralize the IOL.

It was challenging to break the nucleus in 2 hypermature cases, so we had to use high ultrasound power and vacuum. Unfortunately, the increased ultrasound power led to a corneal burn approximately 2x2 mm in size at the main incision site. It has been revealed that high ultrasonic power and vacuum should not be used for performing phacoemulsification in cases of hypermature cataracts.

The anterior chamber was shallow at the end of the IOL implantation in 6 cases, so we tied the main corneal incision to cease the leakage and maintain anterior chamber depth. While in 13 cases, corneal hydration was enough to stabilize the anterior chamber.

As indicated in the literature, some complications were encountered after the phacoemulsification operation. Corneal edema was observed in all cases. However, bullous keratopathy was seen only in one patient in the late postoperative period. Anterior uveitis, anterior synechia, and pupillary membrane developed in 3 cases. Posterior capsule opacification developed in the late period in one of our patients and decreased the visual outcome. Intraocular pressure did not elevate in any of our patients, but retinal detachment was seen in one case. Endophthalmitis did not develop in any of the patients. With these results in 5 cases, a slight improvement in vision was not achieved.

Table 1. Demographic data of the dog patients.

Case No	Species	Etiology	Stage of the Cataract	
			Right Eye	Left eye
1	Terrier	Senile	Mature cataract	Mature cataract
2	Terrier	Senile	Hypermature cataract	Hypermature cataract
3	Golden Retriever	Traumatic	-	Hypermature cataract
4	Spaniel Cocker	Senile	Mature cataract	Mature cataract
5	Husky	Senile	Mature cataract	Mature cataract
6	Pinscher	Senile	Mature cataract	Hypermature cataract
7	Golden Retriever	Traumatic	Immature cataract	Hypermature cataract
8	Terrier	Senile	Hypermature cataract	Hypermature cataract
9	Pinscher	Senile	Mature cataract	Hypermature cataract
10	Terrier	Senile	Mature cataract	Mature cataract
11	Golden Retriever	Traumatic	Immature cataract	Mature cataract
12	Pug	Traumatic	Mature cataract	Mature cataract
13	Spaniel Cocker	Senile	Mature cataract	Mature cataract
14	Golden Retriever	Senile	Mature cataract	Mature cataract
15	Terrier	Metabolic	Mature cataract	Mature cataract
16	Chihuahua	Traumatic	Mature cataract	Immature cataract
17	Spaniel Cocker	Traumatic	Mature cataract	Mature cataract
18	Pug	Traumatic	Mature cataract	Mature cataract
19	Spaniel Cocker	Traumatic	Mature cataract	Mature cataract

Discussion and Conclusion

The goal of cataract surgery is to preserve the integrity of the eye and achieve the best possible visual outcomes with minimal complications. The utilization of the phacoemulsification method in cataract surgery is growing in popularity due to its various advantages. These include reducing the surgical duration, enabling smaller incisions, and facilitating faster postoperative visual recovery. Additionally, this method enables the implantation of an IOL to correct postoperative aphakia (Newbold et al., 2015).

Intraoperative complications of cataract surgery include posterior capsule rupture, which is the most common intraoperative complication associated with phacoemulsification in dogs (Johnstone and Ward, 2005). The posterior capsule tears usually occur due to excessive manipulation in difficult cases. The vitreous may move anteriorly and cause several complications such as ocular hypertension, retinal detachment, bacterial contamination, endophthalmitis, and decentralization of intraocular lens implants. If the posterior capsule is perforated during surgery, a vitrectomy can be performed to reduce the risk of glaucoma (Maggs et al., 2010). We performed anterior vitrectomy on our patients after posterior capsule rupture to avoid the aforementioned complications.

Small pupils, or miotic pupils, can be a challenge during cataract surgery. Myotic pupils have various reasons such as aging, posterior synechiae, trauma, chronic use of miotics, diabetes, syphilis, pseudoexfoliation, and uveitis (Dularent et al., 2023; Kershner, 2002). Additionally, factors such as prolonged time for corneal incision and anterior capsulotomy, frequent iris touch, excessive use of irrigation fluid during phacoemulsification, and prolonged surgery time may also contribute to small pupil formation (Saroglu, 2013). In cases where mydriatics are insufficient to enlarge the small pupil, various techniques such as simple iris dilating techniques, sphincterotomy, iris retractors, or pupil expanders are recommended (Vasavada and Singh, 2000). In human eyes, iris hooks are widely used to mechanically dilate the pupil and prevent complications (Balal et al., 2021; Nderitu and Ursell, 2019). However, there is limited literature on the use of iris hooks in canine eyes. In our study, we encountered resistant miosis in 4 cases (8 eyes) during phacoemulsification, which may have been due to iris touch and prolonged surgery time. In these cases, we used iris hooks to dilate the pupil and were able to complete the surgery successfully. We hope that sharing our experiences with the use of iris hooks can help other veterinary surgeons facing similar challenges during cataract surgery.

The CTR was first introduced in 1991 and was used in the first human eye during cataract surgery in 1993. The CTR is an open band-shaped ring made of polymethyl methacrylate (PMMA). The ring dimensions are 0.2 mm in thickness, 0.7 mm in width, 11.0 mm in diameter when closed, and 13.0 mm in diameter when open (Nishi et al., 1998). It was designed to be permanently implanted into the capsular bag and has blunt-tipped eyelets on both ends (Bayraktar et al., 2001). CTR may mechanically compress the capsule and shorten the distance between the IOL and capsular bag due to its square cross-section and sharp edges. Thus, according to some researchers, it inhibits the migration of lens epithelial cells (LECs) and retards the development of posterior capsuler opacification (Menapece et al., 2008). In the literature, the use of CTR during surgery reduced the risk of posterior capsule rupture. This study compared two canine groups with CTR and without CTR in phacoemulsification (Wilkie et al., 2015). Some researchers reported the usefulness of the CTR in the prevention of

posterior capsule opacification till the 210th day of the postoperative period (Santosh et al., 2019). However, both studies did not provide information on the intraoperative benefits of the CTR in difficult cases such as zonular weakness. Many investigators implanted CTR before phacoemulsification (Jacob et al., 2003; Ma and Li, 2014), while others implanted CTR after cortical aspiration and before IOL implantation (Ahmed et al., 2005; Praveen et al., 2003). In our study, we used the CTR in both stages depending on the amount of zonular dialysis and phacodonesis. The implantation of CTR allowed us to continue phaco safely and to implant IOL in the center of the bag. Additionally, the posterior capsule opacification rate was quite low in the early postoperative period.

The hydrophobic or hydrophilic structure of intraocular lenses made of silicone is important. Although hydrophobic acrylic IOLs have a lower incidence of posterior capsule opacification and better biocompatibility, they can cause phimosis or severe opacification at the anterior capsule edge. On the other hand, hydrophilic acrylic IOLs have a higher incidence and severity of posterior capsule opacification, but less lens epithelial cell metaplasia and anterior capsule fibrosis (Kugelberg et al., 2006). In our study, 14 out of 19 cases (24 eyes) had hydrophilic acrylic IOLs implanted, while 5 cases were left aphakic. Contrary to the literature, in the acute phase, phimosis was observed very quickly in the anterior capsule within the first 0-6 hours, but uveitis and pupillary membrane decreased afterward. No posterior capsule opacification was observed in any of the cases.

Following cataract surgery, several complications may be encountered, albeit not necessarily common. These complications include lagophthalmos, corneal ulceration, iris bombe, corneal opacities, chemosis, hypopion, focal posterior synechiae, capsular phimosis, glaucoma, retinal detachment, corneal edema, and endophthalmitis (Sigle and Nasisse, 2006). In all cases, corneal edema was observed after surgery. These complications are thought to be due to intraoperative complications such as deterioration of endothelial pump function as a result of high ultrasonic energy, high vacuum values, and long working hours. Also the failure of the pet owners to comply with the postoperative medical treatment procedures. To treat corneal edema, a 5% NaCl solution was instilled in the cornea in the postoperative period. Corneal edema disappeared by the end of the second week in the phaco group, while in those undergoing ECCE for hypermature cataracts, this period was extended.

Dogs are living longer due to the efforts of conscious dog owners who provide good living conditions for their pets. However, there is often a lack of sensitivity when it comes to scheduling routine eye examinations for dogs. This can lead to the detection of cataracts in very advanced stages and increase the risk of complications during surgery. In this study, we aimed to present the short-term results of using iris hooks and capsular tension rings in cases of resistant pupillary miosis, small pupils, and zonular weakness, which are the primary causes of complications. While a limited number of reports have shown that capsular tension rings can also prevent posterior capsular opacification in the long term, preventing the formation of this opacity is crucial for providing dogs with visual rehabilitation for many years. We believe that randomized controlled clinical studies with larger participant populations and long-term results are necessary.

Conflict of Interest

The authors stated that they did not have anyreal, potential or perceived conflict of interest.

Ethical Approval

This study was approved by the Mugla Sıtkı Kocman University Animal Experiments Local Ethics Committee (2014-075 Number Ethics Committee Decision). In addition, the authors declared that Research and Publication Ethical rules were followed.

Funding

This study was supported by *Aydın Adnan Menderes University as scientific research,* (Project Number: VTF15046).

Similarity Rate

We declare that the similarity rate of the article is 15% as stated in the report uploaded to the system.

Explanation

It was presented as a fully paper at the I. International Makuvet Applied Education Congress (2018). And it was summarized from the 1st author's doctoral thesis with the same name.

Author Contributions

Motivation / Concept: OB, AB
Design: OB, AİAÜ
Control/Supervision: OB, AİAÜ, AB
Data Collection and / or Processing: OB, AİAÜ, AB
Analysis and / or Interpretation: OB, AİAÜ, AB
Literature Review: OB, AİAÜ, AB
Writing the Article: OB, AİAÜ, AB
Critical Review: OB, AİAÜ, AB

References

Ahmed IK, Cionni RJ, Kranemann C, Crandall AS, 2005: Optimal timing of capsular tension ring implantation: Miyake-Apple video analysis. *J Cataract Refract Surg*, 31, 1809-1813.

Alagoz G, Yalcin A, Serin D, Sahap Kukner A, Elcioglu M, Celebi S, 2009: Fakodonezisli Katarakt Olgusunda İris Germe Kancaları ile Lensin Korneaya Asılması. *Duzce Uni Tip Fak Derg*, 11, 48-50.

Balal S, Jbari AS, Nitiahpapand R, Cook E, Akhtar W, Din N, Sharma A, 2021: Management and outcomes of the small pupil in cataract surgery: iris hooks, plugin ring or phenylephrine? *Eye*, 35, 2714-2718.

Bayraktar S, Altan T, Kucuksumer Y, Yilmaz OF, 2001: Capsular tension ring implantation after capsulorhexis in phacoemulsification of cataracts associated with pseudoexfoliation syndrome. Intraoperative complications and early postoperative findings. *J Cataract Refract Surg*, 27, 1620-1628.

Chen TM, Lasarev MR, Eaton JS, 2023: Retrospective investigation of perioperative risk factors for immediate postoperative corneal erosions in dogs undergoing phacoemulsification. *Vet Ophthalmol*, 26, 191-204.

Dowler KK, Middleton JR, Dufour S, Hood AM, Giuliano EA, 2021: Characterization of postoperative ''fibrin web'' formation after cataract surgery. *Vet Ophthalmol*, 24, 37-47.

Dularent T, Steun L, Isard PF, 2023: Eye trauma from a cat scratch with retention of the claw in the anterior chamber in a dog. *Open Vet J*, 13, 388-393.

Edelmann ML, Mohammed HO, Ledbetter EC, 2022: Retrospective evaluation of phacoemulsification and aspiration in 182 eyes: Visual outcomes and CDE-predictive value. *Vet Ophthalmol*, 25, 316-325.

Jacob S, Agrawal A, Agrawal S, Patel N, Lal V, 2003: Efficacy of capsular tension ring for phacoemulsification in eyes with zonular dialysis. *J Cataract Refract Surg*, 29, 315-321.

Johnstone N, Ward DA, 2005: The incidence of posterior capsule disruption during phacoemulsification and associated postoperative complication rates in dogs: 244 eyes (1995-2002). *Vet Ophthalmol*, 8, 47-50.

Kershner RM, 2002: Management of the small pupil for clear corneal cataract surgery. *J Cataract Refract Surg*, 28, 1826-1831,

Kugelberg M, Wejde G, Jayaram H, Zetterstrom C, 2006: Posterior capsule opacification after implantation of a hydrophilic or a hydrophobic acrylic intraocular lens: One-year follow-up. *J Cataract Refract Surg*, 32, 1627-1631.

Ma X, Li Z, 2014: Capsular tension ring implantation after lens extraction for management of subluxated cataracts. *Int J Clin Exp Pathol*, 7, 3733-3738.

Maggs DJ, Nasisse MP, Marrion RM, Priddy NH, Doham JR, 2010: Effects of intracameral administration of α – chymotrypsin on intracapsular lens extraction and postoperative outcome in clinically normal dogs. *Am J Vet Res*, 71, 1475-1483.

Menapace R, Sacu S, Georgopoulos M, Findl O, Rainer G, Nishi O, 2008: Efficacy and safety of capsular bending ring implantation to prevent posterior capsule opacification: Three-year results of a randomized clinical trial. *J Cataract Refract Surg*, 34, 1318-1328.

Nderitu P, Ursell P, 2019: Iris hooks versus a pupil expansion ring: Operating times, complications, and visual acuity outcomes in small pupil cases. *J Cataract Refract Surg*, 45, 167-173.

Newbold GM, Kelch WJ, Chen T, Ward DA, Hendrix DV, 2015: Phacoemulsification outcomes in Boston terriers as compared to non-Boston terriers: a retrospective study (2002–2015). *Vet Ophthalmol*, 21, 353-361.

Nishi O, Nishi K, Mano C, Ichihara M, Honda T, 1998: The inhibition of lens epithelial cell migration by a discontinuous capsular bend created by a band-shaped circular loop or a capsule-bending ring. *Ophthalmic Surg Lasers*, 29, 119-125.

Praveen MR, Vasavada AR, Singh R, 2003: Phacoemulsification in subluxated cataract. *Indian J Ophthalmol*, 51, 147-154.

Santosh HK, Ranganath L, Nagaraja BN, Satyanarayana ML, Narayanaswamy M, 2019: Studies on the influence of capsular tension ring (CTR) on intraocular lens (IOL) implantation following phacoemulsification in cataractous dogs. *J Entomol Zool Stud*, 7, 1071-1078.

Saroğlu M, 2013: Kedi ve Kopek Goz Hastaliklari. 2nd ed., Nobel Tip Kitabevleri, Türkiye.

Sigle KJ, Nasisse MP, 2006: Long-term complications after phacoemulsification for cataract removal in dogs: 172 cases (1995–2002). *J Am Vet Med Assoc*, 228, 74-79.

Vasavada A, Singh R, 2000: Phacoemulsification in eyes with a small pupil. *J Cataract Refract Surg,* 26, 1210-1218.

Wilkie DA, Hoy SS, Metzler AG, Colitz CMH, 2015: Safety study of capsular tension ring use in canine phacoemulsification and IOL implantation. *Vet Ophthalmol,* 18, 409-415.