COMPARISON OF DIAMOND BURR DEBRIDEMENT WITH SOFT CONTACT BANDAGE LENS AND CORNEO-CONJUNCTIVAL TRANSPOSITION FOR TREATMENT OF CORNEAL ULCER IN DOG

THESIS

Submitted

In partial fulfillment of the requirements for the Degree of

MASTER OF VETERINARY SCIENCE

IN

VETERINARY SURGERY AND RADIOLOGY

BY

KAMAT NIRALI MILIND

Enrollment No. :V/13/144

Mumbai Veterinary College, Mumbai

MAHARASHTRA ANIMAL AND FISHERY SCIENCES UNIVERSITY, NAGPUR – 440 001

(INDIA)

2021

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Dedicated To…
My Beloved Parents

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DECLARATION OF STUDENT

I hereby declare that the experimental research work and interpretation of the thesis entitled "**COMPARISON OF DIAMOND BURR DEBRIDEMENT WITH SOFT CONTACT BANDAGE LENS AND CORNEO-CONJUNCTIVAL TRANSPOSITION FOR TREATMENT OF CORNEAL ULCER IN DOG.**" or part thereof has not been submitted for any other degree or diploma of any University, nor the data have been derived from any thesis/publication of any University or scientific organization. The sources of the materials used and all assistance received during the course of any investigation have been duly acknowledged.

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DECLARATION OF ADVISORY COMMITTEE

Kamat Nirali Milind has satisfactorily prosecuted his course of research for a period of not less than one semester and that the thesis entitled **"COMPARISON OF DIAMOND BURR DEBRIDEMENT WITH SOFT CONTACT BANDAGE LENS AND CORNEO-CONJUNCTIVAL TRANSPOSITION FOR TREATMENT OF CORNEAL ULCER IN DOG"** submitted by him is the result of research work is sufficient to warrant its presentation to the examination in the subject of Veterinary Surgery and Radiology for the award of Master of Veterinary Science (M. V. Sc.) degree by the Maharashtra Animal and Fishery Sciences University, Nagpur.

We also certify that the thesis or part thereof has not been previously submitted by him for a degree of any other University.

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III)	Dr. R. R. Rohi	Assistant Professor, Department of Veterinary Surgery and Radiology	
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CERTIFICATE

This is to certify that the thesis entitled **"COMPARISON OF DIAMOND BURR DEBRIDEMENT WITH SOFT CONTACT BANDAGE LENS AND CORNEO-CONJUNCTIVAL TRANSPOSITION FOR TREATMENT OF CORNEAL ULCER IN DOG"** submitted by **Ms. Kamat Nirali Milind** of the Maharashtra Animal Sciences University, Nagpur, in partial fulfillment of the requirement for the degree of Master of Veterinary Science has been approved by the Student's Advisory Committee after examination in collaboration with the External Examiner.

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"One piece of log creates a small fire, adequate to warm you up, add just a few more pieces to blast an immense bonfire, large enough to warm up your entire circle of friends; needless to say that individuality counts but teamwork dynamites." – Jin Kwon

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Place: Mumbai Nirali Milind Kamat

Date:

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LIST OF ABREVIATIONS

Abbreviations	Full Form
ALT	Alanine aminotransferase
AST	Asparatate aminotransferase
ALP	Alkaline phosphatase
bpm	Beats per minute
BSDPHA	Bai Sakarbai Dinshaw Petit Hospital for Animals
BID	*Bis in die* (Latin)- two times a day
BUN	Blood Urea Nitrogen
BW	Body weight
b.wt	Body weight
cm	Centimeter
CRI	Constant rate infusion
EDTA	ethylenediaminetetraaceticacid
et al.	*Et alia* (Latin)- And others
Fig.	Figure
g %	Gram percent
HR	Heart rate
hrs	Hours
Hb	Haemoglobin
IU/L	International Units per Litre
IOP	Intraocular pressure
i.e.	That is
IV	Intravenous
i.v	Intravenous
i/v	Intravenous
Kg	Kilograms

KCS	Keratoconjunctivitis sicca
MELE	Medial entropion of the lower eyelid
min	Minute
mg/kg	Milligram per kilogram
millions/mm^3	Millions per cubic millimeter
ml	Mililitre
mm	Millimeter
mm^3	Cubic millimeter
No.	Number
NS	Normal saline
PCV	Packed Cell Volume
pH	Power of hydrogen
ppm	Pulse per minute
s/q	Subcutaneous
S.E	Standard error
SCCED	Spontaneous chronic corneal epithelial defects
thousands/mm^3	Thousands per cubic millimeter
Tab	Tablet
TEC	Total Erythrocyte Count
TLC	Total Leucocyte Count
viz.	namely
wt	Weight
yrs	Years
°F	Degree Fahrenheit

1. INTRODUCTION

Eyes are an important sensory organ in a living individual. They communicate by means of it with the same species or with heterospecific individuals like humans. The repertoire of visual, acoustic and olfactory signals is vast in dogs (Siniscalchi *et al*., 2018).

One of the most common ocular affections in dogs is corneal ulcers. The outer fibrous coat of the eye consists of the opaque sclera to the posterior and the transparent cornea at the anterior aspect. The translucent bulbar conjunctiva covers the anterior most aspect of the sclera. The limbus is the point where the sclera, cornea and the bulbar conjunctiva merge. The cornea is made up of four layers namely the stratified squamous epithelium externally, collagenous stroma, descemet's membrane and endothelium internally. The most powerful refracting surface of the eye is the cornea. This ability is mainly because of the appropriate corneal curvature and its transparency. The transparency is maintained by special attributes like the lack of blood vessels and pigment (melanin), a smooth surface owing to the precorneal tear film, a high level of regular arrangement of the stromal collagen fibrils and the lack of keratinization (Maggs, 2008).

A corneal ulcer is a break in the corneal epithelium and exposes the underlying stroma of the cornea. Clinically the presence of a corneal ulcer may result in blepharospasms, corneal edema, photophobia, lacrimation, aqueous flare and miosis (Ledbetter and Gilger, 2013).

The abrasion of the corneal epithelium is a continuous process aided by blinking normally and replaced with normal cells. This physiological phenomenon helps to reduce the development of corneal ulcers. The cornea is mainly protected by the tear film along with both the eyelids (upper and lower) and also the third eyelid. Any deflection from normal production, retention or dispersion of the tear film and excessive corneal abrasion can result in corneal ulceration. Corneal ulcers may be caused because of other endogenous causes like abnormal eyelashes and their positioning (Maggs, 2008) such as aberrant cilia (distichia) and ectopic cilia, eyelid position and abnormalities like

lagopthalmos, trichiasis, entropion, ectropion and blepharitis (Brooks, 2005). Corneal ulcers caused due exogenous causes may include foreign body, trauma, bacterial and viral infection (Maggs, 2008).

Corneal ulcers are classified on the basis of the depth of the corneal involvement into the following four categories namely superficial corneal ulcers, stromal corneal ulcers, descemetocele, and perforations (Ledbetter and Gilger, 2013).

Superficial ulcers heal rapidly without complications within 7 days with topical treatment and prevention of self trauma (Maggs, 2008). Usually only medical therapy using topical antibiotics, artificial tears and mydriatic-cycloplegic drugs is enough to prevent or eliminate infection, alleviate pain and discomfort and facilitate healing (Wilkie and Whittaker, 1997).

Stromal ulcers (deep corneal ulcers) involves the corneal stroma and is also rapidly progressing causing stromal loss, stromal melting and sometimes exposing the descemet's membrane causing a descemetocele, if it has microbial infection. This may result in scar formation and impaired vision. Complicated corneal ulcers persists for more than 7 days. Spontaneous rupture of the descemet's membrane can cause rupture of the eyeball also resulting in iris prolapse (Maggs, 2008).

Successful treatment of deep corneal ulcers is not possible by employing only medical therapy, hence surgical intervention is indicated in deep corneal ulcers where more than 50% of the corneal thickness is involved (Ledbetter and Gilger, 2013).

The principle behind the surgical treatment of deep corneal ulcers is to protect the corneal surface during the corneal healing process by providing mechanical support to the weakened cornea and retarding the corneal stromal 'melting' thereby preventing the progression of corneal ulceration (Wilkie and Whittaker, 1997).

Surgical procedures that can be employed for the treatment of corneal ulcers include corneal debridement, third eyelid flaps, amniotic, conjunctival

membrane (or other body membrane) transposition, corneal and synthetic or bioengineered grafts (Ledbetter and Gilger, 2013).

Diamond burr debridement removes the abnormal membrane and non-adherent epithelial cells without penetrating into normal stroma and is safe to use in dogs. Diamond burr debridement in conjunction with soft contact bandage lens improves healing by protecting the migrating epithelial cells and improves patient comfort by covering the exposed corneal nerves (Rienstein, 2019).

It is thought that bandage contact lenses helps in improving the healing of the migrating epithelial cells by protecting them and covering the exposed cornea, it also helps in increasing patient comfort (Rienstein, 2019).

Third eyelid flaps are contraindicated in most corneal ulcers as they do not provide blood supply nor fibrovascular tissues to the corneal ulcer. They interfere with the penetration of topical medications, facilitate retention of inflammatory exudate adjacent to the ulcer and make it difficult to monitor disease progression/healing by covering the normal cornea (Wilkie and Whittaker, 1997).

A conjunctival flap or graft is a surgical procedure used for chronic, progressive or infected corneal ulcers however, conjunctival tissue may not always be strong enough to maintain corneal integrity and provide mechanical support. It may even cause considerable scarring of the conjunctival tissue over the ulcerated cornea even after dissection of the pedicle. Therefore, other tissues with better structural integrity may help in overcoming these problems like, the cornea (Jaksz and Busse, 2017).

Corneo-Conjunctival transposition is an example of autologous sliding lamellar keratoplasty where in a corneal pedicle attached to the limbus and conjunctiva is used for repairing a corneal defect (Jaksz and Busse, 2017). Deep axial corneal ulcers and perforations are treated with this surgical procedure as it serves to transpose healthy cornea into the axial location, maintaining a clear axial cornea while repairing the defect. (Wilkie and Whittaker, 1997).

This procedure is advantageous owing to the use of own tissue resulting in decreased corneal scarring and therefore leading to a more transparent cornea post operatively. Since the cornea remains attached to the conjunctiva, it enhances the viability of the graft and after a lag period provides vascularization of the corneal defect (Jaksz and Busse, 2017). However sufficient documented research is not available in Indian conditions. Therefore, this research project title "**Comparison of diamond burr debridement with soft contact bandage lens and corneo-conjunctival transposition for treatment of corneal ulcer in dog**," has been undertaken with the following objectives:-

Objectives:

1. To study the prevalence and etiological factors of corneal ulcers in dogs selected in the research study.
2. To evaluate the efficacy of diamond burr debridement with soft contact bandage lens and corneo-conjunctival transposition for the treatment of corneal ulcers in dogs.
3. To evaluate the efficacy of diamond burr debridement with soft contact bandage lens as compared to corneo-conjunctival transposition for the treatment of corneal ulcers in dogs.

2. REVIEW OF LITERATURE

The present study entitled "Comparison of diamond burr debridement with soft contact bandage lens and corneo-conjunctival transposition for treatment of corneal ulcer in dog" was undertaken in 12 healthy dogs.

Review of literature has been described below as:

2.1: Review of literature on corneal ulcers.
2.2: Review of literature on diamond burr debridement.
2.3: Review of literature on soft bandage contact lens.
2.4: Review of literature on corneo-conjunctival transposition.
2.5: Review of literature on diagnostic techniques for corneal ulcers.
2.6: Review of literature on ocular microbiology.
2.7: Review of literature on physiological parameters and hematology.
2.8: Review of literature on ocular therapeutics.
2.9: Review of literature on corneal healing.

2.1: Review of literature on corneal ulcers

2.1.1 Incidence of corneal ulcers in dogs

2.1.1.1 Age

Wilkie and Whittaker (1997) stated that dogs of any age or sex could be affected. However, older dogs of certain breeds such as golden retriever, corgi, boxer and miniature poodle were more susceptible to corneal ulceration.

Murphy *et al.* (2001) observed spontaneous chronic epithelial defects more in middle-aged and elderly dogs in breeds like Boxers, Golden retrievers

and Keeshonds with higher incidence of corneal ulceration found in age group 1- 3 years (50%) followed by 4-7 years (29%) and above 8 years (21%).

Moore (2003) reported that Boxer was the most common breed in over 45 different breeds with highest incidence 24.56% of corneal ulceration, followed by mixed breeds 11.03% but a high number of cases occurred in Corgis, Labradors, GSD, poodles, Golden retrievers and Springer spaniels.

Ramani *et al.* (2012) reported the highest occurrence of corneal ulcers 63.35% in dogs between 3 months and 3 years, those between ages 3 and 7 years showed 21.7%, 7-10 years showed 5.15% and those between 10-15 years had 9.3% corneal ulcers; whereas in breed distribution, highest incidence was recorded in pug 37.26% followed by Spitz 26.7 %, non-descript 16.7% Labradors and Boxers showed 4.94%, Pekingese, Great dane and Rottweiler had 1.24% whereas, Beagle, Cocker spaniel, Dachshund and Bulldog had 0.62% incidence rate. The authors also recorded the incidence rate of corneal ulcers was 60.2% in males and 39.8% in females. Out of 526 dogs with corneal ulcers 283 (53.8%) were bilateral and the rest 243 (46.2%) were unilateral.

2.1.1.2 Sex

Gilger *et al.* (1991) reported that female dogs had a consistently thinner cornea than male dogs by measuring their corneal thickness using ultrasound pachymetry.

Ramani *et al.* (2013) concluded from their study on surgical bacteriology and grading of corneal ulcers in dogs that occurrence of corneal ulceration in male dogs was 67% and in female dogs was 33%.

2.1.1.3 Breed

Tilley and Smith (2011) stated that certain breeds of dogs might be more predisposed to the development of ulcerative keratitis secondary to other corneal diseases such as Boston terriers, where there was degeneration of the lining of the cornea leading to fluid build up called “corneal endothelial dystrophy” and degeneration of the top surface of the cornea, leading to corneal ulcers called “corneal epithelial dystrophy” in Shetland terriers.

Packer *et al.* (2015) noted that dogs with exaggerated juvenile like craniofacial conformation with wide eyes were suspected risk factors in the development of corneal ulcers, which include the presence of nasal fold, eyelid aperture width, brachycephalic skull shape and exposed sclera. Pugs were reported to be the most diagnosed breed for the development of corneal ulcers.

Suhas (2015) reported highest incidence of corneal ulcers (83%) in Chinese pugs and 17% in Spitz.

2.1.2 Etiology of corneal ulcer in dogs

Brooks (1991) stated that the corneal ulcers in dogs that involve the ventromedial cornea and that were recurrent or refractory to therapy might be caused by a nictitans foreign body.

Gelatt (1991) recorded conditions like ectopic or aberrant cilia, distichiasis, trichiasis, entropion and ectropion resulted in or produced mild conjunctivitis and keratitis in dogs.

Moore and Nasisse (1999) mentioned tear film disturbances, microtraumas, bacterial infections, corneal surgical interventions and disorders of the immune system like autoimmune diseases and immune-deficiencies were the main factors for the development of ulcerative keratitis.

Ollivier (2003) observed that corneal ulcers in dogs were not primarily infected and were frequently traumatic in origin but were rapidly contaminated by bacteria.

Maggs (2008) studied the common causes of corneal ulceration in dogs and has broadly categorized them into endogenous causes such as abnormal anatomy or lid position, eyelash abnormalities and exogenous causes such as foreign body retention in the conjunctival fornix and trauma.

Kim *et al.* (2009) reported lagophthalmos to be the most common cause of ulcerative keratitis in brachycephalic dog breeds followed by keratoconjunctivitis sicca.

Sale *et al.* (2013) attributed the development of corneal lesions in canines to eye abnormalities like dry eye, nasal trichiasis, trauma, medial entropion, allergy and lagophthalmos with exposure keratoconjunctivitis.

Sanchez (2014) divided the prevalence of canine ulcerative keratitis into primary corneal disease, trauma (non-penetrating or penetrating and irritants), tear film defects, eyelid or periorbital disease, infection and neurological disease.

2.1.3 Classification of corneal ulcers

Whitley and Gilger (1999) classified corneal ulcers into superficial, deep, stromal and descemetocoele according to the depth of corneal involvement. Superficial ulcers further were classified as uncomplicated, progressive or refractory whereas deep stromal ulcers were classified into progressive and non progressive type.

Miller (2001) classified corneal ulcers from grade 1 to grade 5, where uncomplicated healed superficial ulcer was classified as Grade 1, persistent corneal ulcer was Grade 2, non progressive stromal ulcer was Grade 3, progressive stromal ulcer was Grade 4 and ulcer progressing to corneal perforation was Grade 5.

Gelatt (2008) opined that corneal ulcers in dogs would be characterized clinically on the basis of varying degrees of blepharospasm, corneal edema, lacrimation, aqueous flare and possibly miosis, photophobia, conjunctival hyperemia and was determined by the amount of topically applied fluorescein dye retained by the corneal stroma.

Ledbetter and Gilger (2013) observed that corneal ulcers were the most common ocular disease in dogs and classified them according to the depth of corneal involvement and its underlying cause into superficial corneal ulcers, stromal corneal ulcers, descemetocele and perforations.

2.1.3.1 Superficial corneal ulcer

Mandell (2000) mentioned that superficial ulcers were more painful since they involved the more innervated part of the epithelium.

Moore (2003) reported that the corneal epithelium and basement membrane with or without the involvement of the stroma were involved in superficial corneal ulcer.

Ollivier (2003) found that uncomplicated corneal ulcers were not infected within a few days, however to prevent secondary bacterial growth, antibiotic therapy was recommended since the epithelial integrity was compromised.

2.1.3.2 Deep stromal ulcer

Mandell and Holt (2005) recorded that deep stromal ulcers in dogs healed by vascularization in 3 weeks and involved more than a third of corneal thickness.

Ledbetter and Gilger (2013) observed that any visible defect in corneal surface suggested stromal involvement since ulcers that involve only the epithelium are not readily visible. The authors further observed that ulcers invading the epithelium go undiagnosed without fluorescein staining.

2.1.3.3 Melting corneal ulcer

Ollivier (2003) stated that corneal destruction started when proteases produced by inflammatory cells, microorganisms, fibroblasts and corneal epithelial cells took an upper hand over its inhibitors.

Ion *et al.* (2015) reported that the imbalance between proteinases and proteinase inhibitors develop melting ulcers. Host neutrophils, damaged keratocytes and bacteria, especially *Pseudomonas spp* were responsible for stromal melting by producing proteolytic enzymes like collagenase.

2.1.3.4 Descemetocele

Hamilton (1999) described descemetocele as a protrusion of the descemet's membrane through the bed of the ulcer due to pressure of aqueous humor behind it.

Mitchell (2011) observed a clear area at the base of the deep corneal defect after instillation of the fluorescein dye to be a descemetocele since the descemet's membrane does not take up the lipophobic stain.

Ledbetter and Gilger (2013) reported a descemetocele as a surgical emergency owing to intraocular inflammatory damage and potential for infection.

2.1.4 Clinical signs associated with corneal ulcers

Andrade *et al.* (1999) reported that clinical signs like photophobia, epiphora in early stages of corneal ulcers and blepharospasm could be due to corneal edema which stimulates the corneal nerves.

Clode (2012) observed the signs of corneal ulcers like stromal loss, cellular infiltrate, corneal edema, corneal vascularization, reflex anterior uveitis flare, fluorescein dye uptake, miosis and low intraocular pressure.

Gosling *et al.* (2013) recorded that blepharospasm, enopthalmos, epiphora, miosis, conjunctival hyperemia, corneal edema, corneal fibrosis and corneal vascularization were clinical signs observed in dogs affected with SCCED.

2.1.4.1 Corneal opacity

Myrna *et al.* (2009) reported that replacement of stromal keratocytes by fibroblasts or myofibroblasts lead to alteration of corneal transparency and subsequent corneal opacity.

Shaheen *et al.* (2014) noted that the corneal opacity was the second highest cause of blindness in humans due to corneal nerve dysfunction.

2.1.4.2 Corneal vascularization

Daxer and Ettle (1995) studied the relationship between surface characteristics of migrating cells and extracellular matrix with respect to vasculogenesis in cases of severe superficial corneal vascularization due to

alkali burns in human eyes.

Renwick (1996) stated that corneal vascularization was either superficial wherein blood vessels branched over the cornea or deep wherein vessels had the tendency to be straight resulting in a brush border appearance.

2.1.4.3 Corneal edema

Startup (1984) reported that lack of hydration lead to a break in the epithelium or endothelium of the cornea which increased the fluid content of the cells owing to the hypotonicity of the corneal tissue fluids to both tears and aqueous humor.

Pontes *et al.* (2014) stated that absence of either corneal epithelium or endothelium gave entry to water into the stroma which resulted in corneal edema.

2.2 Review of literature on diamond burr debridement

Dawson *et al.* (2015) opined that diamond burr debridement resulted in significant reduction of hyaline acellular zone in spontaneous chronic superficial corneal epithelial defects and this reduction of its thickness aids in healing rates of this method as hyaline acellular zone is responsible for poor attachment of corneal epithelium.

Nevile *et al.* (2015) observed all diamond burr debridement treated eyes of dogs healed within 62 days of treatment out of which at first re-examination 82% of eyes were healed (median: 13 days) and all were healed by their second re-examination (median: 24 days) and stated that this method was found effective and safe for rapid resolution of superficial corneal ulcers.

Rienstein (2019) reported that diamond burr debridement removes the abnormal membrane and non-adherent epithelial cells without penetrating into normal stroma and recommended its use in dogs.

2.3 Review of literature on soft contact bandage lens

Munro (2001) opined that soft contact bandage lens was an alternative to third eyelid flaps for corneal ulcer management by acting as a protective layer between the eyelid and cornea as it enhanced the contact between the underlying basement membrane and the regenerative epithelium to stabilize the ocular tear film and to avoid corneal nerve stimulation by improving patient comfort. It also provided better anterior chamber visualization.

Turner and Blogg (1997) used soft contact bandage lenses as an adjunct therapy in cases of corneal ulcers. He observed that it helped to retain the tear film over the affected area and reduces pain; thereby encouraging healing.

Rienstein (2019) observed that diamond burr debridement in conjunction with soft contact bandage lens improves healing by protecting the migrating epithelial cells and improves patient comfort by covering the exposed corneal nerves.

2.3.1 Classification and composition of contact lens

Schmidt *et al.* (1977) used two types of hydrophilic contact lens viz. poly-hydroxyethyl methacrylate crosslinked with ethylene glycol dimethylacrylate and polyvinyl pyrolidone hydrated with 39 per cent and 55 per cent respectively as a therapeutic regime for recurrent corneal ulcers in dogs and cats and found that hydrophillic contact lenses were beneficial to use in recurrent and superficial corneal erosions in dogs and cats.

Grinninger *et al.* (2015) used 2-hydroxyethylmethacrylate, vinylpyrolidine and 75 per cent water to be commercially available contact bandage lens as therapeutic protocol for treating spontaneous chronic corneal epithelial defects in ten dogs.

Ranganath (2016) classified contact lens as hard, soft and rigid gas permeable lens based on the nature of the material used. Availability of hard and gas permeable sclera lens, hard sclera lens and silicone hydrogels was 38%, hydrogel soft lens (low water content-38-45%, mid water content- 45-55%, high water content- 67-80%), soft lens (spherical, disposable and coloured lens), collagen shields, multifocal contact lens and extended wear contact lens were also commercially available.

2.3.2 Therapeutic applications of contact lens

Rosenthal *et al.* (2000) reported reduced persistent corneal epithelial defect, aided epithelial regeneration by combination of providing oxygenation, moisture and protection of fragile epithelium with continuous wear of gas permeable sclera contact lens.

Gosling *et al.* (2013) reported complete resolution of SCCED using diamond burr debridement and bandage contact lens in 40 dogs and assessed healing by observing absence of non-adherent epithelial margins, decrease or absence of fluorescein retention in the cornea.

Grinninger *et al.* (2015) opined that the use of soft contact bandage lens as adjunct therapy reduces the healing time significantly (mean 14 +/- 0 days) than in cases without lenses (mean 36 +/- 17 days) in dogs.

2.3.3 Postoperative effects of contact lens

Dohlman *et al.* (1973) reported complications like early lens loss, photophobia, increased stromal vascularization, corneal aberrations and corneal infiltrations in dogs that were given soft contact bandage lens.

Polse and Decker (1979) observed that corneal edema that developed in dogs was related to the increase in central thickness of contact lens and reduced oxygen tension.

Wooff and Norman (2015) reported that contact lens had been retained in 71.4 per cent of dogs and the rest had early lens loss of contact lens ranging from 1 hour to 6 days postoperatively.

Braus *et al.* (2018) evaluated the retention time of human size silicone lenses and veterinary hydrogel lenses with specific dimensions which was (2 days) as compared to human lens (8.8 days). The authors observed veterinary hydrogel lenses have comparatively shorter retention time than human lenses

and were more expensive. Further opined, that with regards to bacterial growth, inflammation and irritation both types of lenses could be used in dogs.

2.4 Review of literature on corneo-conjunctival transposition

Wilkie and Whittaker (1997) noted that the corneo-conjunctival transposition failed to provide endothelium to full-thickness wounds as the graft was of partial thickness leading to vasularization and scar formation due to the presence of blood supply. The authors further stated that corneo-conjunctival transposition was a type of sliding autologous lamellar keratoplasty and could be used to treat axial corneal ulcers which were less than 25% to 30% of the corneal diameter.

Andrew *et al.* (2001) has used corneo-conjunctival transposition to treat feline corneal sequestra, deep corneal ulceration and descemetocele with excellent cosmetic appearance and no reoccurrence.

Ledbetter *et al.* (2013) stated that corneo-conjunctival transposition was indicated for deep, perforated corneal lesions and central ulcers with significant amount of healthy cornea available for the procedure. The distance from the lesion's peripheral edge to the limbus should be at least 1mm longer than the diameter of the ulcer itself. Since the need for corneal tissue donors was eliminated with this procedure by using 'self' tissues it minimized immune-mediated inflammation that helps in reduction of the scarring and allows a clearer post-operative cornea.

Jaksz and Busse (2017) stated that the advantage of corneo-conjunctival transposition was the use of own tissue which results in a more

transparent cornea due to decreased corneal scarring resulting in increased viability of the graft which was because of the vessels supplied by the attached conjunctiva.

Kim *et al.* (2019) mentioned that autologous lamellar graft reduces the need to obtain donor material from another donor due to the lack of corneal bank facilities worldwide.

2.5 Review of literature on diagnostic techniques for corneal ulcers

2.5.1 Ophthalmic examination

Miller and Crenshaw (1988) mentioned the need for assessing corneal clarity, contour, symmetry, contact between eyelids margins and cornea, location and extent of lesion, direct diffuse illumination during ophthalmic examination.

Renwick (1996) opined that a bright focal source of light, a transilluminator and a means of magnification were the basic requirements for conducting an ophthalmic examination.

Ollivier (2003) stated that eyes should be examined for opacity, loss of transparency, pigmentation, vascularization, growths, laceration, presence of foreign body, changes in contour and symmetry of eye balls, eye lash disorders and corneal ulceration.

2.5.2 Ocular reflexes

Moore (2003) described the innervation of cornea through ophthalmic branch of the trigeminal nerve by using a cotton- tip applicator or wisp of cotton to bring about a blinking response after it was touched to the peripheral cornea.

Mitchell (2011) stated that it was important to observe the normal closure of the eyelids as a positive while eliciting a palpebral reflex in animals.

2.5.2.1 Palpebral reflex

Moore (2003) described a positive palpebral reflex as a blinking response upon innervations of the ophthalmic branch of trigeminal nerve by touching the medial or lateral canthus.

Mitchell (2011) stated that a full neurological examination was warranted to observe the normal closure of the eyelids and normal blink response since ophthalmic diseases such as blindness could have a neurological component in dogs.

2.5.2.2 Menace reflex

Martin (2001) explained that threatening or sudden movement near the eye produces a blinking reflex which was known as menace reflex and that care should be taken to avoid air currents by presenting the fingers or using a transparent shield to prevent false positive responses.

Moore (2003) described that visual status and eyelid function were the two components of menace response and required a clear optic medium, a functioning retina and intact optic and facial nerves.

2.5.2.3 Pupillary light reflex (PLR)

Felche and Urbanz (2001) noted that the function of retina, optic nerve and the iris sphincter could be effectively evaluated by pupillary light reflex.

Featherstone and Heinrich (2013) stated that if a bright focal light source was pointed at the eye, a direct PLR was elicited which resulted in constriction of the ipsilateral pupil and indirect PLR was the simultaneous constriction of the contralateral pupil.

2.5.2.4 Corneal reflex

Rylander (2013) described that lightly touching the cornea with a moist cotton tip applicator, the animal should retract the eye.

2.5.2.5 Dazzle reflex

Mowat (2002) described dazzle reflex as squinting of the eye when a bright focal light was aimed at the eye. Dazzle reflex and consensual PLR were diagnostic when the retina could not be observed due to corneal or intraocular disease in predicting the prognosis in cases of suspected trauma.

Cebra and Metzler (2014) described dazzle reflex as perception of bright light indicated by a blink response.

2.5.2.5 Tracking test

Martin (2001) observed the common means to evaluate vision was to drop a cotton ball in the visual field of the patient. Initial impressions seen during the test was important as subsequently the animals got bored with the test.

2.5.3 Schirmer's tear test

Ludder and Heavner (1979) recorded decreased tear formation following administration of atropine topically or systemically, alone or in conjunction with general anaesthesia.

Kaswan *et al.* (1995) reported that topical medications could influence STT values viz; atropine that decreased the tear production. Topical solutions may falsely increase the tear production values, whereas fear experienced by animal increases the sympathetic stimulation and falsely decreases the tear production.

Kotani (2001) reported the STT values for adult canine as 21.30 ± 3.80 mm/min, 18.89 ± 2.62 mm/min and 18.64 ± 4.47 mm/min in a study on estimation of tear production rate by Schirmer's tear test. STT readings of 11-14 mm/min were considered moderately low and readings equal to or less than 10 mm/min were considered low.

Munro (2001) noted that the readings of STT were greatly reduced during sedation, general anesthesia, topical anesthesia and administration of parasympatholytic agents and suggested that STT should be performed prior to sedation and topical administration.

Thangamuthu and Varshney (2002) conducted a study to generate baseline data on tear production in dogs to determine the effects of sex, age, body weight and breed on tear production and found that STT values for left and right eyes were 22.54 ± 0.41 mm/min and 22.62 ± 0.41 mm/min respectively. Tear production pattern of right and left eyes were similar and the sex, age, body weight and breed did not significantly influence the STT values.

Morreale (2003) described STT to be the most common test for pre corneal tear film and assessment of quantitative production of the aqueous portion of the tear film. He also stated that the normal value of Schirmer's tear test in a dog was between 14 to 25 mm/min, a Schirmer's tear test result of less than 15 mm/min was under suspicion and less than 10 mm/min was indicative of keratoconjunctivitis sicca.

2.5.4 Fluorescein dye test

Slatter (1990) used fluorescein to detect corneal defects, pre corneal tear-film deficiencies and conjunctival epithelial defects. Intact healthy cornea and descemet's membrane was not stained by hydrophilic fluorescein stain however, on the loss of corneal integrity, the dye could enter the water-soluble corneal stroma and stain the intracellular spaces.

Strubbe and Gelatt (1999) described the use of Seidel test to check for leaks in the cornea by application of fluorescein stain to the corneal surface. The leaky cornea was detected by means of magnification.

Felche and Urbanz (2001) reported that lipophilic corneal epithelium was not penetrated by the hydrophilic stain but in case of any corneal defects it would stain the corneal epithelium and could be examined under the blue filter of the ophthalmoscope in a dark room.

Moore (2003) stated that the integrity of the corneal epithelium was determined by visualization of the fluorescein stain with cobalt blue light after touching the tip of the stain strip to the cornea.

Bromberg (2002) evaluated the efficacy of cyanoacrylate tissue adhesive for the treatment of refractory corneal ulcers in dogs, cats and rabbits and observed that negative fluorescein dye test indicated complete corneal healing.

Beranek and Vit (2007) observed that corneal defects appeared green when seen under ultraviolet light (Wood's lamp) or cobalt filter.

Singh *et al.* (2016) stated that detection of corneal ulcers and conjunctival defects could be diagnosed ideally by using fluorescein stain. Fluorescein sodium stain was taken up by exposed corneal stroma and defined the corneal ulcer margins green.

2.5.5 Direct Ophthalmoscopy

Gelatt *et al.* (2008) opined that structures like eye lids, conjunctiva, cornea, anterior chamber and the fundus of a canine eye could be visualized using a direct ophthalmoscope between +3 and -3 diopters.

Maggs (2008) described the method of a direct ophthalmoscope to visualize the ocular fundus of the canine eye after dilatation of pupil using mydriatics.

2.6 Review of literature on ocular microbiology

Gaskin (1980) studied that the conjunctival sac microbiota consists of most commensal bacteria, maintaining normal ocular health by stunting overgrowth of potentially pathogenic agents however, if there was corneal damage, microorganisms of the normal flora can become potential pathogens.

Kecova *et al.* (2004) stated the importance of resident microflora in the cornea and that opportunistic flora took over and caused disease when the growth of resident flora was precluded by disease or long-term application of antibiotics and/or corticosteroids. *Staphylococcus spp* was the most commonly isolated bacteria followed by less frequent species like *Streptococcus spp*, *Enterococcus spp* and others.

Prado *et al.* (2005) evaluated 22 samples of corneal ulcers and found bacteria in each one of them. A single bacterial species was recovered from 14 specimens (63.6%), whereas eight (36.4%) samples had two to three different microorganisms. Out of the 31 isloates that were recovered Gram-positive cocci (51.7%) was the most predominant group, followed by Gram-positive bacilli (29%) and Gram-negative bacilli (19.3%). The most frequently isolated genus was *Staphylococcus spp (*45.2%) followed by *Corynebacterium spp* (22.5%).

Lin and Petersen- Jones (2007) isolated bacteria from 190 eyes of dogs with corneal ulcers. It was found that the gram-positive bacteria constituted 78% of the isolates and the gram-negative were 28%. The most commonly isolated bacteria was *Staphylococcus spp* (49 per cent), *Streptococcus spp* (7 per cent) and *Corynebacteriumspp* (7 per cent), while most common gram-negative bacteria were *Pseudomonas aeruginosa* (7.6 per cent) and *Escherichia coli* (5.8 per cent). *Staphylococcus, Streptococcus, Corynebacterium, Pseudomonas* and *Escherischia* species isolates showed resistance to ophthalmic antibiotics.

Morales (2009) reported the number of positive and negative cases for bacterial invasion out of the 86 samples cultured from Shih-tzu (31.25%), Poodle (15%) and Lhasa apso (8.75%) in between the ages 6 months to 14 years, prevalence being higher in the ages 1-6 years, 22 were found negative (25.58%), 64 positive (92.18%), 59 for one or more bacteria (92.18%) and 5 for yeast (7.82%). The most frequent group was found to be the gram-negative rods (48.43%), *Pseudomonas aeruginosa* being the most common isolated bacteria in 21 cases followed by (39.06%) of gram-positive cocci (*staphylococcus spp + streptococcus spp).*

Varges *et al.* (2009) studied the prevalence of *Staphylococci* isolated from external ocular diseases and found *Staphylococcus intermedius* (45%) to

be the most frequent isolate followed by *Staphylococcus aureus* (22.5%), *Staphylococcus epidermidis* (20%) and *Staphylococcus stimulans* (12.5%).

Scott and Carter (2014) evaluated 11 dogs with predisposing factors for fungal keratitis. 6 of the 11 eyes demonstrated yeast or hyphae in the corneal cytology and fungal cultures with positive results in 7 of the 11 eyes. Fungal organisms isolated were *Aspergillus spp* (n = 1), *Penicillium spp* (n = 1), *Cladosprium spp* (n = 1), *Curvularia spp* (n = 2), *Phialemonium spp* (n = 1) and *Chrysosporium spp.*

2.7 Review of literature on physiological parameters and hematology

Schalm *et al.* (2000) stated that normal values of hemoglobin concentration was between 12 and 18 g/dl (av 14.9 g/dl) and packed cell volume was 37- 55 per cent (av 45.54%), total leukocyte count, neutrophils 60-77 per cent (av 70 %),band cells 0-3 per cent (av 0.8%), lymphocytes 12-30 per cent (av 20%), monocytes 3-10 per cent (av 5.2 %), eosinophils 2-10 per cent (av 4.0%) and basophils rare.

Raji (2006) reported no alterations in the hematological parameters and physiological parameters from the normal range in dogs with corneal affections.

Chinchu (2010) studied the efficacy of collagen sheet in the management of corneal ulcers in dogs. He observed no significant alteration in the hematological parameters or physiological parameters between the groups.

Sarangom *et al.* (2012) conducted a clinical study on the evaluation and management of eye affections in Chinese pugs and reported no significant difference in the hematological or physiological values between normal and dogs with ocular affections.

Antonia (2014) studied the incidence and management of ophthalmic conditions in dogs and found that the hematological parameters and physiological parameters were within normal range in all the ophthalmic affections.

2.8 Review of literature on ocular therapeutics

Tolar *et al.* (2006) evaluated 97 dogs with bacterial keratitis and isolated *Staphylococcus intermedius* (29%) which was found to be the most common bacteria, followed by *Pseudomonas aeruginosa* (21%) and beta-hemolytic *Streptococcus spp* (17%). More than 80% of beta-hemolytic *Streptococcus spp* isolates were resistant to neomycin, tobramycin and polymixin B. Isolates of *P. aeruginosa* had limited resistance to enrofloxacin and ciprofloxacin and were susceptible to gentamicin and tobramycin. They suggested the use of or combination of first-generation cephalosporin, ciprofloxacin and tobramycin in the treatment of bacterial keratitis while awaiting results of bacterial culture and susceptibility testing.

Maggs (2008) stated that 1% tropicamide when instilled into the conjunctival sac, brings about mydriasis in 15 to 20 min (slightly longer in animals with highly pigmented irides). Mydriasis can be hastened by a second drop five minutes after the first. Presence of uveitis or posterior synechia was indicated by lack of mydriasis 20 min after 2 drops of 1% tropicamide.

Morales *et al.* (2009) studied the susceptibility of gram-negative bacteria to the most common antibiotics used in clinical practice : quinolones (moxifloxacin, ciprofloxacin, gatifloxacin and levofloxacin), aminoglycosides (tobramycin, gentamicin and amikacin). *P. aeroginusa* strain was resistant to all antibiotics except polymixin B and *E. coli* resistant to quinolones were found. 52.17% of *P. aeroginusa* strains were resistant to chloramphenicol and tetracycline. The gram-positive bacteria was susceptible to all the antibiotics except *staphyloccocus* for tetracycline. All *staphylococcus* were susceptible to oxacillin and *staphylococcus aureus* and *streptococci equii* were susceptible to quinolones but ciprofloxacin resistant.

Parchen *et al.* (2011) determined and compared the anaesthetic effects of 1% tetracaine, in combination with phenylephrine 0.1% and 0.5% proparacaine drops in two different doses in dogs. They found minor structural differences in the two drugs, proparacaine is a meta-aminobenzoic ester while tetracaine is a para-aminobenzoic ester. Development of allergic reactions may be linked to the type of ester group. Irritation to the ocular tissues is higher if the contrast of anaesthetic drops pH is higher than 7.4 (physiological pH). Proparacaine's average pH is 4.8 and that of tetracaine drops is 4.5, creating adverse effects and greater eye pain. This showed that topical anaesthesia of cornea with proparacaine had less adverse effects and presented less tissue reaction.

Herring (2013) found that tropicamide was useful in inducing mydriasis before a cataract extraction surgery, where in the hours preceding the procedure; multiple doses are applied. Tropicamide was less likely to exacerbate postoperative IOP spikes than a longer acting agent like atropine due to its relatively short duration of action.

Sarchahi and Eskandari (2018) evaluated the changes in IOP after using topical anaesthetics like proparacaine, tetracaine, bupivacaine and lidocaine. IOP decreased gradually after 15 min of instillation of tetracaine, IOP was significantly lower than the baseline ($p = 0.022$) and control values ($p = 0.048$) as compared to the baseline values ($p = 0.046$), proparacaine also reduced IOP after 10 min but bupivacaine and lidocaine had no significant effect on IOP. Tetracaine, lidocaine, bupivacaine and proparacaine had 16, 20, 22 and 34 min of duration of anaesthesia respectively.

Cavens (2019) observed that adding a tetracycline in addition to topical antibiotic, artificial tear supplement and pain medication aids healing while treating corneal ulcers. Tetracyclines also function as antiproteases and enhance epithelialization of corneal ulcers. They have anti-inflammatory and anti-collagenase effects on the ocular surface.

2.9 Review of literature on corneal healing

Willeford *et al.* (1998) reported that epithelial cells release plasminogen activator because of matrix proteins like fibrin and fibronectin. Plasminogen gets converted to plasmin and enables the epithelial cells to adhere to the underlying basement membrane leading to detachment of the newly formed scaffold.

Featherstone *et al.* (2001) stated that corneal scarring and possible visual impairment occurred during corneal healing as collagen type III fibrils were laid down in a less regular manner than the type I fibrils in normal cornea.

Miller (2001) observed that the keratocytes get altered to fibroblast due to stromal damage and the fibroblasts fill the defect randomly with collagen and produced a scar. The limbal vessels were made to progress towards the wound by disrupted stromal architecture. These blood vessels stay there even after the wound shows healing.

Bentley and Murphy (2004) categorized corneal wound healing as epithelial, stromal and endothelial wound healing. They found that epithelial cells start migrating radially at a constant rate of approximately 20-50 μm/h after the initial lag phase of epithelial wound healing. In case of breach in the underlying basement membrane, corneal healing slows down, which could take upto a year to heal.

Carter (2009) reported that important mediators in corneal restoration were fibrin, fibronectin and plasmin. Fibrin and fibronectin produced by basal epithelial cells and stromal keratocytes acted as temporary scaffold for new migrating epithelial cells. Plasmin was responsible for cleavage of old epithelial cell attachments.

3. MATERIAL AND METHODS

3.1. SELECTION OF CASES

The present clinical study entitled “Comparison of diamond burr debridement with soft contact bandage lens and corneo-conjunctival transposition for treatment of corneal ulcer in dog” was undertaken on 12 dogs presented to the Department of Surgery and Radiology, Mumbai Veterinary College as well as to the Out Patient Department of Mumbai Veterinary College and affiliated Bai Sakarbai Dinshaw Petit Hospital for Animals, Parel, Mumbai. 12 dogs with history and symptoms suggestive of corneal ulceration were included in this study.

3.2. ANAMNESIS

Detailed history was obtained regarding the age, sex, breed, manner of onset and duration of the complaint, chief signs and symptoms, recent behavioral changes, possible trauma, previous use of medication and history of other illness, if any.

3.3. DESIGN OF STUDY

The present study was conducted on twelve (12) dogs with signalment suggestive of corneal ulceration. The dogs were randomly divided into two groups namely group A and group B, irrespective of their age, sex and breed consisting 6 dogs in each group.

In group A the corneal ulcers of dogs were treated with diamond burr debridement and application of soft contact bandage lens and routine medical treatment.

In group B the corneal ulcers of the dogs were treated with corneo-conjunctival transposition technique and routine medical treatment. The details are presented in Table no. 3.1.

Table no.3.1 – Design of Study

Group	No. of Dogs	No. of Corneal Ulcers	Treatment Option
Group A	6	6	Diamond burr debridement with soft contact bandage lens and medical treatment
Group B	6	6	Corneo-conjunctival transposition and medical treatment

3.4. CLINICAL AND OPHTHALMIC EXAMINATION

3.4.1. Examination of the eye

All the animals presented for treatment underwent a detailed ophthalmic examination pre and post operatively, wherein the gross examination of the eye and its adnexa was performed to find presence of blepharospasms, lacerations, neoplasms, dermoid cysts, abnormal secretions and epiphora in order to determine the causes of the corneal ulcers. The eyelids were examined at the lid margins and conjunctival surfaces to find presence of disorders of cilia, distichiasis, trichiasis, ectopic cilia, ectropion and entropion. The lower eyelid was retracted and the palpebral mucus membrane was examined to rule out existing diseases. The cornea was examined for lesions such as pigmentation, vascularization, opacities and irregularities. The bulbar conjunctiva was

examined and the anterior segment was checked to determine the depth and presence of abnormalities along with the iris, pupil and lens thoroughly.

3.4.2. Neuro-ophthalmic/ Visual function tests

Visual activity of the eye was assessed and scored pre and post operatively by standard procedures (Maggs, 2013).

a) Palpebral reflex:

It was tested by lightly tapping the lateral and medial canthus of both eyes with a finger tip to ascertain the integrity of the auriculopalpebral branch of the facial nerve and the facial and maxillary branch of the trigeminal nerve. Presence or absence of a blink response was recorded and noted as:

Present (+): Blink response to stimulus and scored was as **2**.

Sluggish (±): Inconsistent or incomplete closure of eyelids in response to stimulus and was scored as **1**.

Absent (-): No response to stimulus and was scored as **0**.

b) Menace reflex:

It was tested by waving a hand close to each eye of the animal in a visually threatening way, any kind of sound or air movements were avoided while conducting the test. Both eyes were tested separately using different angles of movement to determine the consistency of the response to stimulus and it was recorded and noted as:

Present (+): Blink response to the stimulus and was scored as **2**.

Sluggish (±): Inconsistent or incomplete closure of eyelids in response to the stimulus and was scored as **1**.

Absent (-): No response to the stimulus and was scored as **0**.

c) Dazzle reflex:

It was conducted by aiming a bright light source in the eye being tested and the response to stimulus was recorded and noted as:

Present (+): Blink response to the stimulus and was scored as **2**.

Sluggish (±): Inconsistent or incomplete closure of eyelids in response to the stimulus and was scored as **1**.

Absent (-): No response to the stimulus and was scored as **0**.

d) Corneal reflex:

It was conducted by touching a wisp of cotton to the peripheral cornea of the eye being tested and the response to stimulus was recorded and noted as:

Present (+): Blink response with retraction of the globe and was scored as **2**.

Sluggish (±): Inconsistent or incomplete closure of eyelids in response to a stimulus and was scored as **1**.

Absent (-): No response to the stimulus and was scored as **0**.

e) Pupillary light reflex (PLR):

It was tested by projecting a pen focal light source into one eye and the resultant degree of pupillary constriction was seen along with consensual PLR of the other eye, these observations were recorded and noted as:

Present (+): Complete and quick constriction of the pupil seen while testing of both direct and consensual PLR and was scored as **2**.

Sluggish (±): Incomplete or slow constriction of the pupil seen while testing of both direct and consensual PLR and was scored as **1**.

Absent (-): No response of pupil to the stimulus and was scored as **0**.

f) Cotton ball test (Tracking reflex):

It was tested by dropping a cotton ball on either side of the eyes, in front of their visual field and the reaction of the animal to the cotton ball was recorded and noted as:

Present (+): Eye balls fixed on the cotton ball throughout its trajectory and was scored as **2**.

Sluggish (±): Inconsistent or incomplete tracking of the cotton ball and was scored as **1**.

Absent (-): No response shown by the animal and was scored as **0**.

g) Maze / obstacle test:

It was performed by keeping different obstacles in the animal's path. The capability of the animal to navigate its path around the obstacle was recorded and noted as:

Present (+): Ability to cross all obstacles without touching them in a prompt manner and was scored as **2**.

Sluggish (±): Ability to cross most obstacles without touching them with slower completion of the course and was scored as **1**.

Absent (-): Unable to complete the course without bumping into obstacles and was scored as **0**.

3.4.3. Special diagnostic tests

a) Schirmer's tear test:

This test was conducted before any topical application to the eyes using Schirmer's tear strips. The lower eyelid was pulled down using a finger to expose the cul-de-sac and the end of the strip with the notch was folded and hooked into the lateral third of the eye for a minute. The extent of the moistened

part of the paper was measured at the end of the designated minute and recorded. The values were recorded as 'mm/min' in all animals.

b) Fluorescein stain test:

This test was conducted using commercially available sterile paper strips impregnated with fluorescein dye at one end. The end of the strip was dampened with sterile water and lightly touched to the dorsal bulbar conjunctiva. Excess dye was gently washed off with sterile water and the cornea was examined in a dimly lit room with a light source. Dye uptake was considered as positive for presence of corneal epithelial defect and was recorded.

c) Direct ophthalmoscopy:

It was performed using a direct ophthalmoscope **(Plate no. 6)** after the instillation of 1% tropicamide in the eye to be examined. The intraocular structures were examined as per standard procedure (Maggs, 2013).

3.5. DIAGNOSIS AND CLASSIFICATION OF CORNEAL ULCERS

A complete evaluation of the eye was performed to confirm the existence of corneal ulcers which included Schirmer's tear test **(Plate no. 2)** using Schirmer's tear strips **(Plate no. 1)**, Fluorescein dye test **(Plate no. 4)** using fluorescein dye strips **(Plate no. 3)**, topical cycloplegic therapy using tropicamide 1% solution **(Plate no. 8)**.On the basis of the position and depth of the corneal ulcers presented in recorded cases, they were classified as follows:

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1. Schirmer's tear strips (Tear strips). Biovision Limited, Wayside. UK.

2. Fluorescein sodium ophthalmic strips USP (FLUO strips). Biovision Limited, Wayside, UK.

3. Pocketscope Ophthalmoscope, Welch Allyn, Skaneateles Falls, New York, USA.

4. Tropicamide 1% eye drops (Tropicacyl). Sunways Pvt. Ltd. Dholka, Ahmedabad (India).

a) Location:

1. Central- corneal ulcers seen at the centre of the cornea.
2. Para-central- corneal ulcers seen away from the center.
3. Peripheral-corneal ulcers seen close to the limbus.

b) Claasification:

1. Superficial corneal ulcers- Corneal ulcers that mostly involve only the epithelium.
2. Deep ulcers- Corneal ulcers that show loss of stromal content.
3. Descemetocele- Descemet's membrane exposed due to complete loss of corneal stroma.
4. Corneal perforation- complete thickness of the cornea involved, with or without iris prolapsed.

3.6. MICROBIOLOGICAL ANALYSIS

Prior to administration of any topical antibiotics, swab samples from the affected eyes were collected for culture and antibiotic sensitivity testing. A sterile swab **(Plate no. 10)** was dampened with sterile water and rolled over the affected area of the cornea after gently retracting the eyelids. Collected samples were sent to the lab for analysis.

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5. Sterile swab, Hiculture collecting device. HiMedia Laboratories, Mumbai, Maharashtra (India).

3.7. ETIOLOGY OF CORNEAL ULCER

After history taking, ophthalmic examination and microbiological analysis, the etiology of the corneal ulcers in selected cases were determined.

3.8. MEDICAL THERAPY

Broad spectrum antibiotic like 0.3% ciprofloxacin **(Plate no. 11)** was administered to the selected cases as 1st line treatment while the antibiotic sensitivity results were awaited. Prophylactic medication like oral doxcycline and artificial tears **(Plate no. 12)** and pain medication like oral tramadol was also prescribed wherever deemed necessary.

3.9. PRELIMINARY PREPARATION

All the animals selected for the procedures underwent a thorough clinical examination to ensure their fitness for the surgery. Prior to the surgery, weights of all the patients were recorded. Whole blood and serum samples were also collected for complete blood count, liver function tests and kidney function tests. Food was withheld for 8 hours and water for 6 hours prior to the surgery.

An intravenous catheter was placed in the cephalic vein of all the patients **(Plate no. 21)** for administration of anaesthetic medications. Using a multipara monitor **(Plate no. 13)** the electrical activity of the heart as well as oxygen saturation was monitored by sticking machine electrodes to the paw pads before induction of anaesthesia and the pulse oximeter to the tongue **(Plate no. 14)** after induction of anaesthesia.

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6. Ciprofloxacin hydrochloride I.P. 0.3 % w/v eye drops (CIPLOX) Cipla Ltd, Jaipur, India.

7. BM3 PRO- Multiparameter patient monitor, Bionet Ltd. USA.

Following the induction of anaesthesia, lavage of the conjunctival sacs and the cornea was carried out with dilute povidone iodine solution **(Plate no. 26)** and then flushing the eye with sterile saline. The preliminary preparation was concluded by scrubbing the periocular area and the eyelids by povidone iodine solution.

3.10. PREANAESTHETIC AND ANAESTHETIC PROCEDURE

3.10.1. Premedication and induction of anaesthesia

All the patients were premedicated with glycopyrrolate **(Plate no. 16)** at the dose rate of 0.01 mg/kg body weight subcutaneously. After 10 min sedation was carried out using diazepam **(Plate no. 17)** at the dose rate of 0.5 mg/kg body weight intravenously and butorphanol **(Plate no. 18)** at the dose rate of 0.2 mg/kg body weight intravenously. All the patients were pre oxygenated **(Plate no. 20)** for 5 minutes before induction of anaesthesia with propofol. For induction of anaesthesia, propofol at the dose of 4 mg/kg body weight was administered intravenously **(Plate no. 21)**.

After complete induction of anaesthesia and jaw relaxation, all the patients were intubated **(Plate no. 23)** with an endotracheal tube **(Plate no. 22)** ranging from 4.5 to 7.0 (internal diameter in mm) according to the size of the dog. The cuff of the endotracheal tube was inflated with air using a 5 ml syringe and the tube was connected to the anaesthetic machine with an isoflurane vaporizer **(Plate no. 25)**. Topical 0.5% proparacaine **(Plate no. 9)** local anaesthesia was used in all patients 5 minutes before commencement of either procedures.

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8. Povidone Iodine 5% (Bectadine), Jeps Pharmaceuticals Dist. Simour, Himachal Pradesh.

9. Glycopyrrolate injction U.S.P. (PYROLATE®), Neon Laboratories Limited, Andheri, Mumbai

10. Diazepam injection I.P. (Rajcalm), HATVET PHARMA PRIVATE LIMITED, Meerut, Uttar Pradesh.

11. Butorphanol inection I.P. (Butadol), Neon Laboratories Limited, Andheri, Mumbai.

12. Propofol injction I.P 1% w/v (PROFOL™). Claris Lifesciences Limited, Ahmedabad.

13. Proparacaine hydrochloride U.S.P. Ophthalmic solution 0.5% (PARACAIN), Sunways Pvt. Ltd Vadodara Gujarat.

3.10.2. Maintenance of anaesthesia

All the patients were maintained at 2.5% isoflurane USP **(Plate no. 24)** with oxygen delivery to maintain the surgical plane of anaesthesia, keeping the airway pressure limiting valve semi closed for emptying of the expiratory gases.

3.11. PATIENT POSITIONING AND DRAPING

After complete induction of anaesthesia, patients were placed in lateral recumbency with the eye to be operated facing the ceiling. Soft padding was kept under the head **(Plate no. 15)** of the patient to elevate it and help maintaining the position of the cornea parallel to the table. Commercially available light colored ophthalmic drape with an operative window in the center was used for draping the eye **(Plate no. 27)** during surgery. The rest of the patient's body was covered with sterile drape to avoid any contamination.

3.12. OPERATIVE PROCEDURES

3.12.1. Group A- diamond burr debridement with placement of soft contact bandage lens

3.12.1.1. Instrumentation

The following instruments were used for the above said procedure:

1. Barraquer eye speculum
2. Algerbrush diamond burr
3. Soft contact bandage lens

14. Isoflurane Vaporizer VP300.
15. Isoflurane USP, Raman and Weil Pvt. Ltd. Daman.

3.12.1.2. Surgical procedure

This technique was performed in six dogs having unilateral corneal ulcer. It was performed by using a handheld, battery operated Algerbrush **(Plate no. 28)** with a diamond burr. Barraquer eye speculum **(Plate no. 34)** was fitted in place retracting the eyelids and exposing the entire cornea. The Algerbrush was turned on and the whirring burr was gently pressed 1-2 mm around the margins of the ulcer in circular motion to debride and remove the loose, non adherent and necrotic corneal epithelium **(Plate no. 30)**. Soft contact bandage lens **(Plate no. 29)** was held in a way that the convex side of the lens was on the index finger **(Plate no. 32)** and applied on the freshly debrided ulcer. Care was taken to avoid air getting trapped by gently pressing on the lens with a cotton swab. No temporary tarsorrhaphy was performed.

3.12.2. Group B- Corneo-conjunctival transposition

3.12.2.1 Instrumentation

The following instruments were used for the above said procedure **(Plate no. 34):**

1. Artery forcep
2. Castroviejo caliper
3. Needle holder micro curved
4. Castroviejo corneal scissor
5. Straight iris scissor
6. Mcpherson tying forcep

16. Algerbrush, Alger Co. USA.
17. Sodt contact bandage lens (ACUVUE Oasys®), Johnson & Johnson Private Limited, Mulund, Mumbai.

7. Castroviejo corneal forcep
8. Suture cutting scissor
9. Barraquer eye speculum
10. Crescent ophthalmic blade

3.12.2.2 Surgical procedure

The surgery was performed in a seated position **(Plate no. 37)** wearing a 6x binocular loupe **(Plate no. 35)** like a spectacle and an LED headlight **(Plate no. 36)** on the forehead facing the patient. The eyelids were retracted using the barraquer eye speculum. A stay suture **(Plate no. 40)** using 4-0 polyglactin **(Plate no. 38)** suture material through the limbus to keep the eyeball in position was held down using an artery forcep. The size of the ulcer was measured using the Castroviejo caliper **(Plate no. 41)**. The initial incision on the cornea **(Plate no. 42)** was taken using a crescent ophthalmic blade approximately 1mm away from the margins of the corneal ulcer on the dorsal, lateral and ventral aspects to mark out a square resembling a ball in a box which was considered the approximate width of the autologous corneal lamellar sliding graft. Dorsal edge of this square was held by the Castroviejo corneal forcep and the crescent blade was advanced under this edge **(Plate no. 43)** in order to slice through the marked out square over the ulcer, the corneal epithelium was freed from all the borders and removed exposing the underlying layer of the cornea. The borders of this square were progressed down to the limbus and the bulbar conjunctiva to make a strip as described earlier. The bulbar conjunctiva was cut **(Plate no. 44)** and the Castroviejo corneal forcep was advanced under it to free it from the underlying layer **(Plate no. 45).**

18. 6x Binocular ophthalmic loupe, Glass Agencies, India.
19. LED headlight, HELHUNLEE, India.
20. 4-0 Polyglactin 910 absorbable surgical suture U.S.P. (SEAMCRYL), Surgical Sutures, Pvt. Ltd.

Conjunctival hemorrhage was controlled by gently pressing a sterile cotton bud on the point of bleeding for a few seconds. At this point the corneal epithelium and the bulbar conjunctiva were free from their underlying layers. The corneal graft was held up using the Castroviejo corneal forcep in order to visualize the limbal attachment, it was cut using an iris scissor **(Plate no. 46)**. Majority of the graft had corneal epithelium, only the limbal border and some bulbar conjunctiva **(Plate no. 47)**. This graft was then pulled and transposed over the corneal ulcer **(Plate no. 48)**. Sterile 0.9% NS was dribbled over the surgical surface a few times during the procedure to maintain the moisture and clear the blood clots from the surgical site. The graft was held in place and sutured to the cornea with 4 simple interrupted sutures using 8-0 polyglactin suture material **(Plate no. 39)** at the 4 edges of the graft **(Plate no. 51)**. Subsequently 4-5 sutures were placed along the margins of the graft with simple continuous sutures **(Plate no. 52)** using Mcpherson tying forcep. A temporary tarsorraphy **(Plate no. 54)** with simple interrupted sutures was performed to prevent any trauma in the first 4-5 days of the post-operative period and was removed on the 5^{th} day since the operation.

3.13. POST-OPERATIVE MANAGEMENT

All the patients were monitored during post anesthesia recovery period. All the patients were mandatorily made to wear an Elizabethan collar to prevent self trauma. Artificial tear eye drops were instilled 3 times a day for 4 weeks. 0.3 % ciprofloxacin eye drops were instilled 2 times a day for 2 weeks. Tab doxycline at the rate of 5 mg BID for 7 days and tab tramadol at the rate 5 mg BID for 3 days was given to all patients.

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21. 8-0 Polyglactin 910 absorbable surgical suture U.S.P. (VICRYL), Ethicon, Johnson & Johnson Ltd., Aurangabad.

3.14. PARAMETERS STUDIED

3.14.1. Surgical parameters

3.14.1.1.Surgical operating time

Time taken for completion of the procedure was recorded in minutes for each case.

3.14.1.2. Pain during surgery

Any sudden movements, signs of discomfort or any abnormal behavior shown by the animals during surgery were recorded.

3.14.1.3. Intra-operative complications

Complications, if any during the procedure were recorded.

3.14.1.4. Quality of induction of anaesthesia

The quality of anaesthesia was judged by different signs like momentary apnoea, yawning reflex, loss of gag reflex, loss of palpebral reflex and pedal reflex during induction with propofol as per the procedure of Muir *et al*, (1998).

The quality of anaesthesia was graded according to the following points.

Excellent: Loss of swallowing reflex, generally unresponsive to all reflexes and regular respiratory movements.

Good: Unresponsive to pedal reflex and needle prick but a little responsive to palpebral reflex, relaxed and no movements observed.

Poor: Long period of apnoea, irregular heartbeat, respiration and involuntary limb movements observed.

3.14.1.5. Quality of maintenance of anaesthesia

Quality of maintenance of anaesthesia was graded as follows:

Excellent: No signs of pain, no movement of animal during surgical procedure.

Good: No sign of pain or discomfort but little movement of animal during the procedure.

Poor: Moderate pain sensation along with movement of animal during surgical procedure. Vocalization during the procedure.

3.14.1.6. Position of eyeballs during surgery

Eyeball position was noted in each case during maintenance of anaesthesia with isoflurane 2.5% with oxygen delivery.

3.14.1.7. Quality of recovery from anaesthesia

All the cases were observed for signs like retching, coughing, hyper excitability, pawing at eye and whimpering during the procedure. On the basis of these signs the quality of recovery was graded as follows:

Excellent: Excitation/whimpering- free recovery, smooth transition to sternal recumbency and standing.

Good: No excitation, may whimper for less than 5 minutes, slightly prolonged sternal recumbency.

Poor: Excitation/whimpering for more than 20 minutes and pawing at eye.

3.14.2. Physiological parameters

Following parameters were studied before administration of anaesthesia and after complete recovery from anaesthesia.

1. Rectal temperature (°F)
2. Heart rate (beats per min)
3. Respiratory rate (breaths/minute)
4. Pulse rate (ppm)

3.14.3. Haematobiochemical parameters

For the haematological estimations, 5 ml of blood was collected aseptically from the cephalic veins of all dogs from both the groups before and 24 hours after the procedure. 2 ml of blood was transferred to sterile EDTA vial and the 3 ml remainder was transferred to a plain vial and was allowed to clot. Serum was later separated to estimate the liver and kidney function tests.

Following hemato-biochemical parameters were studied as described by Rizzi *et al*., (2010).

3.14.3.1. Hemoglobin (g %)

3.14.3.2. Total Erythrocyte Count (million/mm^3)

3.14.3.3. Total Leukocyte Count (thousand/mm^3)

3.14.3.4. Packed Cell Volume (%)

3.14.3.5. Liver function tests

As per the procedure of Reitman (1957), following liver function tests were performed:

3.14.3.5.1. Alanine Aminotransferase (ALT) IU/L

3.14.3.5.2. Aspartate Aminotransferase (AST) IU/L and

3.14.3.5.3. Alkaline Phosphatase (ALP) IU/L

3.14.3.6. Kidney function tests

As per the procedures of Marsh *et al*., (1965) for BUN and Bonses and Tausskay (1945) for serum creatinine, following kidney function tests were performed:

3.14.3.6.1. Blood urea nitrogen (BUN) (mg/dl) and

3.14.3.6.2. Serum Creatinine (mg %)

3.15. COMPARISON OF THE TWO TECHNIQUES

The efficacy of the two techniques were compared based on the observations of the following corneal parameters which were recorded on the day of presentation day 0, day 5, day 15 and day 30 post surgery and post operative clinical and ophthalmic examination.

3.15.1 Corneal opacity

Corneal clarity was evaluated on the basis of presence of corneal opacity and corneal melanosis. It was graded as complete opacity (+3), moderate opacity (+2) or clear (+1).

3.15.2. Corneal edema

Corneal edema was recorded as present (+) or absent (-) in each case.

3.15.3. Corneal vascularization

Corneal vascularization was graded as extensive vascularization (+3), mild superficial vascularization (+2) or no vascularization (+1).

3.15.4. Post operative clinical and ophthalmic examination

3.15.4.1. Examination of the eye

All the cases were subjected to a thorough ophthalmic examination as described before to assess the changes in clinical signs related to corneal ulcers.

3.15.4.2. Neuro-ophthalmic/ visual function tests

All the cases were evaluated for improvement of vision on day 30 of the observation period.

3.15.5. Special diagnostic tests

3.15.5.1. Schirmer's tear test

All the cases underwent Schirmer's tear test on day 30 of the observation period to evaluate the improvement in tear production, if any.

3.15.5.2 Fluorescein staining

All the cases were subjected to fluorescein staining on day 30 of the observation period to revaluate dye uptake, if any.

3.15.5.3. Direct Ophthalmoscopy

Direct ophthalmoscopy was done for all the cases on day 30 of the observation period to revaluate the intracocular structures.

3.16. COMPLICATIONS OF THE TWO TECHNIQUES

Any complications encountered in both the techniques during the observation period were recorded.

3.17. STATISTICAL ANALYSIS

The data generated during the study were analyzed following standard procedure as per Snedecor and Cochram (1980).

4. RESULTS AND DISCUSSION

4.1. SELECTION OF CASES

The clinical research project titled "**Comparison of diamond burr debridement with soft contact bandage lens and corneo-conjunctival transposition for treatment of corneal ulcer in dog**" was undertaken to determine the effectiveness of the procedures for the treatment of corneal ulcers in dogs.

A total of 12 dogs were selected for this study based on their history and clinical signs on presentation and were randomly divided into 2 groups; Group A and Group B, with 6 dogs in each group. Group A included 3 females and 3 males while Group B included 1 female and 5 males. All dogs were subjected to a thorough physical and ophthalmic examination. The corneal ulcers in all the cases were classified according to their location and depth. Corneal ulcers in Group A were treated with diamond burr debridement and placement of soft contact bandage lens and corneal ulcers in Group B were treated with corneo-conjunctival transposition technique under general anaesthesia.

Inittially, glycopyrrolate (0.01 mg/kg b.wt) was administered subcutaneously. After 10 min sedation was carried out using diazepam (0.5 mg/kg b.wt) intravenously and butorphanol (0.2 mg/kg b.wt) intravenously. Induction of anaesthesia was done using propofol (4 mg/kg b.wt) intravenously and all the patients were maintained using isoflurane USP 2.5% in oxygen.

The results of this study under taken with respect to ophthalmic examination, surgical, haemato-biochemical parameters and post-operative parameters have been described and discussed below:

4.2. CLINICAL AND OPHTHALMIC EXAMINATION

Complete clinical examination of the eyes was carried out in each case selected for the study.

4.2.1. Anamnesis and examination of the eye without magnification:

Details of the breed, age, sex and weight of each dog are given in table no. 4.1.

Table no 4.1: Details of the breed, age, sex and weight of the each dog.

Group A- Diamond burr debridement with soft contact bandage lens				
Dog no.	**Breed**	**Age (years)**	**Weight (kg)**	**Sex**
1	Chinese Pug	2	11	F
2	Chinese Pug	5	10.2	F
3	Shih Tzu	2	5.7	F
4	Boxer	1	37	M
5	Pekingese	3	4.5	M
6	Chihuahua	4	5.3	M
Group B- Corneo-conjunctival transposition				
1	Chinese Pug	1	6.5	M
2	Rottweiler	5	41	M
3	Chinese Pug	3	9	M
4	Shih Tzu	3.5	3.6	F
5	Chinese Pug	2	11	M
6	Bulldog	2.5	34.2	M

Observations recorded pre-operatively after history taking and examination of the eye with respect to the symptoms and clinical signs of all the animals in both the Groups A and B are listed in Table no. 4.2 and 4.3. The most common clinical signs noted in both the groups were pawing of eye, blepharospams, epiphora, corneal pigmentation, disorder of cilia. Similar findings have been described by Slatter (2001), Ollivier (2003) and Ledbetter and Gilger (2013).

In Group A, accurate history was not available for C1, C3 and C5. The owners of C2 and C6 reported chronic and recurrent ocular disease in the patient and no improvement was reported inspite of medical treatment. In the case of C4, trauma was the cause for the formation of the corneal

defect as the dog scratched its eye. Corneal pigmentation was noted in two out of the six cases i.e. C1 and C2, whereas C3 had long aberrant cilia on its eyelid and C1 and C2 displayed mild degree of entropion of the lower eyelid. All cases displayed hyperemia of the bulbar conjunctiva and their anterior chamber could not be visualized due to corneal opacity except in C5 where no abnormality was noted.

In Group B, trauma to the eye was the reason for formation of corneal ulcer in C1 and C2. Corneal pigmention was seen in three out of the six cases i.e. C1, C2 and C3. Mild entropion of the lower eyelid was noted in two out of the six cases i.e. C2 and C6. All the cases, except C6 had hyperemia of the bulbar conjunctiva and the anterior chamber could not be visualized in all cases except C4 and C6 due to corneal opacity.

The hyperemia seen in the cases mentioned above could be due to low STT values, adenexal disease such as entropion or aberrant cilia and chronic corneal exposure due to lagophthalmos. Similar findings were reported by Laminack *et al.* (2013) who in their study based on dogs also found that hyperemic bulbar conjunctiva was associated with KCS, entropion, ectopic cilia, exophthalmos, lagophthalmos and chronic corneal exposure.

Corneal pigmentation seen in cases mentioned above could be because of the constant irritation caused by entropion of the lower eyelid. Maini *et al.* (2019) also reported similar findings in their study on pigmentary keratitis in pugs due to age and the presence of medial entropion of the lower eyelid (MELE).

Table no 4.2: History and clinical signs seen during preoperative examination of group A

Patient	History	Previous medication	Pawing eye	Blepharospam	Epiphora	Corneal pigmentation	Bulbar conjunctiva	Anterior chamber	Disorder of cilia	STT (mm/ min)
1.	Unavailable	None	+	+	-	+	Hyperemic	Not visualized	Mild entropion	6
2.	Chronic corneal disease	Refresh eye drops	-	-	-	+	Hyperemic	Not visualized	Mild entropion	8
3.	Unavailable	None	+	+	-	-	Hyperemic	Not visualized	Long abberant cilia	3
4.	Trauma	None	+	+	+	-	Hyperemic	Not visualized	NAD	21
5.	Unavailable	None	-	+	+	-	NAD	NAD	NAD	19
6.	Chronic ulcer	Moxifloxacin drops	-	+	-	-	hyperemic	Not visualized	NAD	8

Table no. 4.3: History and clinical signs seen during preoperative examination of group B

Patient	History	Previous medication	Pawing eye	Blepharospasm	Epiphora	Corneal pigmentation	Bulbar conjunctiva	Anterior chamber	Eyelid disorder	STT (mm/min)
1.	Trauma	None	+	+	+	+	Hyperemic	Not visualized	NAD	19
2.	Trauma	None	+	-	+	+	Hyperemic	Not visualized	Mild entropion	22
3.	Progressive corneal ulceration	Applicaps	+	-	-	+	Hyperemic	Not visualized	NAD	7
4.	Unavailable	None	-	-	+	-	Hyperemic	NAD	NAD	4
5.	Unavailable	None	+	+	-	-	Hyperemic	Not visualized	NAD	5
6.	Nasal fold dermatitis	Cephalixen	-	-	-	+	NAD	NAD	Mild entropion	8

4.2.2. Neuro-ophthalmic/visual function tests:

Pupillary light reflex, dazzle reflex, menace reflex, palpebral reflex, tracking response and obstacle tests were performed pre-operatively for assessment of neuro-ophthalmic function and vision in all the cases. The findings of the tests performed is given in table no. 4.4.

Table 4.4: Neuro-ophthalmic vision testing (n=12)

Observation	PLR	Dazzle	Menace	Palpebral	Tracking response	Obstacle	Corneal reflex
Present (+)	3	6	8	12	8	8	12
Sluggish (±)	-	6	4	-	4	4	-
Absent (-)	9	-	-	-	-	-	-

In the present study out of the 12 eyes, pupillary light reflex was present in 25% (n=3) eyes and in 58.33% (n=7) eyes it could not be determined due to corneal pigmentation, opacity and deep epithelial defects. These finding are similar to the observations of Cullen and Grahn (2005) and Felchle and Urbanz (2001) who used pupillary light reflex for confirmation of corneal transparency and vision function. Dazzle reflex was present in 50% (n=6) eyes and was sluggish in 50% (n=6) eyes. It was found to be useful in cases where pupils were not seen like in cases of corneal opacity. Mowat (2002) also recorded similar findings. Menace reflex was present in 66.66% (n=8) eyes and was sluggish in 33.33% (n=4) eyes. Palpebral reflex was present in 100% (n=12) eyes. Tracking response was present in 66.66% (n=8) eyes and sluggish in 33.33% (n=4) eyes. Tracking response was accepted as positive if the animal followed the object to the floor. It was also noted that animals got bored with repeated use of cotton ball to elicit the tracking response and that led to

negative results, this finding was supported by Martin (2001) and Maggs (2008). Obstacle test was positive in 66.66% (n=8) eyes and was sluggish in 33.33% (n=4) eyes. Corneal reflex was positive in 100% (n=12) eyes. Neuro-ophthalmic vision testing score of Group A and Group B is given in table no. 4.5 and table no. 4.6 respectively.

Table no.4.5: Pre-operative Neuro-ophthalmic vision testing score of group A

Case No.	PLR	Dazzle	Menace	Tracking response	Obstacle	Total score
1.	0	1	1	1	1	4
2.	0	1	1	1	1	4
3.	0	1	2	2	2	7
4.	0	2	2	2	2	8
5.	2	2	2	2	2	10
6.	0	2	2	2	2	8

Table no. 4.6: Pre-operative Neuro-ophthalmic vision testing score of group B

Case No.	PLR	Dazzle	Menace	Tracking response	Obstacle	Total score
1.	0	1	2	2	2	7
2.	0	2	2	2	2	8
3.	2	1	1	1	1	6
4.	0	2	2	2	2	6
5.	0	1	1	1	1	4
6.	2	2	2	2	2	10

Present (2) Sluggish (1) Absent (0)

4.2.3. Special diagnostic tests

4.2.3.1. Schirmer's tear test:

In this study Schirmer's tear test was done on all 12 cases and the mean value of tear production measured by STT (mm/min) on the day of presentation in Group A was recorded as 10.83 ± 3 and in Group B as 10.83 ± 3.1. No topical medication was administered, neither was the animal sedated or given anaesthesia before STT was performed as stated by Munro (2001) and Morreale

(2003). Ludders and Heavner (1979) found administering atropine topically or systemically, alone or in conjunction with general anaesthesia resulted in decreased tear production. Tear production was also influenced by fear which increased sympathetic stimulation and falsely reduced STT values as recorded by Kaswan *et al*. (1995). Gelatt (1991) observed the normal range of canine tear production to be 15-25 mm/min. Thangamuthu and Varshney (2002) recorded normal canine tear production as 22.54 ± 0.41 mm/min where as Kotani (2001) recorded it as 21.3 ± 3.8 mm/min.

4.2.3.2. Fluorescein stain test:

Out of the 12 dogs selected, 50% (n=6) were positive for dye uptake whereas 50% (n=6) were negative for dye uptake due the corneal lesion being a descemetocele. Pre corneal tear film deficiencies, corneal and conjunctival epithelial defects could be detected using fluorescein dye according to Slatter (1990). Fluorescein dye not only stained the ulcerated area but also migrates under the loose epithelium and stains the surrounding stoma making the ulcer appear larger than its actual size as noted by Whitley and Gilger (1999). Felchle and Urbanz (2001) observed that fluorescein uptake is absent in healthy intact corneal epithelium and descemet's membrane however, Kern 1990 has stated that the dye will enter and stain the water soluble corneal stroma and the intercellular spaces if corneal integrity is compromised. Singh *et al*. (2016) also used this staining technique to detect corneal ulcers. Strubbe and Gelatt (1999) observed the corneal lesions with naked eye or with the help of magnification after staining. Ollivier (2003) observed that during staining to avoid misinterpretation of a positive result, the moistened tip is touched to the bulbar conjunctiva and not the cornea. Bromberg (2002) considered a negative fluorescein dye test as an indication of a healthy cornea or complete corneal healing. Brunott *et al*. (2007) also considered a negative fluorescein dye test as completion of corneal epithelialisation.

4.2.3.3. Direct ophthalmoscopy:

Direct ophthalmocscopy was done in all the cases as per the procedure described by by Gelatt *et al*. (2008). Out of the 12 cases selected for the study, in 9 cases direct ophthalmoscopy was not possible as intraocular structures could not be visualized due to corneal pigmentation, corneal vascularization and opacity. In 3 cases direct ophthalmoscopy did not reveal any abnormality and intraocular structures were visualized between +3 to -3 diopters.

4.3. AGE WISE DISTRIBUTION

The distribution of corneal ulcers in the selected dogs were ranging from 1 to 5 years with a mean age of 2.8 ± 0.39 years. This observation was similar to the findings of Kim *et al.* (2009) who also reported the percentage of ulcerative keratitis to be higher in dogs less than 3 years of age. The age wise distribution of dogs with corneal ulcers is given in table no. 4.7 and is represented graphically in fig. 1.

Table 4.7: Age wise distribution of dogs with corneal ulcers

Age group	No. of cases	Percentage (%)
1-2 years	5	41.66
2.5-3.5 years	4	33.33
> 3.5 years	3	25

Highest percentage of corneal ulcers was seen in the age group of 1-2 years 41.66% (n=5), followed by age group 2.5-3.5 years 33.33% (n=4) and age group > 3.5 years 25% (n=3). Murphy *et al*. (2001) and Ramani *et al.* (2013) also found that corneal ulceration was more prone to happen in ages between 1-3 years. In contrast, Moore (2003) reported high percentage of corneal ulcers in

middle aged dogs with a mean age of 8.2 year however, Wilkie and Whittaker (1997) opined that corneal ulcers could affect dogs of any age. The higher percentage of corneal ulcers in age group of 1-2 years in this study could be related to the improper management of pets. The owners might not have supervised the pets due to either being first time pet owners and lacking information about ocular health or due to improper obedience training of the pets which could have increased the percentage of corneal trauma by scratching, playful nature of younger dogs, engaging with other animals etc.

4.4. SEX WISE DISTRIBUTION

Out of the 12 dogs selected for the study, 8 were males (66.66%) and 4 were females (33.33%). Moore (2003) and Ramani *et al*. (2013) also reported that male dogs (67%) had a higher percentage of corneal ulceration than female dogs (33%). Stanley *et al.* (1998) reported higher percentage of corneal ulcers in male dogs (57%) than female dogs (43%) however, both Murphy *et al*. (2001) and Wilkie and Whittaker (1997) stated that sex of the animal was not related to epitheial defects and that dogs of any sex were equally prone to corneal ulceration. The sex wise distribution of dogs with corneal ulcers is given in table no. 4.8 and is represented graphically in fig. 2.

Table 4.8: Sex wise distribution of dogs with corneal ulcers

Sex	No. of cases	Percentage (%)
Male	8	66.66
Female	4	33.33

4.5. BREED WISE DISTRIBUTION

Out of the 12 dogs selected for this study, 5 were Chinese pugs 41.66% (n=5), 2 were Shih- tzu's 16.66 % (n=2) and the rest were Boxer 8.33% (n=1), Bulldog 8.33% (n=1), Chihuahua 8.33 % (n=1), Pekingese 8.33% (n=1) and Rottweiler 8.33% (n=1) each. Ramani *et al*. (2013) also observed the highest percentage of corneal ulcers in Pugs followed by Spitz, non-descript breeds, Boxers and Labrador retrievers, Terriers, Rottweilers and Great danes. Thompson (2007) reported that Shih-tzu, Bulldog, Lhasa apso, Pekingese and Pug like brachycephalic breeds were more prone to ulcerative keratitis. Kim *et al*. (2009) stated that in brachycephalic breeds, predisposition to corneal injuries was owing to characteristic features like lagophthalmos. The breed wise distribution of dogs with corneal ulcers is given in table no. 4.8 and is represented graphically in fig. 3.

Table 4.9: Breed wise distribution of dogs with corneal ulcers

Breed	No. of cases	Percentage (%)
Chinese pug	5	41.66
Shih Tzu	2	16.66
Boxer	1	8.33
Bulldog	1	8.33
Chihuahua	1	8.33
Pekingese	1	8.33
Rottweiler	1	8.33

4.6. DIAGNOSIS AND CLASSIFICATION OF CORNEAL ULCERS

4.6.1. Location of corneal ulcers:

In the present study out of the 12 eyes, in 50% (n=6) eyes the corneal ulcer was located centrally, 41.66% (n=5) it was para-central and in 8.33% (n=1) it was peripheral. Dorbandt *et al.* (2015) also found higher percentage of centrally located corneal ulcers in dogs. This might be due to incomplete

palpebral apposition due to exophthalmia leading to lagophthalmos and uneven distribution of tear film in the central region of the cornea. The location of the corneal ulcer in affected dogs is given in table no. 4.10 and is represented graphically in fig. 4.

Table 4.10: Location of the corneal ulcer in affected dogs

Location of corneal ulcer	No. of cases	Percentage (%)
Central	6	50
Para-central	5	41.66
Peripheral	1	8.33

4.6.2. Classification of corneal ulcers:

In this study out of the 12 eyes, 50% (n=6) eyes presented descemetocele, 33.33% (n=4) had the presence of superficial corneal ulcers and 16.66% (n=2) showed deep stromal corneal ulcer. These findings are in accordance with the findings of Kim *et al*. (2009) who also reported superficial ulcers (22%), deep corneal ulcers (22%), descemetocele (26%) and corneal perforation to be (8%) in dogs however, Patel *et al*. (2020) reported that the percentage of superficial ulcers was (62.16%), indolent ulcer was (18.91%), deep ulcer was (13.51%) and descemetocele was (5.40%) in dogs. The higher percentage of descemetocele in this study could be because of trauma to the eye or leaving the corneal ulcer untreated for many days leading to erosion of the layers of the cornea upto the descemet's membrane. The depth of the corneal ulcer in affected dogs is given in table no. 4.11 and is represented graphically in fig. 5.

Table 4.11: Classification of the corneal ulcer in affected dogs

Classification of corneal ulcer	No. of cases	Percentage (%)
Superficial corneal ulcer	4	33.33
Deep stromal corneal ulcer	2	16.66
Descemetocele	6	50

4.7. MICROBIOLOGICAL ANALYSIS

In the present study 12 swabs collected from 12 dogs were processed for bacterial isolation. 33.33% (n=4) samples were positive for bacterial growth while 66.66% (n=8) samples were negative for any growth. Main bacterial isolates in the 4 samples were *Staphylococcus aureus* (16.66%), *Staphylococcus epidermidis* (8.33%) and *Pseudomonas aeruginosa* (8.33%). Anoop *et al*. (2015) found *Staphylococcus aureus* (40%), *Enterococci spp* (16%), *Staphylococcus intermedius* (10%), *Corynebacterium spp* (12%), *Klebsiella spp* (7%), *Bacillus spp* (4%), *E-coli* (4%) and *Actinobactor spp* (6%) from swabs taken from dogs suffering from pigmentary keratitis. Kecova *et al.* (2004) also found that the most frequent isolate was *Staphylococcus spp* followed by less frequent species such as *Streptococcus spp, Enterococcus spp*. Varges *et al.* (2009) observed that *Staphylococcus intermedius* (45%) was the most frequent isolate followed by *Staphylococcus aureus* (22.5%), *Staphylococcus epidermidis* (20%) and *Staphylococcus stimulans* (12.5%). Prado *et al.* (2005) observed that Gram-positive bacteria (86.5%) pre-dominated gram-negative bacteria (13.5%) in the comparative study of normal dogs and those with ulcerative keratitis. Morales (2009) reported that Gram-negative rods (43.43%) was the most frequent group with *Pseudomonas aeruginosa* being the most common isolated bacteria followed by (39.06%) of gram-positive cocci (*Staphylococcus spp* + *Streptococcus spp*). The microbial analysis of the corneal swabs in given in table no. 4.12.

Table 4.12: Microbiological analysis of corneal swabs

Organism isolated	Direct smear	No. of cases	Antimicrobial sensitivity
Staphylococcus aureus	Gram +ve cocci	2	Gentamicin, Ciprofloxacin, Doxycycline and Chloramphenicol
Staphylococcus epidermidis	Gram +ve cocci	1	Gentamicin, Ciprofloxacin and Chloramphenicol
Pseudomonas aeruginosa	Gram –ve bacilli	1	Amikacin, Gentamicin, Ciprofloxacin and Tobramycin
No growth	-	8	-

4.8. ETIOLOGY OF CORNEAL ULCERS

In the present study keratoconjunctivitis sicca 41.66% (n=5), trauma 33.33% (n=3) and infection 25% (n=3) were majority of etiological factors for corneal ulcers. Similar findings have been reported by Moore and Naisse (1999) and Moore (2003), whereas, Kim *et al*. (2009) found that keratoconjunctivitis sicca (KCS) in 31% cases, lagophthalmos in 28% cases, bacterial infection in 11% cases, nasal fold trichiasis in 11% cases and trauma in 8% cases were the most common etiological factors contributing to corneal ulcers. Hakanson and Merideth (1987) have stated that the cornea's protective mechanism was negatively impacted by inherently lower corneal sensitivity in brachycephalic breeds. Crispin (2002), Martin (2005), Gilger *et al*. (2007) and reported that the etiology of corneal ulcers was allergy, distichiasis, ectopic cilia, entropion, foreign body, trauma, lack of tears, infection or may be congenital. The etiological factors in the cases of corneal ulcers are given in table no. 4.13 and represented graphically in fig. 6.

Table 4.13: Etiological factors in the cases of corneal ulcers

Etiological factors	No. of cases	Percentage (%)
Trauma	4	33.33
Keratoconjunctivitis sicca	5	41.66
Infection	3	25

4.9. PRE AND POST-OPERATIVE MEDICAL THERAPY

The pre-operative medical therapy included the use of 0.3% ciprofloxacin antibiotic drops, artificial tears eye drops, oral pain medication like tramadol and prophylactic antibiotic like doxycycline. The same medical therapy was continued post-operatively as the organisms found in antibiotic culture sensitivity test were susceptible to 0.3 % ciprofloxacin eye drops. The prescribed medical therapy was found to be adequate as it reduced the signs seen on presentation and made the patient more comfortable. Morales (2009) reported aminoglycosides and quinolones to be the first choice of antibiotics to be used immediately while awaiting results of the cultures and susceptibility tests.

4.10. PRE-ANAESTHETIC AND ANAESTHETIC PROCEDURE

In this study, anaesthetic regimen of glycopyrrolate, diazepam, butorphanol and propofol along with instilling 0.5% proparacaine topically in the eye produced satisfactory anaesthesia for corneal surgery. Clutton (1988) opined that anticholinergics prevented or reversed the oculocardiac reflex. Watkins *et al*. (1987) stated that propofol provided smooth and rapid induction while Young *et al.* (1991) reported a quicker recovery from anaesthesia in dogs anaesthetized with propofol. Kovalcuka *et al*. (2013) reported that diazepam increased the horizontal pupil diameter 10 min after administration and made it

easy for examination. Douet *et al*. (2014) reported that butorphanol provided a good restraint for ophthalmic examination, but interefered with STT and IOP values.

4.11. PATIENT POSITIONING AND DRAPING

The dogs were placed in lateral recumbency with the affected eye facing the ceiling and the head was positioned by placing a soft padding under the head. Eye was draped with a drape having an operating window diameter of 5 cm in the centre. Similar method of patient positioning and draping has been described by Balaji (2016) and Vedpathak (2015).

4.12. OPERATIVE PROCEDURES

4.12.1. Group A- Diamond burr debridement with soft contact bandage lens

Debridement with an Algerbrush was carried out in call cases included in this group followed by placement of soft contact bandage lens. This procedure was simple and did not require a high level of skill. Although this procedure has been done under topical anaesthesia with proparacain eye drops, general anaesthesia was opted for in this study due to the fractious nature of the patients.

Moore (2003) has stated that debridement stimulated proliferation of adjacent epithelium and thus stimulated corneal healing by promoting the attachment of basement membrane. In the present study diamond burr debridement was found to remove the abnormal membrane and non-adherent epithelial cells without penetrating into normal stroma and was safe to use in dogs. Rienstein (2019) has also stated that diamond burr debridement in conjunction with soft contact bandage lens improved healing by protecting the migrating epithelial cells and also improved the patient comfort by covering the

exposed corneal nerves. Neville *et al*. (2015) have also reported similar findings.

4.12.2. Group B- Corneo-conjunctival transposition

Corneo-conjunctival transposition was carried out in all cases in this group followed by temporary tarsorrhaphy. This technique required a high level of skill, good hand eye co-ordination and extreme concentration. An operating microscope was used routinely to do this procedure. However, 6x ophthalmic loupe and an LED headlight was used in this study which increased the operating time, time taken to get used to the instruments under magnification and put a lot of strain on the eyes which hampered the speed of performing the procedure.

Wilkie and Whittaker (1997) stated that deep axial corneal ulcers and perforations could be treated with corneo- conjunctival transposition as this surgical procedure served to transpose healthy cornea into the axial location, maintaining a clear axial cornea while repairing the defect. Jaksz and Busse (2017) also reported corneo-conjunctival transposition to be advantageous because of the use of one's own tissue resulting in decreased corneal scarring and leading to a more transparent cornea post operatively.

4.13. POST-OPERATIVE MANAGEMENT

Oral administration of tab doxycycline (5 mg/kg b.wt), tramadol at (5 mg/kg b.wt) and topical applications of ciprofloxacin and artificial tear eye drops effectively controlled infection in all the cases. Sansom (2000) reported that it was difficult to treat established infection due to presence of blood ocular barrier and absence of lymphatics, therefore both systemic and topical treatment was warranted. Munro (2001) stated that the use of antibiotics was indicated to treat corneal ulceration as the loss of epithelial barrier exposed the corneal

stroma which could be colonized by bacteria. Lamont and Mathews (2007) recommended tramadol an opioid analgesic for management of moderate to severely moderate pain. In the present study use of Elizabethan collar was mandatory for all cases in the post operative period. Similar method of protecting the eye post surgery has been described by Startup (1984) and Collins *et al*. (1995).

4.14. PARAMETERS STUDIED

4.14.1. Surgical parameters

4.14.1.1. Surgical operating time (in minutes):

The time required for performing the surgery was noted in each case and is given in table no. 4.14 and represented graphically in fig. 7.

Table 4.14: Surgical operating time (in minutes)

Case No.	Group A	Group B
1.	5	85
2.	6	70
3.	9	65
4.	5	70
5.	4	60
6.	5	62
Mean ± SE	5.6 ± 0.71	68.66 ± 3.66

Parameter	Group	Mean ± SE	t- value	t- critical
Surgical operating time (in minutes)	A	5.6 ± 0.71	16.67	2.57
	B	68.66 ± 3.66		

The mean surgical operating time in group A was 5.6 ± 0.71 minutes. Banks *et al.* (2019) performed diamond burr debridement for 120 seconds on corneal stroma using the Algerbrush. Operating time in this study was increased trying to place the soft contact bandage lens properly on the cornea so as to avoid folding of the lens.

The mean surgical operating time in group B was 68.66 ± 3.66 minutes. Utter *et al*. (2009) also reported similar findings. who also reported operating time with a range of 40-135 minutes for performing conjunctival grafts in 21 horses with corneal lesions. Wilkie and Whittaker (1997) opined that microsurgery requires practice and constant work on the part of the surgeon since it is a technique and an art. Difficulty was faced during this study to get proper magnification through the binocular loupes to visualize the instruments and the suture material while operating. Also, handling of the instruments under magnification required practice.

4.14.1.2. Pain during surgery:

Signs of pain like sudden movements, discomfort or abnormal behaviour were not noted throughout the surgery in all cases and could be due to the use of anaesthetics producing balanced anaesthesia.

Diazepam, a benzodiazepine sedative, was used as premedication in this study. Bader *et al*. (2017) reported that diazepam had a significant anti-inflammatory effect in albino rats. Aarnes and Muir (2011) reported that butrophanol could be used for mild to moderate pain and was more effective for visceral pain than for musculoskeletal pain. Robertson *et al*. (2009) reported that butorphanol produced further analgesia in cats with interstitial cystitis following an IM injection (0.1mg/kg). Tamura *et al*. (2002) found that intramuscular shot of butorphanol administered (0.1 mg) did not have any effect on IOP in dogs after intubation and could be added to the sedation protocol for ophthalmic surgeries in dogs.

4.14.1.3. Intra-operative complications:

In group A, no intra-operative complications were noted throughout the procedure. This could be because of the simplicity of the technique used and a short operating time therefore, diamond burr debridement technique was best suited for superficial ulcers to debride the superficial layer of non adherent epithelial cells and promote migration of healthy cells in the corneal defect.

In group B, 2 cases had mild bleeding after the incision on the bulbar conjunctiva due to its vascularity. The hemorrhage was controlled by applying pressure on the point of bleeding with a sterile cotton swab. Coster *et al*. (2008) reported that conjunctival bleeding could be controlled with 2.5% phenylephrine nasal or ocular drops. However, the above mentioned method was found to be adequate for arresting the hemorrhage. Corneo-conjunctival transposition was best suited for deep corneal defects like descemetoccele and corneal perforations which would require mechanical support and unwanted incision on the bulbar conjunctiva could be avoided in case of superficial ulcers.

4.14.1.4. Quality of induction of anaesthesia:

Quality of induction of anaesthesia observed in each patient of groups A and B is given in table no. 4.15 and 4.16 respectively.

Table no. 4.15: Quality of induction of anaesthesia in group A

Case no.	Quality of induction of anaesthesia
1.	Good
2.	Good
3.	Good
4.	Excellent
5.	Excellent
6.	Excellent

Table no. 4.16: Quality of induction of anaesthesia in group B

Case no.	Quality of induction of anaesthesia
1.	Good
2.	Excellent
3.	Good
4.	Excellent
5.	Good
6.	Excellent

The quality of induction of anaesthesia in group A and B was found to be good to excellent. No complications were observed during induction of anaesthesia. A brief period of apnoea was noted in C1 and C2 of group A after which regular respiration was resumed. No agitation or involuntary movements were observed. These findings are consistent with Watkins *et al.* (1987), who stated that propofol provided smooth and rapid induction. Morgan and Legge (1989) reported that complications with propofol induction were infrequent but a transient apnea was the most common complication which was in accordance to the observations made in this study. The premedication may also have contributed to the better quality of induction. Pottie *et al.* (2008) also reported that dogs administered with premedication and propofol were more likely to have an excellent quality of induction.

4.14.1.5. Quality of maintenance of anaesthesia:

Quality of maintenance of anaesthesia observed in each patient of groups A and B is given in table no. 4.17 and 4.18 respectively.

Table no. 4.17: Quality of maintenance of anaesthesia in group A

Case no.	Quality of maintenance of anaesthesia
1.	Excellent
2.	Excellent
3.	Excellent
4.	Excellent
5.	Excellent
6.	Excellent

Table no. 4.18: Quality of maintenance of anaesthesia in group B

Case no.	Quality of maintenance of anaesthesia
1.	Excellent
2.	Excellent
3.	Excellent
4.	Excellent
5.	Excellent
6.	Excellent

The quality of maintenance of anaesthesia in group A and B was found to be excellent. No signs of pain or discomfort were noted during the entire surgical procedure. Maintenance of anaesthesia was carried out under 2.5% isoflurane with oxygen supplementation. Isoflurane was found to maintain a satisfactory plane of surgical anaesthesia. Jones and Seymour (1986) also reported similar findings with a rapid and dose dependant change in depth of anaesthesia.

4.14.1.6. Position of eyeballs during anaesthesia:

Position of the eyeballs observed in each patient of groups A and B is given in table no. 4.19 and 4.20 respectively.

Table no. 4.19: Position of eyeballs during anaesthesia in group A

Case no.	Position of eyeballs during anaesthesia
1.	Partial downward rotation
2.	Partial downward rotation
3.	Partial downward rotation
4.	Complete downward rotation
5.	Complete downward rotation
6.	Complete downward rotation

Table no. 4.20: Position of eyeballs during anaesthesia in group B

Case no.	Position of eyeballs during anaesthesia
1.	Partial downward rotation
2.	Complete downward rotation
3.	Partial downward rotation
4.	Complete downward rotation
5.	Partial downward rotation
6.	Complete downward rotation

Downward rotation of the eyeballs was seen in all cases of group A and group B in this study. The downward rotation of the eyeballs observed during this study may be attributed to the anaesthetic agents used for induction and maintenance of general anaesthesia in the surgical plane. Auer et al. (2007) also reported downward rotation of eyeballs in dogs anaesthetized using propofol and maintained on a propofol CRI.

In this study, the downward rotation of the eyeball made it difficult to visualize the corneal ulcer and incise the cornea to prepare the graft. This was overcome by stay a suture placement on the limbus. The eyeball was pulled into central position by gentle traction using an artery forcep applied to the limbal stay suture. Gelatt (2011) stated that mechanical traction may lead to distortion of the fibrous tunics which predisposed to difficulty in the operative procedure but such findings were not encountered in this study.

Briganti *et al.* (2015) reported the use of rocuronium, in propofol induced dogs maintained under isoflurane anaesthesia, for adequate central position of the globe in ophthalmic surgeries. Accola *et al.* (2006) recommended the use of a retrobulbar injection of local anaesthetic as an alterantive to the use of neuromuscular blocking agents for improving the position of the eyeball during ophthalmic surgeries. However, these techniques were not found to be necessary for obtaining central position of the eye in this study.

4.14.1.7. Quality of recovery from anaesthesia:

Quality of recovery from anaesthesia observed in each patient of groups A and B is given in table no. 4.21 and 4.22 respectively.

Table no. 4.21: Quality of recovery from anaesthesia in group A

Case no.	Quality of recovery from anaesthesia
1.	Excellent
2.	Excellent
3.	Excellent
4.	Excellent
5.	Excellent
6.	Excellent

Table no. 4.22: Quality of recovery from anaesthesia in group B

Case no.	Quality of recovery from anaesthesia
1.	Good
2.	Good
3.	Excellent
4.	Excellent
5.	Excellent
6.	Excellent

Overall quality of recovery from anaesthesia in group A and group B was found to be good to excellent. Some amount of whimpering was noted in C1 and C2 of group B which lasted for a short period of time. No complications like vomiting or coughing were observed in any of the patients in this study.

Smooth and rapid recovery observed in this study could be because of the pre-anaesthetics and anaesthetic drugs used during surgery. Watkins et al. (1987) and Morgan and Legge (1986) have also reported the rapid and excitement free recovery after administration of propofol. Clarke and trim (2013) reported that isoflurane had a low blood and tissue solubility which resulted in rapid and smooth recovery from anaesthesia. This property of isoflurane may have contributed to the good quality of recovery in the patients in this study.

4.14.2. Physiological parameters

4.14.2.1. Rectal temperature (°F):

The rectal temperature (°F) recorded before induction and 24 hours after the procedure in this study is given in table no. 4.23 and represented graphically in fig. 8.

Table 4.23: Rectal temperature (°F)

Case No.	Group A		Group B	
	Pre-op	Post-op	Pre-op	Post-op
1.	101.8	101.7	101.7	101.5
2.	101.2	101.1	102.2	101.1
3.	101.5	101	101.8	101.2
4.	101.2	101.4	101.3	101.5
5.	101.3	100.8	101.2	100.6
6.	102.1	101.3	102	101.6
Mean ± SE	101.5 ± 0.14	101.2 ± 0.13	101.7 ± 0.15	101.2 ± 0.15

Parameter	Group	Mean ± SE	t- value	t- critical
Rectal temperature	A	101.5 ± 0.14	2.02	2.57
		101.2 ± 0.13		
	B	101.7 ± 0.15	2.52	
		101.2 ± 0.15		

The mean pre-operative rectal temperature was 101.5 ± 0.14 (°F) and 101.7 ± 0.15 (°F) in groups A and B respectively whereas, the mean post-operative rectal temperature was 101.2 ± 0.13 (°F) and 101.2 ± 0.15 (°F) in groups A and B respectively.

No significant difference in the rectal temperatures was noted within or between groups A and B during the pre and post-operative period. This could be because of lack of systemic infection and administration of prophylactic antibiotics.

4.14.2.2. Heart rate (beats/min):

The heart rate (beats/min) recorded before induction and 24 hours after the procedure in this study is given in table no. 4.24 and represented graphically in fig. 9.

Table 4.24: Heart rate (beats/min)

Case No.	Group A		Group B	
	Pre-op	Post-op	Pre-op	Post-op
1.	109	115	96	90
2.	120	125	99	110
3.	135	120	105	112
4.	98	110	125	120
5.	112	96	115	98
6.	90	98	100	105
Mean ± SE	110.6 ± 6.5	110.6 ± 4.7	106.6 ± 4.5	105.8 ± 4.3

Parameter	Group	Mean ± SE	t- value	t- critical
Heart rate	A	110.6 ± 6.5	0	2.57
		110.6 ± 4.7		
	B	106.6 ± 4.5	0.19	
		105.8 ± 4.3		

The mean pre-operative heart rate was 110.6 ± 6.5 (beats/min) and 106.6 ± 4.5 (beats/min) in groups A and B respectively whereas, the mean of post-operative heart rate was 110.6 ± 4.7 (beats/min) and 105.8 ± 4.3 (beats/min) in groups A and B respectively.

No significant difference in the heart rate was noted within or between groups A and B during the pre and post-operative period. This could be due to the preanaesthetic use of glycopyrrolate. Bloor *et al*. (1992) opined that premedication with glycopyrrolate prevents clinically significant episodes of bradycardia, which was not noted in this study.

4.14.2.3. Respiratory rate (breaths/min):

The respiratory rate (breaths/min) recorded before induction and 24 hours after the procedure in this study is given in table no. 4.25 and represented graphically in fig. 10.

Table 4.25: Respiratory rate (breaths/min)

Case No.	Group A		Group B	
	Pre-op	Post-op	Pre-op	Post-op
1.	45	42	47	45
2.	42	45	38	35
3.	32	35	42	39
4.	39	36	40	42
5.	40	43	37	34
6.	35	40	32	33
Mean ± SE	38.83 ± 1.92	40.16 ± 1.62	39.33 ± 2.06	38 ± 1.96

Parameter	Group	Mean ± SE	t- value	t- critical
Respiratory rate	A	38.83 ± 1.92	0.94	2.57
		40.16 ± 1.62		
	B	39.33 ± 2.06	1.4	
		38 ± 1.96		

The mean pre-operative respiratory rate was 38.83 ± 1.92 (breaths/min) and 39.33 ± 2.06 (breaths/min) in groups A and B respectively whereas, the mean post-operative respiratory rate was 40.16 ± 1.62 (breaths/min) and 38 ± 1.96 (breaths/min) in groups A and B respectively.

No significant difference in the respiratory rate was noted within or between groups A and B during the pre and post-operative period. This could be due to relatively short surgical time and use of propofol for induction of anaesthesia which lead to faster recovery of the patient. Duke (1995) also stated that with the use of propofol the patient was bright and alert sooner, had rapid recovery and was desirable for anaesthetic management of brachycephalic dogs.

4.14.2.4. Pulse rate (pulse/min):

The pulse rate (pulse/min) recorded before induction and 24 hours after the procedure in this study is given in table no. 4.26 and represented graphically in fig. 11.

Table 4.26: Pulse rate (pulse/min)

Case No.	Group A		Group B	
	Pre-op	Post-op	Pre-op	Post-op
1.	109	115	96	90
2.	120	125	99	110
3.	135	120	105	112
4.	98	110	125	120
5.	112	96	115	98
6.	90	98	100	105
Mean ± SE	110.6 ± 6.5	110.6 ± 4.7	106.6 ± 4.5	105.8 ± 4.3

Parameter	Group	Mean ± SE	t- value	t- critical
Pulse rate	A	110.6 ± 6.5	0	2.57
		110.6 ± 4.7		
	B	106.6 ± 4.5	0.19	
		105.8 ± 4.3		

The mean pre-operative pulse rate was 110.6 ± 6.5 (pulse/min) and 106.6 ± 4.5 (pulse/min) in groups A and B respectively whereas, the mean post-operative pulse rate was 110.6 ± 4.7 (pulse/min) and 105.8 ± 4.3 (pulse/min) in groups A and B respectively.

No significant difference in the pulse rate was noted within or between groups A and B during the pre and post-operative period.

There was no significant variation noted in any of the physiological parameters like rectal temperature, heart rate, respiratory rate and pulse rate within and between group A and group B in this study. These findings are similar to the findings of Raji (2006), Chinchu (2010) and Sarangom (2012). A general physical examination should preceed the ophthalmic examination since ocular involvement may indicate systemic diseases as per Felche and Urbanz (2001).

4.14.3 Haematobiochemical parameters

4.14.3.1. Hemoglobin (g%):

The hemoglobin (%) levels at different time intervals in all cases is given in table no. 4.27 and represented graphically in fig. 12.

Table 4.27: Haemoglobin (g%)

Case No.	Group A		Group B	
	Pre-op	Post-op	Pre-op	Post-op
1.	12.5	12.4	14	13.5
2.	13.2	13	12.6	12.5
3.	11	11.2	10.8	10.5
4.	12.2	12.3	11.5	11
5.	13.7	13	12.6	12.4
6.	14.4	13.6	12	12.3
Mean ± SE	12.83 ± 0.49	12.58 ± 0.33	12.25 ± 0.44	12.03 ± 0.44

Parameter	Group	Mean ± SE	t- value	t- critical
Haemoglobin	A	12.83 ± 0.49	1.48	2.57
		12.58 ± 0.33		
	B	12.25 ± 0.44	1.77	
		12.03 ± 0.44		

The mean pre-operative hemoglobin was 12.83 ± 0.49 (%) and 12.25 ± 0.44 (%) in groups A and B respectively whereas, the mean post-operative hemoglobin was 12.58 ± 0.33 (%) and 12.25 ± 0.44 (%) in groups A and B.

No significant difference was noted within or between groups A and B during pre and post-operative observation period. Superficial ophthalmic surgeries do not lead to major blood loss and hence these procedures did not have any systemic effects.

4.14.3.2. Total Erythrocyte Count (millions/mm^3):

The total erythrocyte count (millions/mm^3) at different time intervals in all cases is given in table no. 4.28 and represented graphically in fig. 13.

Table 4.28: Total Erythrocyte Count (TEC) (millions/mm^3)

Case No.	Group A		Group B	
	Pre-op	Post-op	Pre-op	Post-op
1.	5.4	5.2	5.2	5.1
2.	6.8	6.4	5.8	5.5
3.	5.3	5.1	4.3	4.2
4.	5.6	5.4	6.5	6.3
5.	4.8	4.7	5.2	5.3
6.	5.1	5.2	5.2	5
Mean ± SE	5.5 ± 0.28	5.3 ± 0.23	5.3 ± 0.29	5.2 ± 0.28

Parameter	Group	Mean ± SE	t- value	t- critical
Total Erythrocyte Count	A	5.5 ± 0.28	2.5	2.57
		5.3 ± 0.23		
	B	5.3 ± 0.29	2.3	
		5.2 ± 0.28		

The mean pre-operative total erythrocyte count was 5.5 ± 0.28 (millions/mm^3) and 5.3 ± 0.29 (millions/mm^3) in groups A and B respectively wheras, the mean post-operative total erythrocyte count was 5.3 ± 0.23 (millions/mm^3) and 5.2 ± 0.28 (millions/mm^3) in groups A and B respectively.

No significant difference in the total erythrocyte count was noted within or between groups A and B during pre and post-operative observation period. Wilson *et al*. (2004) described a lack of correlation between hematocrit and spleen size following the anaesthetic protocols with propofol, suggesting sequestration of red blood cells in nonsplenic sites. The non-signifcant alteration in the TEC noted in this study indicated that the corneal abnormalities did not cause any systemic effects and the anaesthetic protocol also was adequate.

4.14.3.3. Total Leucocyte Count (thousands/mm^3):

The total leucocyte count (thousands/mm^3) at different time intervals in all cases is given in table no. 4.29 and represented graphically in fig. 14.

Table 4.29: Total Leucocyte Count (TEC) (thousands/mm^3)

Case No.	Group A		Group B	
	Pre-op	Post-op	Pre-op	Post-op
1.	13.7	13.7	12.4	12.2
2.	10.5	10.5	10.2	10.3
3.	12.3	12.3	7.6	7.6
4.	9.6	9.6	6.3	6.2
5.	11.7	11.6	14.8	14.8
6.	6.5	6.5	11.5	11.2
Mean ± SE	10.71 ± 1.02	10.7 ± 0.86	10.46 ± 1.28	10.38 ± 1.27

Parameter	Group	Mean ± SE	t- value	t- critical
Total Leucocyte Count	A	10.71 ± 1.02	1	2.57
		10.7 ± 0.86		
	B	10.46 ± 1.28	1.38	
		10.38 ± 1.2		

The mean pre-operative total leucocyte count was 10.71 ± 1.02 and 10.46 ± 1.28 in groups A and B respectively whereas, the mean post-operative total leucocyte count was 10.7 ± 0.86 and 10.38 ± 1.27 in groups A and B respectively.

No significant difference in the total leucocyte count was noted within or between groups A and B. The non-signifcant alteration in the TLC noted in this study indicated that the corneal abnormalities did not cause any systemic effects and the anaesthetic protocol also was adequate.

4.14.3.4. Packed Cell Volume (%):

The packed cell volume (%) at different time intervals in all cases is given in table no. 4.30 and represented graphically in fig. 15.

Table 4.30: Packed Cell Volume (PCV) (%)

Case No.	Group A		Group B	
	Pre-op	Post-op	Pre-op	Post-op
1.	38.4	38	40.3	40.3
2.	45.2	45.2	23.4	23.5
3.	36.4	36	28.6	28.5
4.	40.9	40.8	37.7	37.8
5.	27.4	27.5	32.4	32.5
6.	32.3	31	43	43
Mean ± SE	36.76 ± 2.57	36.41 ± 2.63	34.23 ± 3.04	34.26 ± 3.04

Parameter	Group	Mean ± SE	t- value	t- critical
Packed Cell Volume	A	36.76 ± 2.57	1.68	2.57
		36.41 ± 2.63		
	B	34.23 ± 3.04	1	
		34.26 ± 3.04		

The mean pre-operative packed cell volume was 36.76 ± 2.57 (%) and 34.23 ± 3.04 (%) in groups A and B respectively whereas, the mean post-operative packed cell volume was 36.41 ± 2.63 (%) and 34.26 ± 3.04 (%) in groups A and B respectively.

No significant difference in the packed cell volume was noted within or between groups A and B during the pre and post-operative observation period. The non-signifcant alteration in the PCV noted in this study indicated that the corneal abnormalities did not cause any systemic effects and the anaesthetic protocol also was adequate.

4.14.3.5. Liver Function Tests:

4.14.3.5.1. Alanine Transaminase (ALT) (IU/L):

The alanine transaminase (ALT) (IU/L) levels at different time intervals in all cases is given in table no. 4.31 and represented graphically in fig. 16.

Table 4.31: Alanine Transaminase (ALT) (IU/L)

Case No.	Group A		Group B	
	Pre-op	Post-op	Pre-op	Post-op
1.	29.8	29.9	27.1	26.7
2.	32.4	32.4	32	32
3.	43.6	43.4	45	45
4.	37.6	27.3	33.2	33
5.	33.9	33.5	34	34
6.	23.4	23.2	32.3	32
Mean ± SE	33.45 ± 2.80	31.61 ± 2.80	33.93 ± 2.42	33.78 ± 2.46

Parameter	Group	Mean ± SE	t- value	t- critical
Alanine Transaminase	A	33.45 ± 2.80	1.68	2.57
		31.61 ± 2.80		
	B	33.93 ± 2.42	1	
		33.78 ± 2.46		

The mean pre-operative alanine transaminase levels was 33.45 ± 2.80 (IU/L) and 33.93 ± 2.42 (IU/L) in groups A and B respectively whereas, the mean post-operative alanine transaminase was 31.61 ± 2.80 (IU/L) and 33.78 ± 2.46 (IU/L) in groups A and B respectively.

No significant difference in the alanine transaminase levels was noted within or between groups A and B during the pre and post-operatively. Similar results were reported by Nadkarni (2014) and Frink *et al.* (1992) in their comparative study on isoflurane, sevoflurane, enflurane and halothane in dogs who concluded that sevoflurane and isoflurane preserved the hepatic flow during anaesthesia. Günay and Ünsaldı (2000) also found no significant increase in the alanine transaminase levels in dogs anaesthetized with isoflurane and propofol infusion in two separate groups.

4.14.3.5.2. Aspartate Transaminase (AST) (IU/L) :

The aspartate transaminase (AST) (IU/L) levels at different time intervals in all cases is given in table no. 4.32 and represented graphically in fig. 17.

Table 4.32: Aspartate Transaminase (AST) (IU/L)

Case No.	Group A		Group B	
	Pre-op	Post-op	Pre-op	Post-op
1.	27	27	28	27.5
2.	32.5	32.6	34	34
3.	43.2	43	21	20.7
4.	23.4	23.5	37	34.6
5.	38	38	46	45
6.	28.9	28.7	21	22
Mean ± SE	32.16 ± 3	32.13 ± 2.97	31.16 ± 3.99	30.63 ± 3.72

Parameter	Group	Mean ± SE	t- value	t- critical
Aspartate Transaminase	A	32.16 ± 3	0.59	2.57
		32.13 ± 2.97		
	B	31.16 ± 3.99	1.15	
		30.63 ± 3.72		

The mean pre-operative aspartate transaminase levels was 32.16 ± 3 (IU/L) and 31.16 ± 3.99 (IU/L) in groups A and B whereas, the mean post-operative aspartate transaminase was 32.13 ± 2.97 (IU/L) and 30.63 ± 3.72 (IU/L) in groups A and B respectively.

No significant difference in the aspartate transaminase levels was noted within or between groups A and B during the pre and post-operative observation period. Similar results were reported by Robinson and Patterson (1984) in women anaesthetized with propofol. Jagtap (2003) also found no significant changes in AST levels in dogs under propofol anaesthesia for various minor and major surgeries.

4.14.3.5.3. Alkaline Phosphatase (ALP) (IU/L) :

The alkaline phosphatase (ALP) (IU/L) levels at different time intervals in all cases is given in table no. 4.33 and represented graphically in fig. 18.

Table 4.33: Alkaline phosphatase (IU/L)

Case No.	Group A		Group B	
	Pre-op	Post-op	Pre-op	Post-op
1.	97	99	70	70
2.	84	85	109	110
3.	102	102	105	107
4.	134	136	120	121
5.	112	109	116	117
6.	90	98	100	105
Mean ± SE	103.1 ± 7.3	104.8 ± 7	103.3 ± 7.2	105 ± 7.4

Parameter	Group	Mean ± SE	t- value	t- critical
Alkaline phosphatase	A	103.1 ± 7.3	1.1	2.57
		104.8 ± 7		
	B	103.3 ± 7.2	2.3	
		105 ± 7.4		

The mean pre-operative alkaline phosphatase levels was 103.1 ± 7.3 (IU/L) and 103.3 ± 7.2 (IU/L) in groups A and B whereas, the mean post-operative aspartate transaminase was 104.8 ± 7 (IU/L) and 105 ± 7.4 (IU/L) in groups A and B respectively.

No significant difference in the alkaline phosphatase levels was noted within or between groups A and B during the pre and post-operative observation period. Jagtap (2003) also found no significant changes in ALP levels in dogs under propofol anaesthesia for various minor and major surgeries. The non-signifcant alteration in the ALP noted in this study indicated that the corneal abnormalities did not cause any systemic effects and the anaesthetic protocol also was adequate.

4.14.3.6. Kidney Function Tests:

4.14.3.6.1. Blood Urea Nitrogen (BUN) (mg/dl):

The blood urea nitrogen (BUN) (mg/dl) levels at different time intervals in all cases is given in table no. 4.34 and represented graphically in fig. 19.

Table 4.34: Blood Urea Nitrogen (BUN) (mg/dl)

Case No.	Group A		Group B	
	Pre-op	Post-op	Pre-op	Post-op
1.	11.2	11	10.7	10.8
2.	13.2	13.2	12.9	13
3.	14.8	14.5	13.4	13.6
4.	10.8	10.6	8	7.6
5.	20.7	19.7	22	21.6
6.	23.4	22	24.7	24
Mean ± SE	15.68 ± 2.12	15.16 ± 1.91	15.28 ± 2.68	15.1 ± 2.60

Parameter	Group	Mean ± SE	t- value	t- critical
Blood Urea Nitrogen	A	15.68 ± 2.12	2.28	2.57
		15.16 ± 1.91		
	B	15.28 ± 2.68	1.22	
		15.1 ± 2.60		

The mean pre-operative blood urea nitrogen levels was 15.68 ± 2.12 (mg/dl) and 15.28 ± 2.68 (mg/dl) in groups A and B respectively whereas, the mean post-operative blood urea nitrogen was 15.16 ± 1.91 (mg/dl) and 15.1 ± 2.60 (mg/dl) in groups A and B respectively.

No significant difference in the blood urea nitrogen levels was noted within and between groups A and B during the pre and post-operative observation period. Similar findings were reported by Jagtap (2003) in dogs under propofol anaesthesia for various minor and major surgeries. Günay and Ünsaldı (2000) and Nadkarni (2004) also reported no significant changes in the BUN levels after propofol and isoflurane anaesthesia.

4.14.3.6.2. Serum Creatinine (mg/dl):

The serum creatinine (mg/dl) levels at different time intervals in all cases is given in table no. 4.35 and represented graphically in fig. 20.

Table 4.35: Serum Creatinine (mg/dl)

Case No.	Group A		Group B	
	Pre-op	Post-op	Pre-op	Post-op
1.	0.9	0.9	1	1.2
2.	0.7	0.7	1	1
3.	1.1	1.2	0.7	0.7
4.	1.2	1.2	0.4	0.5
5.	0.6	0.7	0.6	0.6
6.	1.3	1.4	1.3	1.4
Mean ± SE	0.96 ± 0.11	1.01 ± 0.11	0.83 ± 0.13	0.9 ± 0.14

Parameter	Group	Mean ± SE	t- value	t- critical
Serum Creatinine	A	0.96 ± 0.11	2.23	2.57
		1.01 ± 0.11		
	B	0.83 ± 0.13	2	
		0.9 ± 0.14		

The mean pre-operative serum creatinine levels was 0.96 ± 0.11 and 0.83 ± 0.13 in groups A and B respectively whereas, the mean post-operative serum creatinine was 1.01 ± 0.11 and 0.9 ± 0.14 in groups A and B respectively.

No significant difference in the serum creatinine levels was noted within or between groups A and B during the pre and post operative observation period. Similar findings were reported by Story *et al.* (2001) in their study on the effect of sevoflurane, isoflurane and propofol on serum creatinine levels. However, Goldberg *et al*. (1996) reported a significant increase in the serum creatinine levels 24 hrs after isoflurane anaesthesia. Such an increase in the serum creatinine levels was not observed in this study indicating that the anaesthetics used in this study did not have any adverse effects on the renal function of the patient.

In this study no significant variation was not noted in any of the haematological parameters like Hb, TLC, TEC, PCV, ALT, AST, BUN and serum creatinine within or between groups A and B in the pre and post-operative observation period. This indicated that the corneal abnormalities were a result of a local tissue response without any systemic effects on the haematological parameters and the anaesthetics used in the study also did not alter the physiological aspects of the patients. Similar findings have been reported by Schalm *et al.*, (2000), Raji (2006), Chinchu (2010) and Sarangom (2012).

4.15. COMPARISON OF THE TWO TECHNIQUES

4.15.1. Corneal opacity:

The observations of corneal opacity in groups A and B at different time intervals in all cases is given in table no. 4.36 and 4.37 respectively.

Table no. 4.36 Observations on degree of corneal opacity in group A

Case no.	Day of observation			
	Day 0	Day 5	Day 15	Day 30
1	+3	+3	+2	+1
2	+4	+3	+2	+1
3	+3	+3	+4	+4
4	+3	+2	+1	+1
5	+2	+2	+1	+1
6	+3	+3	+2	+1
Mean ± S.E				1.5 ±0.5

Table no. 4.37 Observations on degree of corneal opacity in group B

Case no.	Day of observation			
	Day 0	Day 5	Day 15	Day 30
1	+4	+4	+3	+3
2	+3	+4	+4	+4
3	+2	+3	+2	+2
4	+3	+3	+3	+2
5	+4	+4	+3	+2
6	+3	+4	+3	+2
Mean±S.E				2.5 ±0.3

complete opacity (+4) hazy (+2)
moderate opacity (+3) clear (+1)

In group A, C1 had moderate corneal opacity on the day of presentation in the central portion of the cornea. By day 5, after Algerbrush debridement it had diffused further and was closer to the limbus. On day 15 opacity was contained to a very small area centrally and was hazy. On day 30 the corneal was found to be clear with a very small central spot of opacity.

C2 had moderate corneal opacity extending from central portion of the cornea to the limbus outwards toward the lateral canthus of the eye. By day 5 the corneal opacity had taken over the entire cornea except near the limbus. On day 15 the corneal opacity had significantly reduced with a hazy area seen closer to the limbus and by day 30 there was just small scar near the original lesion with the rest of the cornea clear.

C3 had most of the corneal opacity concentrated in the central portion going up to the limbus at 12 o' clock position. By day 5 the central opacity became hazy but still occupied most of the cornea and there was scleral congestion. By day 15 the entire cornea was completely opaque with eyeball protrusion seen. On day 30 the eye was still completely opaque with persistent eyeball protrusion. Wilkie and Whittaker (1997) also observed that opacification of the cornea was frequently observed with healing of the wound which may or may not be irreversible due to the deposition of a type of collagen

fibrils not characteristic of the cornea.

C4 had moderate corneal opacity extending from the central cornea to the limbus towards the lateral canthus. By day 5 the opacity had contained towards the limbus and became hazy. On day 15 the entire cornea was clear with a central pin point opacity. On day 30 the pin point opacity was barely seen.

C5 had diffused haziness of cornea. From day 5 to day 30 it appeared to be clear.

C6 had moderate opacity mainly in the center of the cornea which became hazy by day 15 and appeared clear by day 30.

Most of the cases showed the presence of a clear cornea except on the region of the ulcer where mild corneal scarring was observed. Miller (2001) also reported the development of corneal scarring subsequent to healing of the ulcer.

In group B, C1 had moderate opacity centrally on day 0, by day 5 the entire cornea was completely opaque. The opacity reduced moderately by day 15 and was hazy by day 30 but was still diffused.

C2 had haziness near the limbus towards the lateral canthus which became completely opaque by day 5 and remained completely opaque till day 30 as the case then developed a melting ulcer.

C3 had peripheral haziness on day 0 that became moderately opaque by day 5 and became hazy again on day 15 till day 30 with opacity only around the graft.

C4 had central moderate opacity which became hazy only by day 30 with opacity limited to the graft.

C5 had moderate opacity towards the lateral canthus which became complete by day 5 and became contained in and around the graft by day 15 and ultimately appeared hazy around the graft by day 30.

C6 had an almost clear cornea which became hazy by day 5 around the graft and remained hazy till day 30.

Herring (2003) reported that the dehydrated state of the cornea and the tear film, avascular nature of the cornea, smoothness of anterior epithelium and regular arrangements of collagen fibrils were the major contributing factors in maintaining the corneal clarity.

In group A; most cases towards the end of the 30 day observation period showed the presence of majority of a clear cornea with a small linear opacity around the lesion with capillaries coming from the limbus towards the center of the cornea. Gogova *et al.* (2020) also reported that a slight peripheral linear opacity remained from the transposed limbus with varying degree of pigmentation but the cornea had healed in the center. Gosling *et al.* (2013) observed that corneal edema, vascularization, corneal haze and conjunctival hyperemia was present in all the eyes when bandage lens was used in dogs. However,these finding were not noted in this study.

In group B; majority of the cases had moderate opacity by the end of the observation period as corneo-conjunctival transposition was a more invasive technique and would require a longer observation period than 30 days. Jaksz *et al.* (2021) also observed a follow up time of 54 days (2 to 462) to see corneal clarity with mild persistent corneal fibrosis in their study on autologous corneal graft for the treatment of corneal defects in dogs. Gogova *et al.* (2020) also recorded a mean follow up time as 107.8 days to see faint to mild opacification among dogs treated with corneo-conjunctival transposition for treatment of full thickness corneal defects.

The mean of corneal opacity on day 30 of the observation period of group A was 1.5 ± 0.5 and group B was 2.5 ± 0.3 indicating that cases in group B still had a hazy cornea compared to the cases in group A.

14.15.2. Corneal edema:

The observations of corneal edema in groups A and B at different time intervals in all cases is given in table no. 4.38 and 4.39 respectively.

Table no. 4.38 Observations on degree of corneal edema in group A

Case no.	Day of observation			
	Day 0	Day 5	Day 15	Day 30
1	+	+	-	-
2	+	+	-	-
3	+	+	+	+
4	+	-	-	-
5	-	-	-	-
6	+	+	-	-

Table no. 4.39 Observations on degree of corneal edema in group B

Case no.	Day of observation			
	Day 0	Day 5	Day 15	Day 30
1	+	+	+	-
2	+	+	+	+
3	-	+	-	-
4	-	+	+	-
5	+	+	+	-
6	+	+	+	-

Present (+) absent (-)

In group A, corneal edema was observed in all the dogs on day 0 except C5. Edema persisted in all the cases near the lesion in C1, C2, C3 and C6 on day 5 but was absent in C4 and C5. By day 15 all the cases showed absence of corneal edema except C3 where corneal edema was not decreasing at all. By day 30 all the cases showed absence of corneal edema except C3.

In group B, except C3 and C4 all the cases had corneal edema which progressively increased post surgery on day 5 and was completely diffused. Corneal edema persisted in all cases except C3 around the graft by day 15 and remained till day 30, C3 developed a melting ulcer during the observation period. All the cases except C3 did not show corneal edema by day 30.

In this study in group A; most of the cases had corneal edema on presentation that gradually decreased by day 15 and showed the presence of clear cornea by day 30. Thajunnisa *et al.* (2020) also reported complete dissolution of corneal edema post 14 days after cornea grafting in dogs. Barros *et al.* (1998) also observed that corneal edema in the presence of corneal opacity 24 hrs after corneal grafting susbsided one week after the grafting procedure.

In group B; most of the cases showed presence of corneal edema which increased 5 days after the surgery and then gradually decreased by day 15 but was present even at the end of the observation period of 30 days. However, Suhas (2015) also reported complete resolution of corneal edema after 60 days post- grafting.

4.15.3. Corneal vascularization:

The observations on corneal vascularization in groups A and B at different time intervals in all cases is given in table no. 4.40 and 4.41

Table no. 4.40 Observations on degree of corneal vascularization in group A

Case no.	Day of observation			
	Day 0	**Day 5**	**Day 15**	**Day 30**
1	+3	+3	+2	+1
2	+3	+3	+2	+1
3	+2	+3	+3	+3
4	+2	+2	+1	+1
5	+1	+1	+1	+1
6	+1	+1	+1	+1
Mean ± S.E				1.33 ± 0.3

Table no. 4.41 Observations on degree of corneal vascularization in group B

Case no.	Day of observation			
	Day 0	Day 5	Day 15	Day 30
1	+1	+2	+2	+2
2	+2	+3	+3	+3
3	+1	+1	+2	+2
4	+2	+3	+2	+2
5	+2	+3	+2	+2
6	+1	+2	+2	+2
Mean ± S.E				2.16 ± 0.1

Extensive (+3) mild (+2) no (+1)

The mean of corneal vascularisation on day 30 of the observation period was 1.33±0.3 and 2.16±0.1 in group A and B indicating that cases in group B still had corneal vascularisation as compared to the cases in Group A.

In group A, C1 had the presence of extensive vascularisation concentrated centrally of the cornea with branching towards the limbus on day 0. By day 5 it was completely diffused throughout the cornea while on day 15 it progressively reduced and was seen only towards the periphery. By day 30 no vascularisation was noticed.

C2 was presented with extensive vascularisation centrally on day 0 which only reduced to a small spot on day 15 and showed no signs of vascularisation on day 30.

C3 was presented with very mild superficial vascularisation around the lesion only on day 0 which progressively increased through day 5 to 30 and became extensive and diffused.

C4 had very mild vascularization towards the periphery which remained the same till day 5 and disappeared after day 15.

C5 and C6 had no vascularisation throughout the observation period.

In group B, C1 was presented with no corneal vascularization on day 0 but had mild superficial vascularization on day 5 post surgery only restricted to the conjunctival portion of the graft and was noticed till day 15 whereas the vascularization which was limited to the conjunctiva had not spread to the cornea and had become diffused.

C2 had very mild vascularization near the limbus toward the lateral canthus. The vascularization took up the entire cornea by day 15 and reduced mildly by day 30 but still occupied an extensive area of the cornea. This case developed a melting ulcer during the observation period.

C3 had no vascularization on day 0 and day 5 post surgery and developed mild vascularization contained only to the transposed graft by day 15 to day 30.

C4 showed very mild central vascularization on day 0 after surgery. The central vascularization was eliminated by the graft and the vascularization was localized to only the graft till day 30.

C5 showed mild vascularization near the lesion which was then seen localized to the graft from day 5 to 30.

C6 was presented with no vascularization which then became evident only on the graft from day 5 to day 30.

In group A; mostof the cases cases showed the presence of corneal vascularization on day 5, this could be because of the use of soft contact bandage lens. Gosling *et al.* (2013) also recorded corneal vascularization in 40 per cent of dogs wearing contact lens. Dohlman *et al.* (1973) also reported stromal vascularization in dogs wearing contact lens. The vascularization seemed to have resolved by day 30.

In group B; most of the cases had extensive vascularization on day 5 to the end of the observation period of 30 days. There was significant variation in vascularization of the cornea in both the groups. This could be because of the larger size of the defect which resulted in delayed wound healing in group B. Similar findings have been reported by Pot *et al*. (2014). Vanore *et al*. (2007) also reported that corneal neovascularization was the primary step for integration of graft into the corneal stroma. Small amount of blood vessels are there around the lesion which get aggravated post surgery during graft integration due to growth factor activation within the graft and the cornea. Chow and Westermeyer (2016) also recorded the incorporation of the graft into the cornea which began through the invasion of the graft with blood filled

capillaries and infiltration with fibroblasts during the first week.

4.15.4. Post operative clinical and ophthalmic examination

4.15.4.1. Examination of the eye:

All the cases were evaluated at the end of the 30 days observation period to assess the changes in clinical signs related to corneal ulcers. The observations in each case of groups A and B are presented in table no. 4.42 and 4.43 respectively. Significant improvement in clinical signs were seen in both groups during post operative evaluation of all the cases. This could be due to proper post operative management of the affected eye however, C3 in group A showed no change in the tear production despite of medical management and was still pawing at the eye and was unable to close the eyelid of the affected eye due to an increase in the IOP and C2 of group B developed a melting ulcer post operatively and still had mild epiphora. This could be because of non compliance of the owner as the Elizabethan collar was not put on the dog and all the temporary tarsorrhaphy sutures were broken on day 5 with a significant amount of dirt in the eyes which could have lead to the development of the melting ulcer.

Table no 4.42: Clinical signs seen during postoperative examination of group A

Patient	Pawing eye	Blepharospam	Epiphora	Corneal pigmentation	Bulbar conjunctiva	Anterior chamber	Disorder of cilia	STT (mm/ min)
1.	-	-	-	+	NAD	Not visualized	Mild entropion	9
2.	-	-	-	+	NAD	Not visualized	Mild entropion	9
3.	+	-	-	-	Hyperemic	Not visualized	NAD	3
4.	-	-	-	-	NAD	NAD	NAD	20
5.	-	-	-	-	NAD	NAD	NAD	17
6.	-	-	-	-	NAD	NAD	NAD	9

Table no 4.43: Clinical signs seen during postoperative examination of group B

Patient	Pawing eye	Blepharospasm	Epiphora	Corneal pigmentation	Bulbar conjunctiva	Anterior chamber	Eyelid disorder	STT (mm/ min)
1.	-	-	-	+	NAD	Not visualized	NAD	17
2.	-	-	+	+	Hyperemic	Not visualized	Mild entropion	19
3.	-	-	-	+	Hyperemic	Not visualized	NAD	9
4.	-	-	-	-	Hyperemic	Not visualized	NAD	6
5.	-	-	-	-	Hyperemic	Not visualized	NAD	8
6.	-	-	-	+	NAD	Not visualized	Mild entropion	10

4.15.4.2. Neuro-ophthalmic/visual function tests:

The observations on neuro-ophthalmic and visual functions test score and percent improvement in vision of all the cases of groups A and B post-operatively is given in table no. 4.44, 4.45 and 4.46 respectively.

Table no. 4.44: Post-operative neuro-ophthalmic vision testing score of group A

Case No.	PLR	Dazzle	Menace	Tracking response	Obstacle	Total score
1.	2	2	2	2	2	10
2.	2	2	2	2	2	10
3.	0	0	0	1	1	2
4.	2	2	2	2	2	10
5.	2	2	2	2	2	10
6.	2	2	2	2	2	10

Table no. 4.45: Post-operative neuro-ophthalmic vision testing score of group B

Case No.	PLR	Dazzle	Menace	Tracking response	Obstacle	Total score
1.	0	1	2	2	2	7
2.	0	2	2	2	2	8
3.	2	1	1	1	1	6
4.	2	2	2	2	2	10
5.	0	1	1	1	1	4
6.	2	2	2	2	2	10

Present (2) Sluggish (1) Absent (0)

Table no. 4.46: Post-operative improvement in vision of group A and B

Case no.	% Improvement in group A	% Improvement in group B
1.	60%	-
2.	60%	-
3.	-	-
4.	20%	40%
5.	-	-
6.	20%	-

In group A, 4 cases i.e. C1 and C2 showed a 60 % improvement in vision and C4 and C6 showed a 20% improvement. This could be due to proper post operative management of the affected eye combined with effective medical therapy. However in group B, only 1 case i.e. C4 had a 40% improvement in vision. This could be due to the longer recovery period, persistence of corneal opacity, corneal neovascularization and shorter observation period.

4.15.5. Special diagnostic tests:

4.15.5.1. Schirmer's tear test:

The observations on Schirmer's tear test values at different time intervals in all the cases is given in table no. 4.47.

Table no. 4.47: Schirmer's tear test

Case No.	Group A		Group B	
	Day 0	Day 30	Day 0	Day 30
1.	6	9	19	17
2.	8	9	22	19
3.	3	3	7	9
4.	21	20	4	6
5.	19	17	5	8
6.	8	9	8	10
Mean ± SE	10.83 ± 3	11.16 ± 2.48	10.83 ± 3.13	11 ± 1.85

Parameter	Group	Mean ± SE	t- value	t- critical
Schirmer's tear test	A	10.83 ± 3	-0.46	2.57
		11.16 ± 2.48		
	B	10.83 ± 3.13	-0.19	
		11 ± 1.85		

The mean value of tear production measured by STT (mm/min) on the day of presentation in group A was recorded as 10.83 ± 3 while in group B it was 10.83 ± 3.1, whereas the the mean value of tear production measured by STT (mm/min) on day 30 of the observation period in group A was recorded as

10.83 ± 3.13 and group B as 11 ± 1.85. No significant improvement was noted between STT values within and between groups A and B and were lower than normal values. However, a non significant improvement was seen in the STT values on day 30 of the observation period in both groups. The lower STT values of the study can be indicative of keratoconjunctivitis sicca (KCS) which seems to be an inciting cause for corneal ulcers as also noted by Kim *et al*. (2009).

4.15.5.2. Fluorescein staining:

Fluorescein dye test was negative in all cases of group A and was positive in one case of group B i.e. C2 who developed a melting ulcer and very little dye uptake was seen around the periphery of the ulcer as it was still healing. Maggs (2008) stated that negative fluorescein stain test was seen both in areas of the cornea where the cornea was not ulcerated, or following complete healing of the corneal ulcers. Similar finding was seen in the present study where all 6 cases of group A and 5 cases of group B were considered to be healed when the eyes tested negative for any dye uptake on day 30.

4.15.5.3.Direct Ophthalmoscopy:

In group A, the anterior chamber of C1 and C2 was not easily visualized because of the pigmented cornea, where as in C3 it was not visualized due to the extreme corneal opacity still present on day 30 of the observation period. The rest of the cases had no visible abnormalities. In group B, anterior chamber of all the cases could not be visualized due to the presence of corneal opacity.

4.16. COMPLICATIONS

In group A, major complication encountered was reduced lens retention times details of which are given in table no. 4.48

Table no. 4.48: Lens retention time in group A

Case no.	Lens retention time (hours)
1.	3
2.	2
3.	1
4.	4
5.	3
6.	5
Mean ± SE	3 ± 1.41

The average lens retention time of the selected cases of group A was 3 ± 1.41 hours post the procedure. Wooff and Norman (2015) also reported similar findings. In contrast Diehl *et al*. (2019) observed longer lens retention time of 5.2 days with human contact lens in dogs. Premature contact lens loss in 3 cases was due to the fractious nature dogs inspite of the Elizebethan collar. Similar findings were observed by Bossuyt (2016) where one dog removed the lens despite of a buster collar on 2 occasions.

In group B, out of 6 selected cases, C2 developed a melting ulcer which was noticed on day 5, the dog had removed most of his temporary tarsorrhaphy sutures, had sand like grit in his eyes and his Elizebethan collar

was not kept clean. On examination there was extreme chemosis and visualization of the entire globe was not possible. There was complete opacity of the cornea with yellow ocular discharge and some mud on the eye lids despite the Elizebethan collar being on. Immediate medical therapy was started with instilling 1 drop of tobramycin eye drops in the affected eye every hour for the next 3 days. This was in congruence with Jaksz and Busse (2017) who also instilled antibiotic drops every 1-2 hours for at least 24 to 48 hours in rapid progression and melting ulcers. Thereafter 1 drop was instilled twice a day for 10 days. Autologous serum drops were prepared which was instilled as 1 drop every hour for 3 days and thereafter 1 drop in the affected eye twice a day for 10 days with a 20 min gap between the two applications was recommended. Maggs (2013) also found that therapy with the patients own serum in combination with a broad spectrum antibiotic like tobramycin, a fluoroquinolone like ofloxacin/ciprofloxacin or fortified, compounded amikacin or gentamicin used as often as once hourly can be used to treat melting corneal ulcers. Oral pain medication included tramadol @ 4 mg/ kg b.wt TID for 5 days. This finding was similar to the finding of Clark *et al*. (2011) who observed that oral tramadol administered at 4 mg/kg b.wt TID in beagle dogs required less rescuing with IM morphine (1mg/kg) than in topical 1.2% nalbuphine and that oral tramadol is a reasonable choice for analgesia in corneal pain. On day 10, ocular discharge and chemosis had reduced with increased vascularization in the central portion of the cornea was seen. The entire cornea was still opaque. On day 15 no ocular discharge was seen with moderate corneal opacity and persistence of the vascularization. On day 20, the corneal vascularization had reduced and was completely contained in a small central area of the cornea with moderate cornea opacity while the cornea near the limbus was clear and the transposed graft was finally visible. It was held in place and seemed to be healing well. On day 30, there was reduced corneal vascularization and moderate central corneal opacity.

5. SUMMARY AND CONCLUSIONS

The research project entitled “Comparison of diamond burr debridement with soft contact bandage lens with corneo-conjunctival transposition for treatment for corneal ulcer in dog” was undertaken to evaluate the efficacy of diamond burr debridement with soft contact bandage lens compared to corneo-conjunctival transposition in the treatment of corneal ulcers in dogs. A total of 12 dogs, divided randomly into two groups viz Group A (n=6) in which diamond burr debridement with soft contact bandage lens was performed and Group B (n=6) in which corneo-conjunctival transposition was performed were accounted for in this study, which were presented to the Department of Surgery and Radiology, Mumbai Veterinary College as well as to the Out Patient Department of Mumbai Veterinary College and affiliated Bai Sakarbai Dinshaw Petit Hospital for Animals, Parel, Mumbai.

All cases were subjected to detailed ophthalmic examination by evaluating various neuro-ophthalmic reflexes like menace, papillary light reflex, palpebral reflex, corneal reflex, dazzle reflex, obstacle test and cotton ball test to assess vision. Specific ophthalmic tests performed for the confirmatory diagnosis were fluorescein dye test, Schirmer’s tear test and direct ophthalmoscopy.

Prevalence of corneal ulcers in the dogs selected in the research study included the age wise distribution of corneal ulcers that showed highest percentage (41.66%) in young age group (1-2 years). Male animals (66.66%) were more prone to corneal ulcerations in this study. Brachycephalic breed (Chinese pug) was the most affected dog breed with corneal ulceration. Location based identification of corneal ulceration showed higher numbers of centrally located corneal ulcers (50%). Classification of corneal ulceration showed high numbers of descemetocele (50%). Keratoconjunctivitis sicca (41.66%), traumatic injuries to the corneal epithelium (33.33%) and infection (25%) were found to be the etiology of corneal ulcers.

Corneal swabs were collected from all cases for microbiological analysis for identification and isolation of prevalent ocular microbes. Bacterial keratitis due to *Staphylococcus aureus* was identified as a cause in 2 cases, *Staphylococcus epidermidis* in 1 case and *Pseudomons aeruginosa* in 1 case.

Culture sensitivity test was carried out revealing gentamicin, ciprofloxacin, doxycycline, tobramycin, amikacin and chloramphenicol to be the most sensitive antiobiotics in the study.

All the cases of corneal ulcers were instilled with topical artificial tear eye drops and ciprofloxacin antibiotic eye drops from the day of presentation.

Anesthetic protocol used for diamond burr debridement with soft contact bandage lens and corneo-conjunctival transposition included premedication with glycopyrrolate @ 0.01 mg/kg b.wt, diazepam @ 0.5 mg/kg b.wt and butorphanol @ 0.2 mg/kg b.wt intravenously. Induction of aneasthesia was done using propofol @ 4mg/kg b.wt intravenously and all patients were maintained using isoflurane USP 2.5% with oxygen delivery.

Surgical parameters such as surgical operating time, pain during surgery, intra-operative complications, quality of induction of anaesthesia, quality of maintenance of anaesthesia, position of the eyeballs during anaesthesia and quality of recovery from anaesthesia were noted. Physiological parameters such as rectal temperature, heart rate, respiratory rate and pulse rate were recorded before administration of anaesthesia and after the termination of the procedure.

Blood was collected before and 24 hours after the surgery to evaluate hematological parameters such as Hb, TEC, TLC, PCV and biochemical parameters such as ALT, AST, ALP, BUN and serum creatinine.

Surgical management of corneal ulcers were carried out in 12 cases. Animals were positioned in lateral recumbency with affected eye facing the ceiling, followed by draping of patient with commercially available ophthalmic drape and eyelids were retracted using a Barraquer eyelid speculum exposing the entire cornea.

In group A (n=6) the corneal ulcers were treated with diamond burr debridement with soft contact bandage lens. The Algerbrush was turned on and the whirring burr was gently pressed around the margins of the ulcer in circular motion to debride and remove the loose, non adherent and necrotic corneal epithelium. Soft contact bandage lens was held in a way that the convex side of the lens was on the index finger and applied on the freshly debrided ulcer. Care was taken to avoid air getting trapped by gently pressing on the lens with a cotton swab.

In group B (n=6) the corneal ulcers were treated with corneo-conjunctival transposition with temporary tarsorrhaphy. The initial incision on the cornea was taken using a crescent ophthalmic blade approximately 1mm away from the margins of the corneal ulcer on the dorsal, lateral and ventral aspects.. Dorsal edge of this square was held by the Castroviejo corneal forcep and the crescent blade was advanced under this edge in order to slice through the corneal epithelium and was freed from all the borders and removed exposing the underlying layer of the cornea. The limbus and bulbar conjunctiva was cut and the Castroviejo corneal scissor was advanced under it to free it from the underlying layer to create an autologous lamellar sliding graft. This graft was then pulled and transposed over the corneal ulcer. The graft was held in place and sutured to the cornea with 4 simple interrupted sutures using 8-0 polyglactin suture material at the 4 edges of the graft. Subsequently 4-5 sutures were placed along the margins of the graft with simple continuous sutures. A temporary tarsorraphy was performed to prevent any trauma in the first 4-5 days of the post-operative period and was removed on the 5^{th} day since the operation.

The mean surgical operating time (in minutes) was **5.6 ± 0.71** minutes and **68.66 ± 3.66** minutes in groups A and B respectively. Surgical time was longer in group B due to handling of microsurgical instruments and suture material under magnification.

No signs of pain were noted during the surgery in any of the patients. Adequate depth of anaesthesia and analgesia was achieved.

Inta-operative complications were only seen in 2 cases of group B where there was mild bleeding after incision of the bulbar conjunctiva. The hemorrhage was controlled by applying pressure on the point of bleeding with a sterile cotton swab.

Quality of anaesthesia was good to excellent in groups A and B. Transient apnea was seen in C1 and C2 of group A. Propofol was found to be a very effective induction agent in this study.

Quality of maintenance of anaesthesia was found to be excellent in all cases of groups A and B. Anaesthetic maintenance under isoflurane 2.5% was found to be safe and effective in this study.

A downward rotation of the eyeball was noted in all cases during anaesthetic maintenance. Central position of the eyeball during preparation and suturing of the graft was achieved by applying mechanical traction to the stay suture placed on the limbus using an artery forcep.

Quality of recovery from anaesthesia was excellent to good in groups A and B. Whimpering was noted in C1 and C2 of group B. No complications like vomiting or coughing were observed in any of the patients in this study.

The mean ± SE rectal temperature in group A before induction of anaesthesia was **101.5 ± 0.14** °F and in group B was **101.7 ± 0.15** °F and did not vary significantly within or between groups 24 hours after the procedure.

The mean ± SE heart rate in group A before induction of anaesthesia was **110.6 ± 6.5** beats per minute and group B was **106.6 ± 4.5** beats per minute and did not vary significantly within and between 24 hours after the procedure.

The mean ± SE respiratory rate in group A before induction of anaesthesia was **38.83 ± 1.92** breaths per minute and in group B was **39.33 ± 2.06** breaths per minute and did not vary significantly within or between 24 hours after the procedure.

The mean ± SE pulse rate in group A before induction of anaesthesia was **110.6 ± 6.5** pulse per minute and in group B was **106.6 ± 4.5** pulse per minute and did not vary significantly within or between 24 hours after the procedure.

The mean ± SE Hb, mean TEC, mean TLC and mean PCV values in group A before induction of anaesthesia were **12.83 ± 0.49** g%, **5.5 ± 0.28** million/mm^3, **10.71 ± 1.02** thousand/mm^3 and **36.76 ± 2.57** % and in group B were **12.25 ± 0.44** g%, **5.3 ± 0.29** million/mm^3, **10.46 ± 1.28** thousand/mm^3 and **34.23 ± 3.04** respectively. The difference in mean values 24 hours after the procedure within or between groups was found to be non-significant.

The mean ± SE ALT, AST and ALP values in group A were **33.45 ± 2.80**, **32.16 ± 3** IU/L and **103.1 ± 7.3** IU/L and in group B were **33.93 ± 2.42**, **31.16 ± 3.99** IU/L and **103.3 ± 7.2** IU/L respectively. No significance difference was noted in the mean values 24 hours after the procedure within or between groups.

The mean ± SE BUN and serum creatinine values in group A were **15.68 ± 2.12** and **0.96 ± 0.11** mg/dl and in group B were **15.28 ± 2.68** and **0.83 ± 0.13** mg/dl respectively. No significance difference was noted in the mean values 24 hours after the procedure within and between groups.

The mean ± SE Schirmer tear test values in group A were **10.83 ± 3** and **11.16 ± 2.48** and in group B were **10.83 ± 3.13** and **11 ± 1.85** respectively. No significant difference was noted in the mean values on day 30 between groups.

The success rate of diamond burr debridement with soft contact bandage lens and corneo-conjunctival transposition techniques was evaluated in terms of lack of corneal opacity, corneal edema, corneal vascularization and clinical and ophthalmic examination pre and post operatively of the affected eyes. At the end of the 30 days observation period all cases in group A except C3 had a relatively clear cornea, had no prominent corneal edema and showed lack of corneal vascularization. C3 developed glaucoma and also had delayed healing. In group B, none of the cases had regained complete transparency of the cornea by the end of 30 days observation period. 4 cases out of 6 had a hazy cornea mainly concentrated around the lesion, 1 case showed moderated opacity where as 1 case had complete opacity as the case developed a melting corneal

ulcer. All cases except 1 had no corneal edema, 4 cases showed mild corneal vascularization where as 2 cases still had extensive corneal vascularization around the lesion.

The mean ± SE of corneal opacity on day 30 of the observation period of group A was **1.5±0.5** and group B was **2.5±0.3** indicating that cases in group B still had a hazy cornea compared to the cases in Group A.

The mean ± SE of corneal vascularisation on day 30 of the observation period of group A was **1.35±0.3** and group B was **2.16±0.1** indicating that cases in group B still had corneal vascularisation as compared to the cases in Group A.

During post operative monitoring, all cases in group A, except C3 showed improvement in clinical signs, however C3 developed glaucoma and had dry eyes. In group B, C2 developed a melting ulcer and still showed signs like epiphora by the end of the 30 days observation period.

Improvement in clinical signs was seen in both groups with vision improvement reported in 4 cases of group A, where as vision improvement was seen only in 1 case of group B post operatively.

Fluorescein staining was negative in all cases of group A however, C2 of group B still had a little dye uptake around the periphery of the corneal ulcer by the end of this study.

Diamond burr debridement technique was best suited for superficial corneal ulcers to debride the superficial layer of non adherent epithelial cells and promote migration of healthy cells in the corneal defect.

Corneo-conjunctival transposition was best suited for deep corneal defects like descemetocele and corneal perforations which would require mechanical support and unwanted incision on the bulbar conjunctiva could be avoided in case of superficial corneal ulcers.

On the basis of the findings following conclusions were drawn from the present study:

1. Diamond burr debridement with soft contact bandage lens and corneo-conjunctival transposition were found to be effective surgical techniques in management of corneal ulcers.
2. Diamond burr debridement with soft contact bandage lens was found to be a better technique as it had better recovery in terms of corneal opacity, corneal edema, corneal neovascularization, improvement in vision, less operating time, reduced anaesthetic exposure and more economical as compared to corneo-conjunctival transposition.
3. The anaesthetic protocol of diazepam (0.5 mg/kg b.wt i/v) and butorphanol (0.2 mg/kg b.wt i/v) sedation, propofol (4 mg/kg b.wt i/v) induction and isoflurane (2.5 %) maintenance is safe for corneal surgery in dogs.
4. Medical therapy with topical ciprofloxacin eye drops and artificial tear eye drops as well as systemic antibiotics like doxycycline (5mg/kg b.wt) BID was effective in subsiding infection in this study.
5. *Staphylococcus aureus* was the most common isolated bacteria in bacterial keratitis.
6. Prevalence of corneal ulcers in this study showed higher percentage of male dogs belonging to brachycephalic breeds within 3 years of age affected with centrally located descemetocele.
7. Keratoconjunctivitis sicca was the most common etiology of the corneal ulcers.

BIBLIOGRAPHY

Aarnes, T. K. and W.W, III Muir, 2011. Pain Assessment and Management. In Small Animal Pediatrics, WB Saunders , 220-232.

Accola, P. J., E. Bentley, L. J. Smith, L. J. Forrest, C. A. Baumel and C. J. Murphy, 2006. Development of a retrobulbar injection technique for ocular surgery and analgesia in dogs. Journal of the American Veterinary Medical Association, **229**(2): 220-225.

Andrade, A. L., J. L. Laus, F. Figueiredo and C. M. Batista, 1999. The use of preserved equine renal capsule to repair lamellar corneal lesions in normal dogs. Veterinary ophthalmology, **2**(2): 79-82.

Andrew, S. E., S. Tou and D. E. Brooks, 2001. Corneoconjunctival transposition for the treatment of feline corneal sequestra: a retrospective study of 17 cases, 1990–1998. Veterinary Ophthalmology, **4(**2): 107-111.

Anoop, S., C. B. Devanand and K. V. Syam, 2015. Assessment of grading and isolation of bacterial organisms in canine pigmentary keratitis. International J Advanced Research, **3**: 440-443.

Antonia, N. A., M. K. Narayanan, S. Anoop, C. B. Devanand, J. Martin and S. K. Venugopal, 2014. Occurrence of ophthalmic disorders in dogs. Indian. J. Vet. **23**: 21-24.

Auer, U., M. Mosing and Y. P. Moens, 2007. The effect of low dose rocuronium on globe position, muscle relaxation and ventilation in dogs: a clinical study. Veterinary ophthalmology, **10**(5): 295-298.

Bader, A. A. S., A. H. Omar and M. H. El-Odemi, 2017. Anti-inflammatory Effects of Diazepam on Different Models of Inflammation: Roles of

Peripheral Benzodiazepine Receptors and Genes for Corticosterone. Nitric Oxide and Cytokines Biosynthesis. J. Clin. Epigenet, **3**: 1-8.

Balaji, C, 2016. Clinical Studies on Diagnosis and Surgical Management of Corneal Ulcers in Dogs. Thesis submitted to College of Veterinary Science, Ludhiana.

Banks, K. C., D. E. Stalla, F. E. Bunyak, T. A. White, L. G. Schultz and E. A. Giuliano, 2019. Comparison of two cleaning and sterilization protocols of diamond burr tips used in debridement for canine superficial chronic corneal epithelial defects. Veterinary ophthalmology, **22**(5): 614-622.

Barros, P. S., J. A. Garcia, J. L. Laus, A. L. Ferreira and T. L. Salles Gomes, 1998. The use of xenologous amniotic membrane to repair canine corneal perforation created by penetrating keratectomy. Veterinary Ophthalmology, **1**(2-3): 119-123.

Bentley, E. and C. J. Murphy, 2004. Topical therapeutic agents that modulate corneal wound healing. Veterinary Clinics: Small Animal Practice, **34**(3): 623-638.

Beranek, J. and P. J. Vit, 2007. Current examination methods of canine eye. European journal of companion Animal Practice, 17(**3**): 221-226.

Bloor, B. C., M. Frankland, G. Alper, D. Raybould, J. Weitz and M. Shurtliff, 1992. Hemodynamic and sedative effects of dexmedetomidine in dog. Journal of Pharmacology and Experimental Therapeutics, **263**, 690-690.

Bonses, R. W. and H. H. Tausskay, 1945. Estimation of serum creatinine. J. Biol. Chem, **158**: 581.

Bossuyt, S. M., 2016. The use of therapeutic soft contact bandage lenses in the dog and the cat: a series of 41 cases. Vlaams Diergeneeskundig Tijdschrift, **85**(6): 343-348.

Braus, B., D. Riedler, A. Tichy, J. Spergser and I. Schwendenwein, 2018. The effects of two different types of bandage contact lenses on the healthy canine eye. Veterinary Ophthalmology, **21**(5): 477-486.

Briganti, A., G. Barsotti, D. A. Portela, C. Di Nieri, G. Breghi, 2015. Effects of rocuronium bromide on globe position and respiratory function in isoflurane-anesthetized dogs: a comparison between three different dosages. Veterinary ophthalmology, **18**(2): 89-94.

Bromberg, N. M., 2002. Cyanoacrylate tissue adhesive for treatment of refractory corneal ulceration. Veterinary Ophthalmology, **5**(1): 55-60.

Brooks, D. E., 1991. Canine conjunctiva and nictitating membrane. Veterinary Ophthalmology 2nd ed. Gelatt K N (Ed). Saunders Elsivier, Philadelphia: Lea and Febiger, 290-306.

Brünott, A., M. H. Boevé and M. A. Velden, 2007. Grid keratotomy as a treatment for superficial nonhealing corneal ulcers in 10 horses. Veterinary ophthalmology, **10**(3): 162-167.

Carter, R. T., 2009. The role of integrins in corneal wound healing. Veterinary ophthalmology, **12**: 2-9.

Cavens, V., 2019. New treatment for corneal ulcers. Cincinnati: MedVet Leading Specialty Healthcare for Pets, 1.

Cebra, C. and A. Gemensky-Metzler, 2014. Disorders of the neurologic system and special senses. Llama and alpaca care: medicine, surgery, reproduction, nutrition, and herd health. St. Louis: Elsevier, 437-63.

Chinchu, J., 2010. Efficacy of collagen sheet for the management of corneal ulcers in dogs. M.V.Sc Thesis. Kerala Veterinary and Animal Sciences University, Pookode.

Chow, D. W. and H. D. Westermeyer, 2016. Retrospective evaluation of corneal reconstruction using AC ell Vet™ alone in dogs and cats: 82 cases. Veterinary ophthalmology, **19**(5): 357-366.

Clark, J. S., E. Bentley and L. J. Smith, 2011. Evaluation of topical nalbuphine or oral tramadol as analgesics for corneal pain in dogs: a pilot study. Veterinary ophthalmology, **14**(6): 358-364.

Clarke, K. W. and C. M. Trim, 2013. Veterinary Anaesthesia, 11th ed. Elsevier Health Sciences: Edinburgh.

Clode, A. B., 2012. Corneal cytology & culture collection. NAVC Clinician's Brief, May, 75-77.

Clutton, R. E., C. Boyd, D. L. S. Richards and K, Schwink, 1988. Significance of the oculocardiac reflex during ophthalmic surgery in the dog. Journal of Small Animal Practice, **29**(9): 573-579.

Collins, B. K., M. E. Gross, C. P. Moore, K. R. Branson, 1995. Physiologic, pharmacologic, and practical considerations for anesthesia of domestic animals with eye disease. Journal of the American Veterinary Medical Association (USA), **207**: 220-230.

Coster, M. E., J. Stiles, S. G. Krohne and R. E. Raskin, 2008. Results of diagnostic ophthalmic testing in healthy guinea pigs. Journal of the American Veterinary Medical Association, **232**(12): 1825-1833.

Crispin, S., 2002. The cornea. In: Peterson-Jones S and Crispin S (Ed.) BASAVA Manual of Small Animal Ophthalmology. 2nd edn. Gloucester: British Small Animal Veterinary Association, 134-54.

Cullen, C. L. and B. H. Grahn, 2005. Diagnostic ophthalmology. Right corneal foreign body, secondary ulcerative keratitis, and anterior uveitis. The Canadian Veterinary Journal, **46**(11): 1054.

Dawson, C. and R. F. Sanchez, 2016. A prospective study of the prevalence of corneal surface disease in dogs receiving prophylactic topical lubrication under general anesthesia. Veterinary Ophthalmology, **19**(2): 124-129.

Dawson, C., C. Naranjo, B. Sanchez-Maldonado, G. Fricker, R. Linn-Pearl, N. Escanilla, C. Kafarnik, D. Gould, R. Sanchez and M. Matas-Riera, 2015. Immediate effects of diamond burr debridement in patients with spontaneous chronic corneal epithelial defects, light and electron microscopic evaluation. Veterinary Ophthalmology, **20**(1): 11-15.

Daxer, A. and A. Ettl, 1995. Corneal vascularisation and its relation to the physical properties of the tissue: a fractal analysis. Current eye research, **14**(4): 263-268.

Diehl, K. A., A. C. Bowden and D. Knudsen, 2019. Bandage contact lens retention in dogs—A pilot study. Veterinary ophthalmology, **22**(5): 584-590.

Dohlman, C. H., S. A. Boruchoff and E. F. Mobilia, 1973. Complications in use of soft contact lenses in corneal disease. Archives of Ophthalmology, **90**(5): 367-371.

Dorbandt, D. M., P. A. Moore and K. E. Myrna, 2015. Outcome of conjunctival flap repair for corneal defects with and without an acellular submucosa implant in 73 canine eyes. Veterinary ophthalmology, **18**(2): 116-122.

Douet, J. Y., A. Regnier, A. Dongay, G. Jourdan and D. Concordet, 2014. Evaluation of the ocular effects of sedation with butorphanol in the dog: Abstract no: 30. Veterinary Ophthalmology, **17**(6).

Duke, T., 1995. A new intravenous anesthetic agent: propofol. The Canadian Veterinary Journal, **36**(3): 181.

Featherstone, H. J., J. Sansom and C. L. Heinrich, 2001. The use of porcine small intestinal submucosa in ten cases of feline corneal disease. Veterinary ophthalmology, **4**(2): 147-153.

Featherstone, H. J. and C. L. Heinrich, 2013. Ophthalmic examination and diagnostics. Veterinary ophthalmology, **1**: 671-683.

Felchle, L. and J. L. Urbanz, J.L, 2001. Examining the anterior segment of the eye in small animals. Veterinary Medicine , **96**(10): 792-799.

Frink Jr, E. J., S. E. Morgan, A. Coetzee, P. F. Conzen and B. R. Brown Jr, 1992. The effects of sevoflurane, halothane, enflurane, and isoflurane on hepatic blood flow and oxygenation in chronically instrumented greyhound dogs. The Journal of the American Society of Anesthesiologists, **76**(1): 85-90.

Gaskin, J. M., 1980. Microbiology of the canine and feline eye. The Veterinary Clinics of North America. Small Animal Practice, **10**(2): 303-316.

Gelatt, K. N. and D. E. Brooks, D. E, 2011. Surgery of the cornea and sclera. Veterinary ophthalmic surgery, 191-236.

Gelatt, K. N., 1991. Text book of Veterinary Ophthalmology, 2nd ed, 429-460. Lea and Febiger Philadelphia, USA.

Gelatt, K. N., 2011. Anesthesia for ophthalmic surgery. Veterinary Ophthalmic Surgery. Eds KN Gelatt, JP Gelatt. Edinburgh, UK: Elsevier Saunders, 37-49.

Gelatt, K. N., D. E. Brooks and M. E. Kallberg, 2008. The canine glaucomas. Essentials of veterinary ophthalmology, **2**: 155-187.

Gilger, B. C., R. D. Whitley, S. A. McLaughlin, J. C. Wright and J. W. Drane, 1991. Canine corneal thickness measured by ultrasonic pachymetry. American journal of veterinary research, 52(**10**): 1570-1572.

Gilger, B. C., E. Bentley and F. J. Ollivier, 2007. Diseases and surgery of the canine cornea and sclera. Veterinary ophthalmology, **2**: 690-752.

Gogova, S., M Leiva, Á Ortillés, R. P. Lacerda, C. Seruca, F. Laguna, M. Crasta, J. Ríos and M. T. Peña, 2020. Corneoconjunctival transposition for the treatment of deep stromal to full-thickness corneal defects in dogs: A multicentric retrospective study of 100 cases. Veterinary ophthalmology, **23**(3): 450-459.

Goldberg, M. E., J. Cantillo, G. E. Larijani, M. Torjman, D. Vekeman and H. Schieren, 1996. Sevoflurane versus isoflurane for maintenance of anesthesia: are serum inorganic fluoride ion concentrations of concern?. Anesthesia and Analgesia, **82**(6): 1268-1272.

Gosling, A. A., A. L. Labelle and C. B. Breaux, C, 2013. Management of spontaneous chronic corneal epithelial defects (SCCEDs) in dogs with diamond burr debridement and placement of a bandage contact lens. Veterinary ophthalmology, **16**(2): 83-88.

Grinninger, P., A. M. J. Verbruggen, I. M. G. Kraijer-Huver, S. C. Djajadiningrat-Laanen, E. Teske and M. H. Boeve, 2015. Use of bandage contact lenses for treatment of spontaneous chronic corneal epithelial defects in dogs. Journal of Small Animal Practice, **56**(7): 446-449.

Günay, C. and S. Ünsaldı, 2000. The effects of enflurane, isoflurane and propofol anaesthetics on blood parameters in dog. Sağlık Bilimleri Dergisi, Firat Üniversitesi, **14**(1): 129-135.

Hakanson, N. E. and R. E. Merideth, 1987. Conjunctival pedicle grafting in the treatment of corneal ulcers in the dog and cat. The Journal of the American Animal Hospital Association **23**: 641-48.

Hamilton, H. L., 1999. Pediatric ocular emergencies. The Veterinary clinics of North America. Small animal practice, **29**(4): 1003-22.

Herring, I .P., 2003. Corneal surgery: instrumentation, patient considerations, and surgical principles. Clinical techniques in small animal practice, **18**(3): 152-160.

Ion, L., I. Ionascu and A. Birtoiu, 2015. Melting keratitis in dogs and cats. Agriculture and Agricultural Science Procedia, **6**: 342-349.

Jagtap, D. A., 2003. Use of Lipid free propofol in day care surgery in Canines. Unpublished M.V.Sc. Thesis submitted to Maharashtra Animal and Fishery Science University, Nagpur.

Jaksz, M. and C. Busse, 2017. Treating corneal ulceration in dogs part 2: deep ulcers. UK: Vet Times, 11-13.

Jaksz, M., M. C. Fischer, E. Fenollosa-Romero and C. Busse, 2021. Autologous corneal graft for the treatment of deep corneal defects in dogs: 15 cases. Journal of Small Animal Practice, **62**(2): 123-130.

Jones, R. S. and C. J. Seymour, 1986. Clinical experiences with isoflurane in dogs and horses. The Veterinary Record, **119**(1): 8-10.

Kaswan, R. L., D. Bounous and S. G. Hirsh, 1995. Diagnosis and management of keratoconjunctivitis sicca. Veterinary medicine **90**:1513-17.

Kecova, H., Z. Hlinomazova, P. Raušer and A. Nečas, 2004. Corneal inflammatory diseases-Infectious keratitis in dogs. Acta Veterinaria Brno, **73**(3): 359-363.

Kern, T. J., 1990. Ulcerative keratitis. Veterinary Clinics of North America: Small Animal Practice, **20**(3): 643-666.

Kim, J. Y., H. J. Won and S. Jeong, S., 2009. A retrospective study of ulcerative keratitis in 32 dogs. International Journal of Applied Research in Veterinary Medicine, **7**(1/2): 27-31.

Kim, S. Y., J. Y. Kim and S. W. Jeong, 2019. Long-term evaluation of autologous lamellar corneal grafts for the treatment of deep corneal ulcer in four dogs: a case report. Veterinární medicína, **64**(2): 84-91.

Kotani A. J. 2001. Ulcerative keratitis in dogs. Indian Journal of Animal Science **2**: 23-33.

Kovalcuka, L., E. Birgele, D. Bandere, D. L. Williams, 2013. The effects of ketamine hydrochloride and diazepam on the intraocular pressure and pupil diameter of the dog's eye. Veterinary ophthalmology, **16**(1): 29-34.

Laminack, E. B., K. Myrna and P. A. Moore, 2013. Clinical approach to the canine red eye. Today's Veterinary Practice, **3**(3): 14.

Ledbetter, E. and B. C. Gilger, 2013. Diseases and Surgery of the Canine Cornea and Sclera. In (Gellat K.N., Gilger B.C., Kern T.J. (Ed.), 2013). Veterinary ophthalmology, 5th ed. Chichester, UK: John Wiley and Sons, 987-994

Lin, C. T. and S. M Petersen-Jones, 2007. Antibiotic susceptibility of bacterial isolates from corneal ulcers of dogs in Taiwan. Journal of small animal practice, **48**(5): 271-274.

Ludders, J. W. and J. E. Heavner, 1979. Effect of atropine on tear formation in anesthetized dogs. Journal of the American Veterinary Medical Association, **175**(6): 585-586.

Maggs, D. J., 2008. Basic diagnostic techniques. Slatter's fundamentals of veterinary ophthalmology, 5th ed, **4**: 81-106.

Maggs, D. J., 2008. Eyelids. In Slatter's fundamentals of veterinary ophthalmology, 5th ed, Elsevier Inc, 107-134.

Maggs, D. J., 2008. Ocular pharmacology and therapeutics table 3-1. Slatter's Fundamentals of Veterinary Ophthalmology, 5th ed, 38-39.

Maggs, D. J., 2013. Cornea and sclera. In Maggs D. J, P. E. Miller, R. Ofri,(Ed). Slatters Fundamentals of Veterinary Ophthalmology, 5th ed. Philadelphia: Elsevier Saunders, 184-219

Maggs, D., 2008. Slatter's Fundamentals of Veterinary Ophthalmology. 5th ed. St Louis, 5th ed, Saunders Elsevier, 183-190.

Maini, S., R. Everson, C. Dawson, Y. M. Chang, C. Hartley and R. F. Sanchez, 2019. Pigmentary keratitis in pugs in the United Kingdom: prevalence and associated features. BMC veterinary research, **15**(1): 1-11.

Mandell, D. C. and E. Holt, 2005. Ophthalmic emergencies. Veterinary Clinics: Small Animal Practice, **35**(2): 455-480.

Mandell, D. C., 2000. Ophthalmic emergencies. Clinical techniques in small animal practice, **15**(2): 94-100.

Marsh, W. H., B. Fingerhut and H. Miller, 1965. Blood urea nitrogen (UN or BUN) determination. Clin. Chem, **11**: 624.

Martin, C. L., 2001. Evaluation of patients with decreased vision or blindness. Clinical techniques in small animal practice, **16**(1): 62-70.

Miller, W.W., 2001. Evaluation and management of corneal ulcerations: a systematic approach. Clinical techniques in small animal practice, **16(**1): 51-57.

Miller, W.W. and K. L. Crenshaw, 1988. The Basics of In- clinic Ophthalmic Examinations.. Veterinary Medicine, 83(**11**): 1154.

Mitchell, N., 2011. Approach to ocular examination in small animals. International Practitioner, **33**(4): 146-154.

Moore C. P and M. P. Naisse, 1999. Clinical microbiology. In: Gelatt K. N (Ed.) Veterinary Opthalmology. 3rd Edn. Philadelphia: Lippincott William and Wilkins, 259-90.

Moore, P. A., 2003. Diagnosis and management of chronic corneal epithelial defects (indolent corneal ulcerations). Clinical techniques in small animal practice, **18**(3): 168-177.

Morales, A., M. A. R. Valinhos, M. Salvadego and C. E. Levy, 2009. Microbiological and clinical aspects of corneal ulcers in dogs. In World Small Animal Veterinary Congress–WSAVA/FECAVA/CSAVA , **34**: 195-197.

Morgan, D. W. and K. Legge, 1989. Clinical evaluation of propofol as an intravenous anaesthetic agent in cats and dogs. The Veterinary Record, **124**(2): 31-33.

Morreale, R. J., 2003. Corneal diagnostic procedures. Clinical techniques in small animal practice, **18**(3): 145-151.

Mowat, F. M., 2002. Management of corneal ulcers. In: Robinson, N. E. Current therapy in equine medicine. (5th Ed.). Saunders, 605- 607.

Muir, W.W. and J. E. Gadawski, 1998. Respiratory depression and apnea induced by propofol in dogs. American journal of veterinary research, 59(**2**): 157-161.

Munro, E., 2001. Advances in ocular therapeutics in dogs and cats. International Practitioner, **23**(6): 316-327.

Murphy, J. Christopher, F. M. Carl, M. Allison, B. Ellison, A. A. George, W. R. Ted and C. Sean, 2001. "Spontaneous chronic corneal epithelial defects (SCCED) in dogs: clinical features, innervation, and effect of topical SP, with or without IGF-1." Investigative Ophthalmology & Visual Science 42, no. **10**: 2252-2261.

Myrna, K. E., S. A. Pot and C. J. Murphy, 2009. Meet the corneal myofibroblast: the role of myofibroblast transformation in corneal wound healing and pathology. Veterinary ophthalmology, **12**: 25-27.

Nadkarni N. N, 2014. Comparative study between Laprpscopic Assisted and Conventional Cystotomy in Dogs. Unpublished M.V.Sc. Thesis submitted to Maharashtra Animal and Fishery Science University, Nagpur.

Nevile, J., S. Hurn, A. Turner and J. Morton, 2015. Diamond burr debridement of 34 canine corneas with presumed corneal calcareous degeneration. Veterinary Ophthalmology, **19**(4): 305-312.

Nevile, J. C., S. D. Hurn and A. G. Turner, 2016. Keratomycosis in five dogs. Veterinary ophthalmology, **19**(5): 432-438.

Ollivier, F.J., 2003. Bacterial corneal diseases in dogs and cats. Clinical techniques in small animal practice, **18**(3): 193-198.

Packer, R. M., A. Hendricks, M. S. Tivers and C. C. Burn, 2015. Impact of facial conformation on canine health: brachycephalic obstructive airway syndrome, **10**(10), Hertfordshire.

Parchen, H. D., M. L. Izar, P. S. Branco, C. Lacowicz, D. H. Sano, C. E. P. Belo and R. O. Vilani, 2011. Ophthalmic and anesthetic evaluation of topical 1% tetracaine and 0.5% proparacaine in dogs. Arquivo Brasileiro de Medicina Veterinária e Zootecnia, **63**(6): 1337-1344.

Patel, K. P., P. V. Parikh, J. K. Mahla, S. N. Ashwath & D. N. Kelawala, 2020. Incidence of corneal ulcer in dogs – A retrospective study. International Journal of Current Microbiology and Applied Sciences, **9**(8): 3174–3179.

Polse, K. A. and M. Decker, 1979. Oxygen tension under a contact lens. Investigative ophthalmology & visual science, 18(**2**): 188-193.

Pontes, C. D. Kelly, P. B. B. Andréa, B. E. Renato, C. N. F. Ana , P. D. M. Daniel, C. C. R. Emily, V. S. Rodrigo, D. D. Tarcísio and L. L. José, 2014. "A new surgical technique to treat corneal perforations using amniotic membrane and surgical adhesive." Arquivo Brasileiro de Medicina Veterinária e Zootecnia 66, no. **3**: 655-664.

Pot, S. A., N. S. Gallhöfer, F. L. Matheis, K. Voelter-Ratson, F. Hafezi and B. M. Spiess, 2014. Corneal collagen cross-linking as treatment for infectious and noninfectious corneal melting in cats and dogs: results of a prospective, nonrandomized, controlled trial. Veterinary ophthalmology, **17**(4): 250-260.

Pottie, R. G., C. M. Dart and N. R. Perkins, 2008. Speed of induction of anaesthesia in dogs administered halothane, isoflurane, sevoflurane or propofol in a clinical setting. Australian veterinary journal, **86**(1-2): 26-31.

Prado, M. R., M. F. Rocha, É. H. Brito, M. D. Girão, A. J. Monteiro, M. F. Teixeira and J. J. Sidrim, 2005. Survey of bacterial microorganisms in the conjunctival sac of clinically normal dogs and dogs with ulcerative keratitis in Fortaleza, Ceará, Brazil. Veterinary ophthalmology, **8**(1): 33-37.

Raji, T. A. 2006. Processed collagen graft for the treatment of corneal lesions in dogs. M.V.Sc Thesis. Kerala Agricultural University, Thrissur.

Ramani, C., K. Rambabu, N. J. D'Souza, S. Vairamuthu, S.Subapriya and B. J. William, 2013. Surgical bacteriology and grading of corneal ulcers in dogs a retrospective study in 24 dogs. Indian J Canine Practice, **5**(1): 136-138.

Ramani, C., M. K. Ahirwars, M. Shafiuzama and L. Nagarajan, 2012. Incidence of Corneal Ulcer in Dogs-A Retrospective Study. Tamilnadu Journal of Veterinary Animal Science, **8**: 250-52.

Ranganath , L., 2016. Contact lenses and doggles for dogs. In : Nair, N. D. (ed.), Proceedings of National Congress on Canine Practice: 100-103.

Reitman, S., 1957. Reitman and Frankel's colorimetric methods for estimating SGOT and SGPT. Am J Clin Pathol, **28**: 56-63.

Renwick, P., 1996. Diagnosis and treatment of corneal disorders in dogs. In Practice, 18(**7**): 315-328.

Rienstein, S, 2019. Diamond Burr Debridement for Treating Indolent Corneal Ulcers. Philadelphia: Veterinary Specialty & Emergency Center, 1.

Rizzi, T. E., J. H. Meinkoth and K. D. Clinkenbeard, 2010. Normal hematology of the dog. Schalm's veterinary hematology, **6**: 799-810.

Robertson, S. A., K. Wegner and B. D. X. Lascelles, 2009. Antinociceptive and side-effects of hydromorphone after subcutaneous administration in cats, 76-81.

Robinson, F. P and C. C. Patterson, 1984. Changes in liver function tests after propofol ('Diprivan'). Postgraduate medical journal, 61, 160-161.

Rosenthal, P., J. M. Cotter and J. Baum, 2000. Treatment of persistent corneal epithelial defect with extended wear of a fluid-ventilated gas-permeable scleral contact lens. American journal of ophthalmology, 130(**1**): 33-41.

Rylander, H, 2013. The Neurologic Examination In Companion Animals, Part 2: Interpreting Abnormal Findings**.**

Sale, M., S. Jhala, P. V. Parikh, D. B. Patil, N. Joy and J. J. Ranpariya, 2013. Incidence of ophthalmic affections in dogs (2004–13). Indian Journal of Veterinary Surgery, **34**(1): 61-62.

Sanchez, R. F., 2014. The cornea. In BSAVA manual of canine and feline ophthalmology , 200-231. BSAVA Library.

Sansom, J., 2000. Diseases involving the anterior chamber of the dog and cat. In Practice, 22(**2**): 58-70.

Sarangom, S. B., N. K. Baburaj, T. E. D'Sa and S. K. Venugopal, 2012. Surgical repair of corneal laceration complicated by iris inclusion in a dog. Veterinary World, **5**(10): 631-633.

Sarchahi, A. and M. Eskandari, 2018.Effect of four local anesthetics (tetracaine, proparacaine, lidocaine, and bupivacaine) on intraocular pressure in dogs. International Ophthalmology, **39**(7): 1467-1474.

Schalm, O. W., B. F. Feldman, J. G. Zinkl and N. C Jain, 2000. Veterinary Hematology. Fifth edition. Lippincott Williams and Wilkins, Philadelphia, 1344.

Schmidt, G. M., G. L. Blanchard and W. F. Keller, 1977. The use of hydrophilic contact lenses in corneal diseases of the dog and cat: a preliminary report. Journal of small animal practice, **18**(12): 773-777.

Scott, E. M. and R. T. Carter, 2014. Canine keratomycosis in 11 dogs: a case series (2000–2011). Journal of the American Animal Hospital Association, **50**(2): 112-118.

Shaheen, B. S., M. Bakir and S. Jain, 2014. Corneal nerves in health and disease. Survey of ophthalmology, **59**(3): 263-285.

Singh, N. P., S. K. Jhirwal and T. K. Gahlot, 2016. Management of corneal ulcer in dogs. Indian Journal of Veterinary Surgery, **37**(1): 67-67.

Siniscalchi, M., S. d'Ingeo, M. Minunno and A. Quaranta, 2018. Communication in Dogs. Bari, Italy, 1-2.

Slatter, D. H, 1990. "Fundamentals of Veterinary Ophthalmology. 2nd edn WB Saunders Company.": 478-511.

Slatter, D., 2001. Eyelids. Fundamentals of Veterinary Ophthalmology (ed 3), 147-203.

Snedecor, G. W and W. G. Cochran, 1980. Statistical methods.

Stanley, R. G., C. Hardman and B. W. Johnson, 1998. Results of grid keratotomy, superficial keratectomy and debridement for the management of persistent corneal erosions in 92 dogs. Veterinary Ophthalmology, **1**(4): 233-238.

Startup, F. G., 1984. Corneal ulceration in the dog. Journal of Small Animal Practice, **25**(12): 737-752.

Story, D. A., S. Poustie, G. Liu and P. Larry McNicol, 2001. Changes in plasma creatinine concentration after cardiac anesthesia with isoflurane, propofol, or sevoflurane: a randomized clinical trial. The Journal of the American Society of Anesthesiologists, **95**(4): 842-848.

Strubble, D. T and K. N. Gelatt, 1999. Ophthalmic examination and dignostic procedures. In Gelatt. K. N (Ed.) Veterinary ophthalmology, 3rd Edn. Philadelphia, PA, Lippincott Williams and Wilkins, 1999, 438-439.

Suhas, K. P., 2015. Evaluation of porcine cholecyst derived collagen scaffold for the treatment of corneal injuries in dogs. M.V.Sc Thesis. Kerala veterinary and Animal Sciences University, Pookode.

Tamura, E. Y., P. S. Barros, S. R. Cortopassi, A. M. Ambrósio and D. T. Fantoni, 2002. Effects of two preanesthetic regimens for ophthalmic surgery on intraocular pressure and cardiovascular measurements in dogs, **3**(1): 81-87.

Thajunnisa, A. S., A. Sainulabdeen, K. M. Dileepkumar, L. M. Philip, V. N. Vasudevan and C. B. Devanand, 2020. Comparative evaluation of decellularized bovine omentum alone and in combination with mitomycin-C in the management of corneal injuries in dogs. Veterinary World, **13**(11): 2401.

Thangamuthu. R and J. P. Varshney, 2002. Clinical evaluation of tear production in dogs. Haryana veterinarian 41: 44-48.

Thomson. S, 2007. Ophthalmic surgery. In: Seymour C, Duke- Novakovaki T (Edn). BASAVA Manual of Canine and Feline Anaesthesia and Analgesia. 2nd edn. BASAVA publications, Gloucester, 183-93.

Tilley, L and F. Smith, 2011. Blackwell's Five-Minute Veterinary Consult: Canine and Feline. 5th ed. John Wiley and Sons, 1-2.

Tolar, E., D. Hendrix, B. Rohrbach, C. Plummer, D. Brooks and K. Gelatt, 2006. Evaluation of clinical characteristics and bacterial isolates in dogs with bacterial keratitis: 97 cases (1993–2003). Journal of the American Veterinary Medical Association, **228**(1): 80-85.

Turner, A. G and J. R. Blogg, 1997. The effect of multiple striate keratotomy: A treatment for corneal erosions caused by epithelial basement membrane disease. Australian Veterinary Journal, **75**: 27-29.

Utter, M. E., E. J. Davidson and K. L. Wotman, 2009. Clinical features and outcomes of severe ulcerative keratitis with medical and surgical management in 41 horses (2000–2006). Equine Veterinary Education, 21(**6**): 321-327.

Vanore, M., S. Chahory, G. Payen and B. Clerc, 2007. Surgical repair of deep melting ulcers with porcine small intestinal submucosa (SIS) graft in dogs and cats. Veterinary ophthalmology, **10**(2): 93-99.

Varges, R., B. Penna, G. Martins, R. Martins and W. Lilenbaum, 2009. Antimicrobial susceptibility of Staphylococci isolated from naturally occurring canine external ocular diseases. Veterinary ophthalmology, **12**(4): 216-220.

Vedpathak A. P 2015. A Clinical Study on the Use of Conjunctival Pedicle Graft for the Treatment of Corneal Ulcers In Canine. M.V.Sc Thesis. Maharashtra Animal and Fishery Sciences University, Nagpur.

Watkins, S. B., L. W. Hall and K. W. Clarke, 1987. Propofol as an intravenous anaesthetic agent in dogs. The veterinary record, **120**(14): 326-329.

Whitley, R. D and Gilger B.C. 1999. Diseases of canine cornea and sclera. In Gelatt K N. Veterinary Ophthalmology, 3rd ed. Philadephia, PA, Lippincott Williams and Wilkins, 635-673.

Wilkie, D. A. and C. Whittaker, 1997. Surgery of the cornea. Veterinary Clinics: Small Animal Practice, **27**(5): 1067-1107.

Willeford, K. O., W. W. Miller, K. L. Abrams and B. M. Vaughn, 1998. Modulation of proteolytic activity associated with persistent corneal ulcers in dogs. Veterinary Ophthalmology, **1**(1): 5-8.

Wilson, D. V., A. T. Evans, R. E. Carpenter and D. R. Mullineaux, 2004. The effect of four anesthetic protocols on splenic size in dogs. Veterinary anaesthesia and analgesia, **31**(2): 102-108.

Wooff, P. J. and J. C. Norman, 2015. Effect of corneal contact lens wear on healing time and comfort post LGK for treatment of SCCEDs in boxers. Veterinary ophthalmology, **18**(5): 364-370.

Young, S. S., K. C. Barnett and P. M. Taylor, 1991. Anaesthetic regimes for cataract removal in the dog. Journal of small Animal Practice, **32**(5): 236-240.

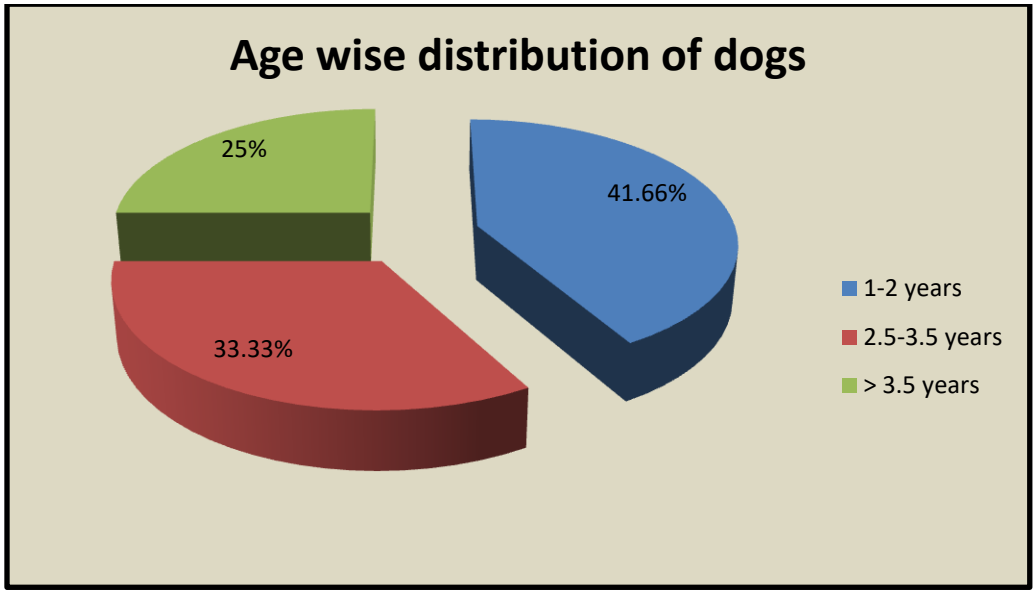


Fig 1: Pie chart showing age wise distribution of dogs with corneal ulcers

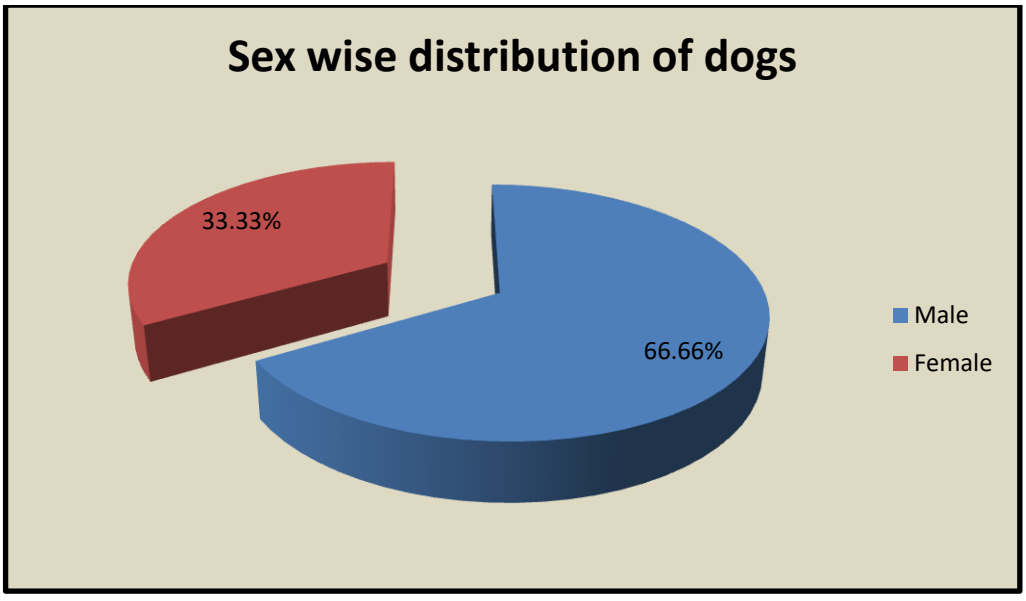


Fig 2: Pie chart showing sex wise distribution of dogs with corneal ulcers

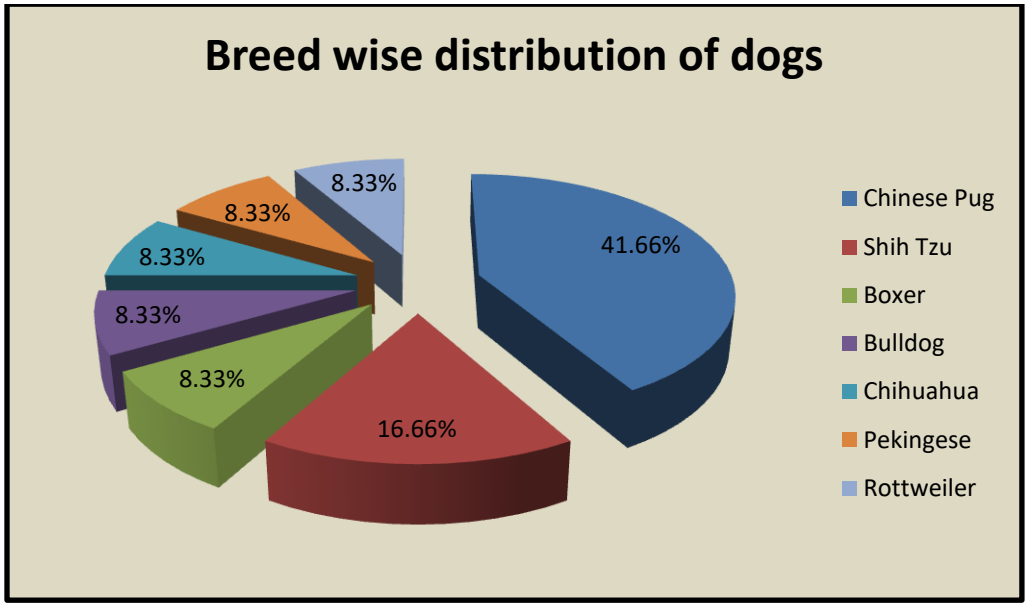


Fig 3: Pie chart showing breed wise distribution of dogs with corneal ulcers

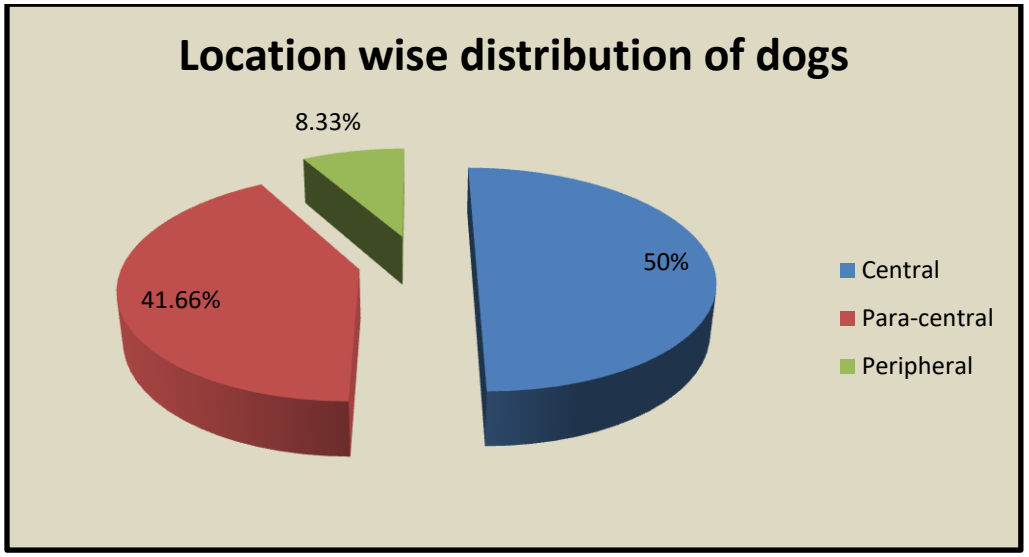


Fig 4: Pie chart showing location of the corneal ulcer in affected dogs

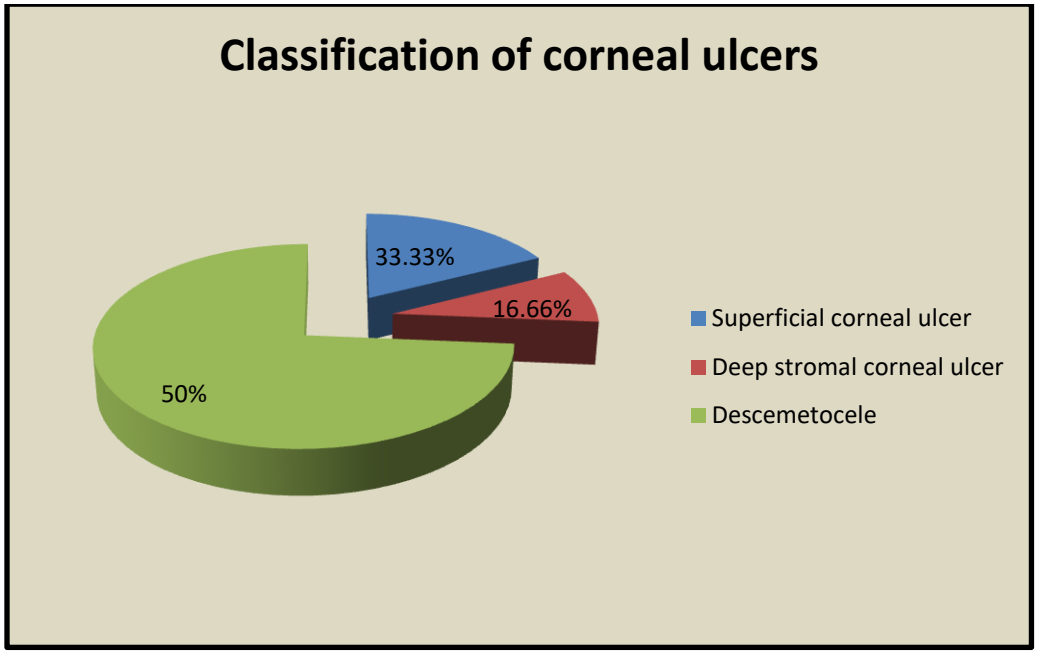


Fig 5: Pie chart showing classification of corneal ulcers in affected dogs

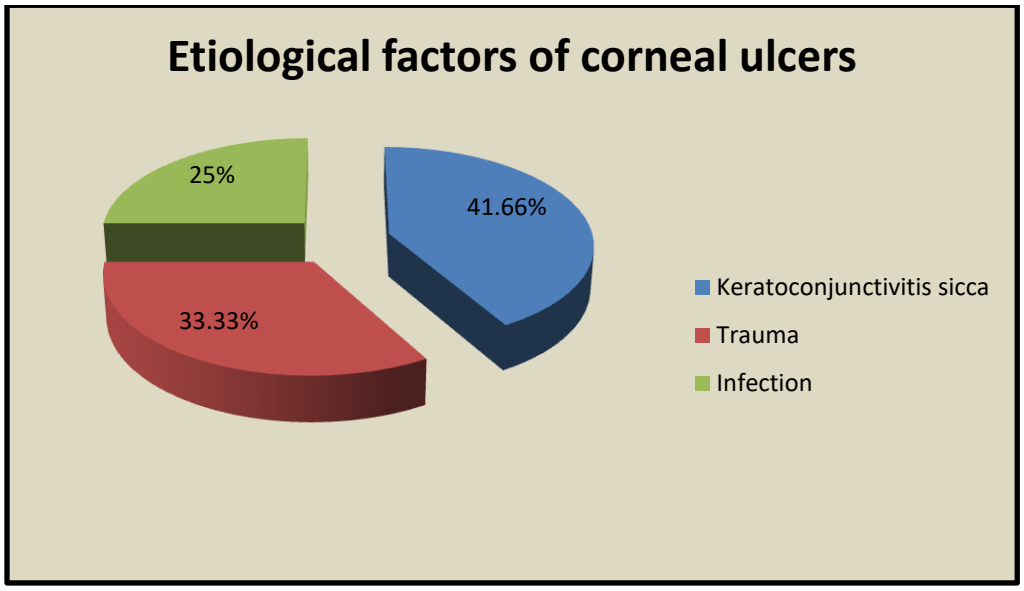


Fig 6: Pie chart showing etiological factors in the cases of corneal ulcers

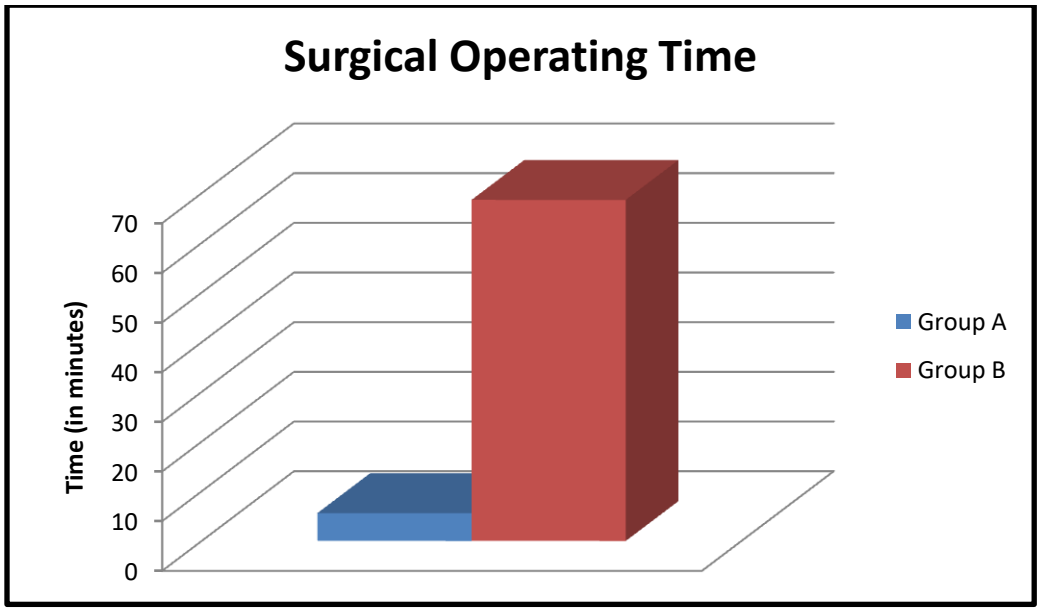


Fig 7: Graph showing surgical operating time (in minutes)

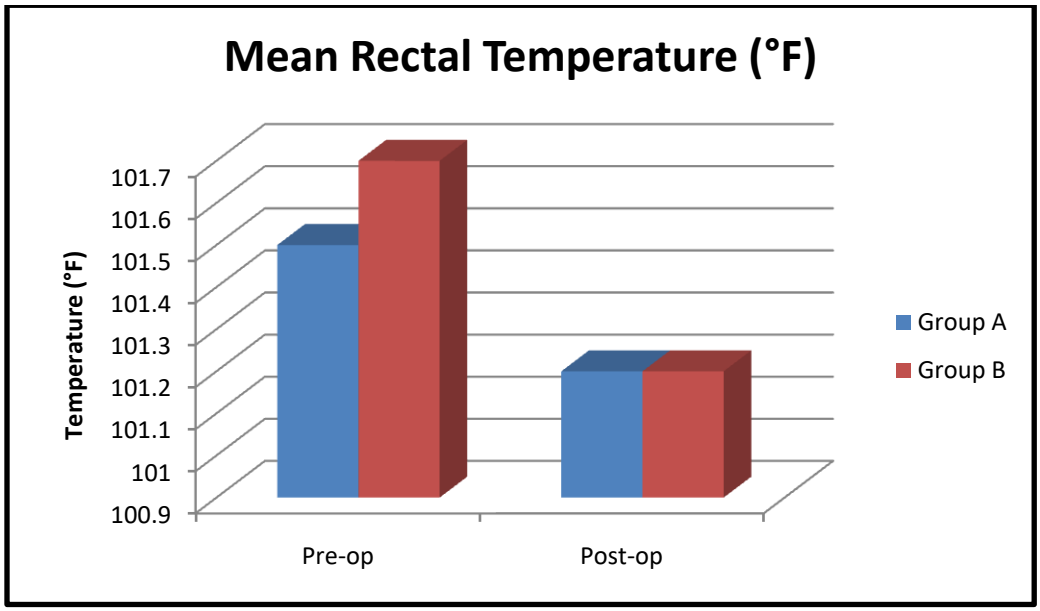


Fig 8: Graph showing mean rectal temperature (°F)

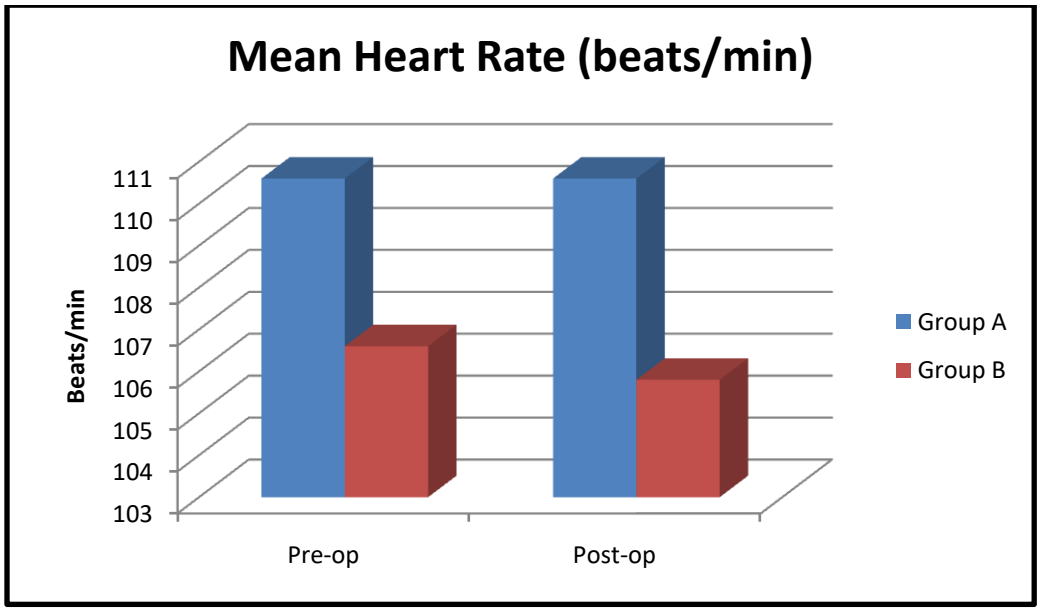


Fig 9: Graph showing mean heart rate (beats/min)

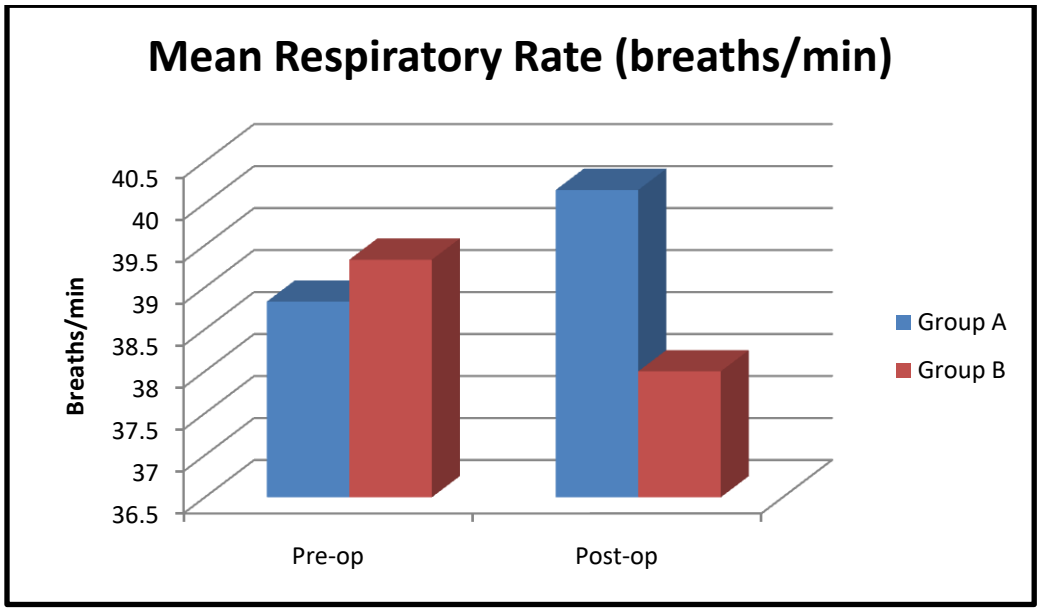


Fig 10: Graph showing mean respiratory rate (breaths/min)

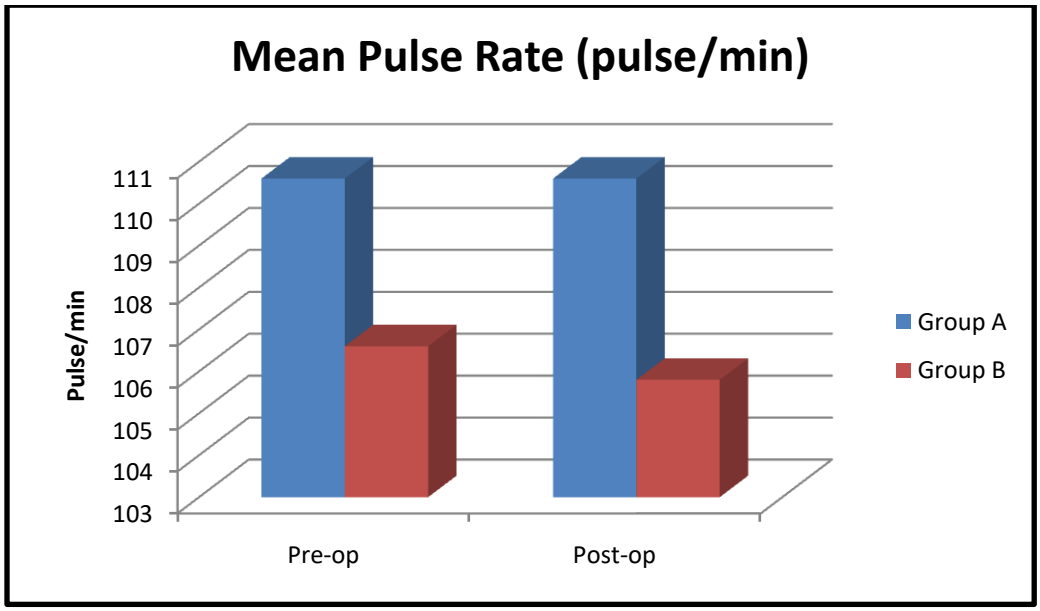


Fig 11: Graph showing mean pulse rate (pulse/min)

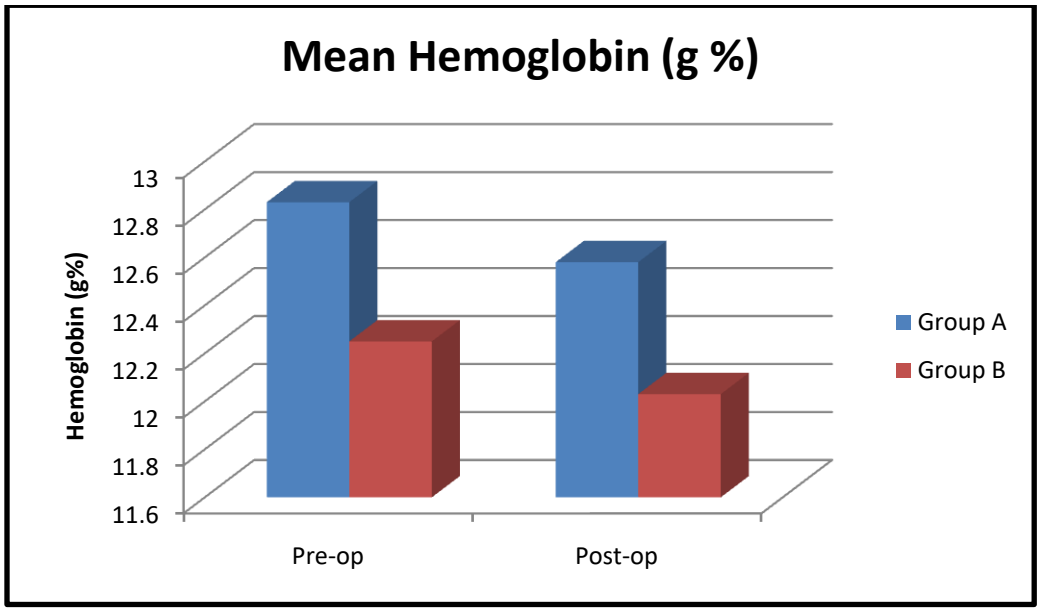


Fig 12: Graph showing mean haemoglobin (g %)

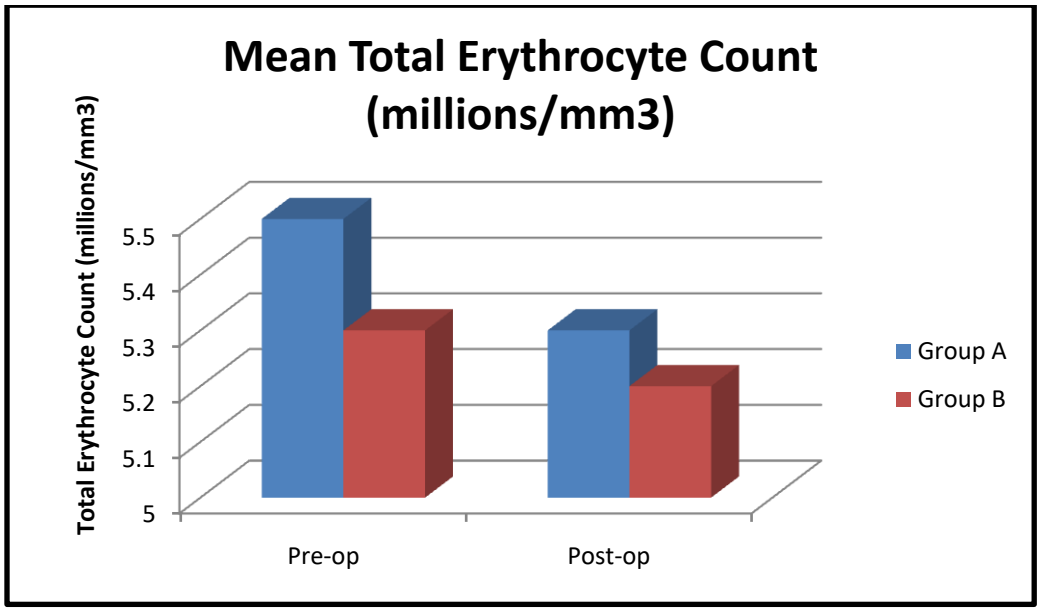


Fig 13: Graph showing mean total erythrocyte count (millions/mm^3)

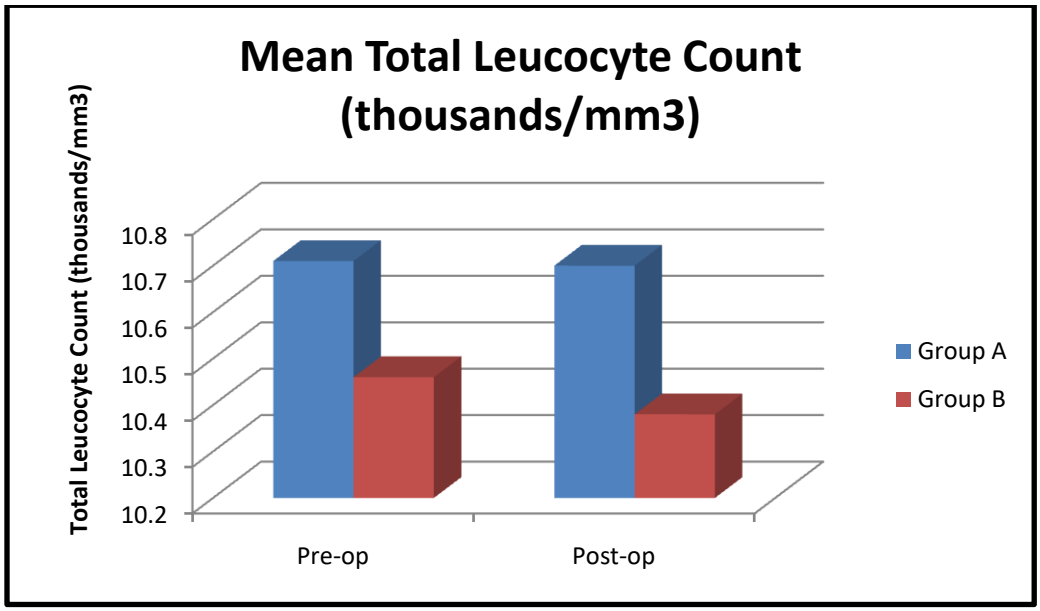


Fig 14: Graph showing mean total leucocyte count (thousands/mm^3)

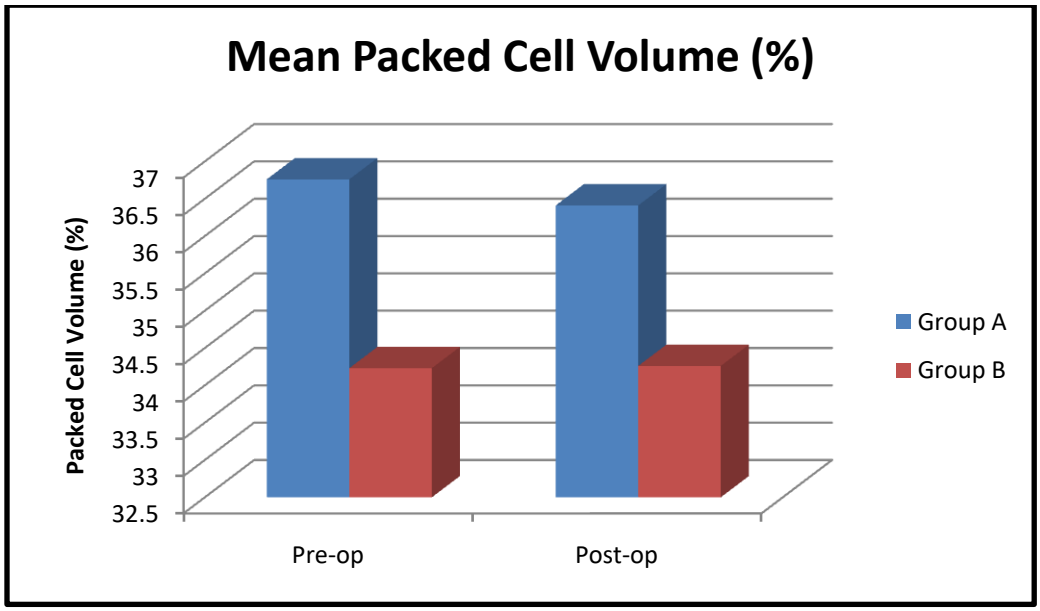


Fig 15: Graph showing mean packed cell volume (%)

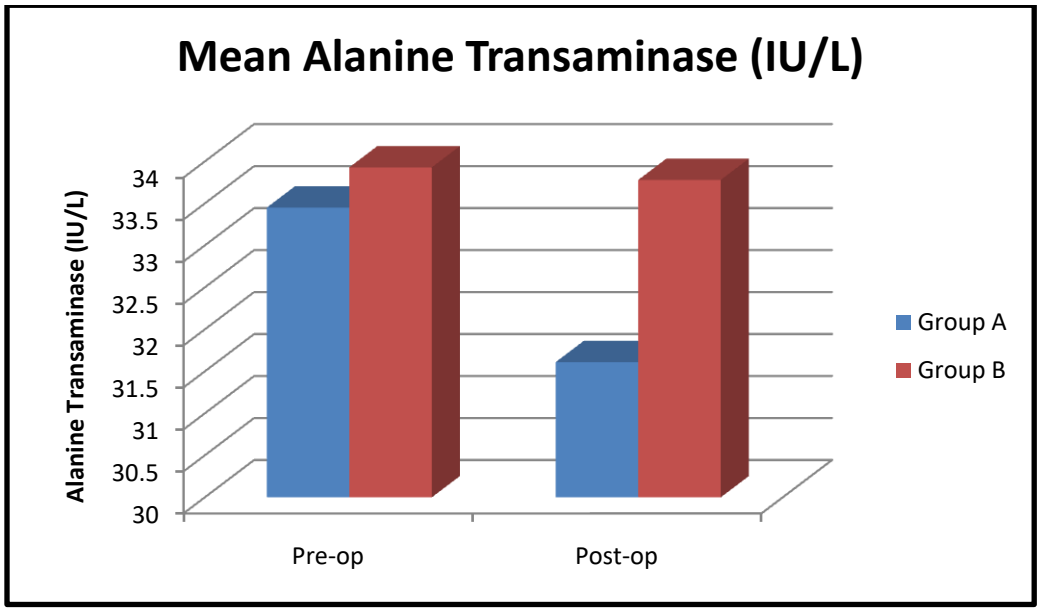


Fig 16: Graph showing mean alanine transaminase (IU/L)

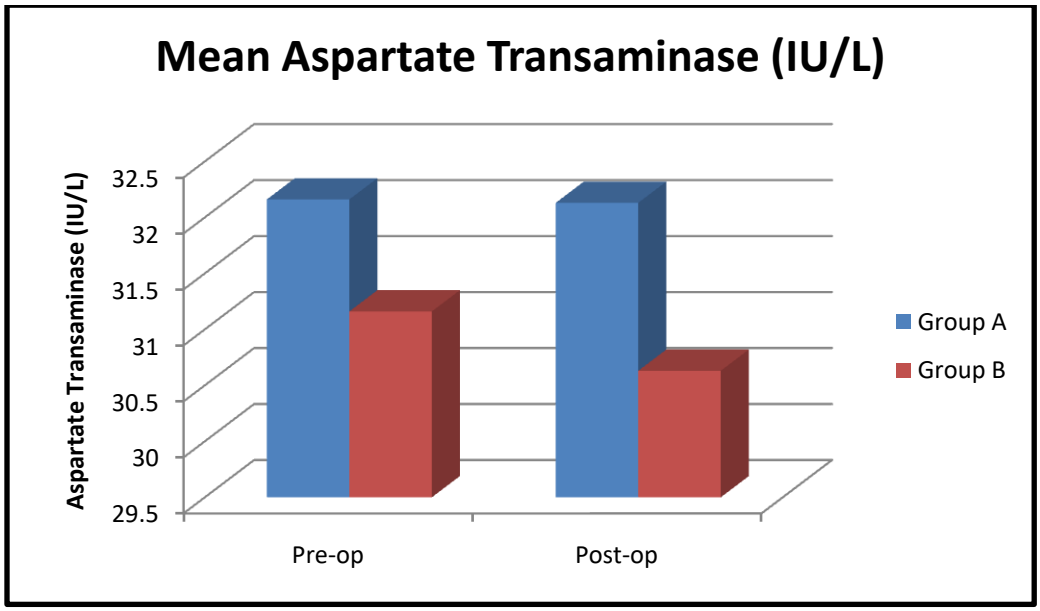


Fig 17: Graph showing mean aspartate transaminase (IU/L)

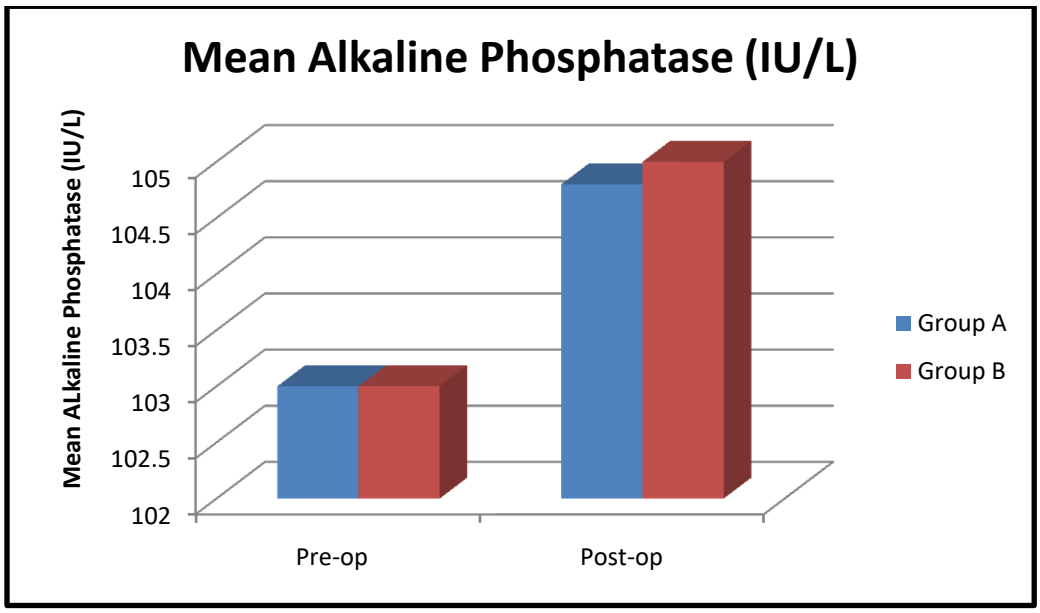


Fig 18: Graph showing mean alkaline phosphatise (IU/L)

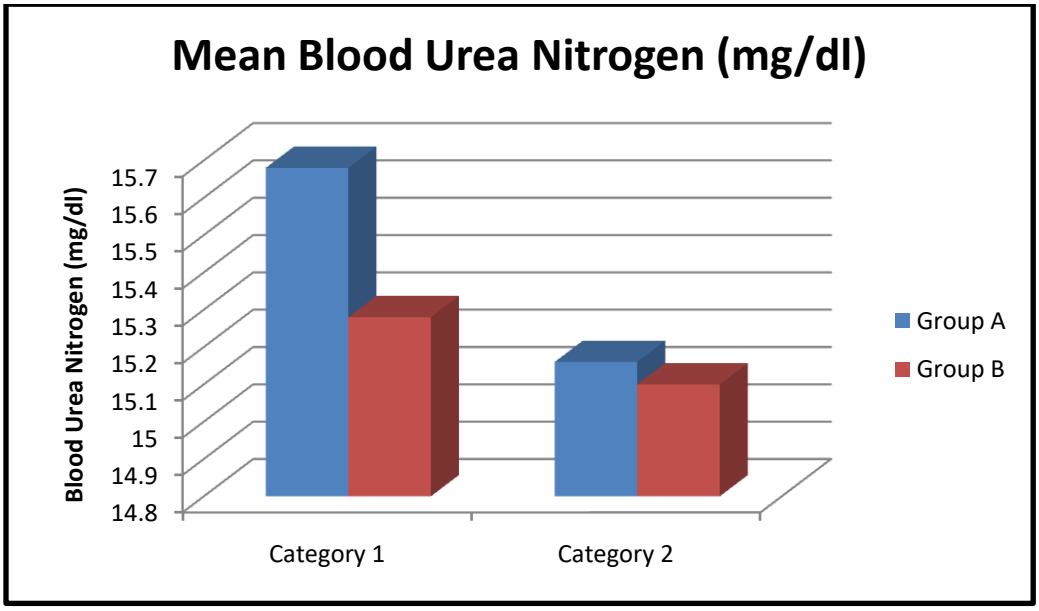


Fig 19: Graph showing mean blood urea nitrogen (mg/dl)

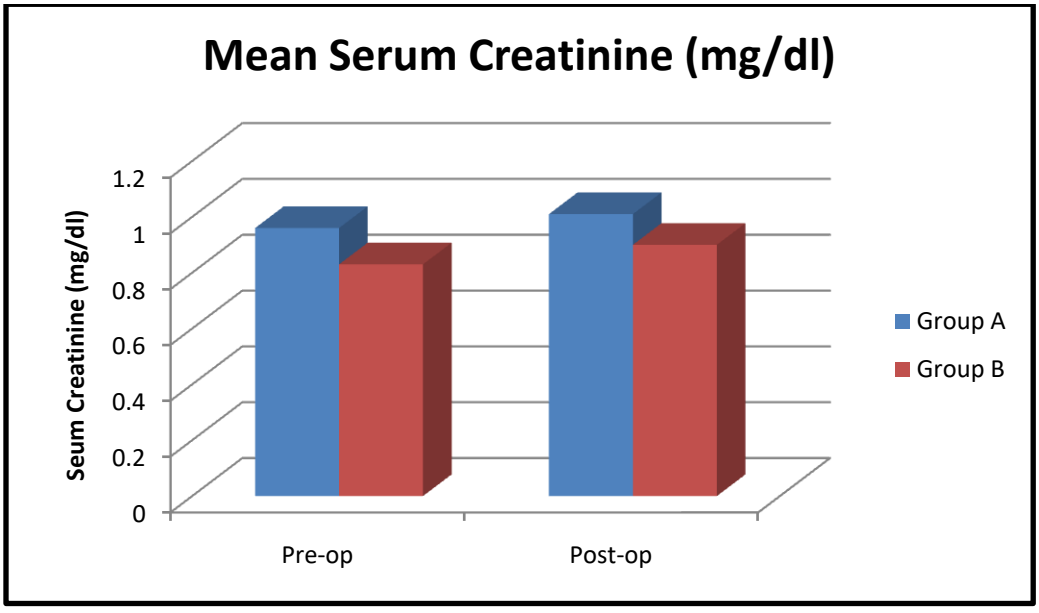


Fig 20: Graph showing mean serum creatinine (mg/dl)

Plate no. 1: Schirmer's tear strip

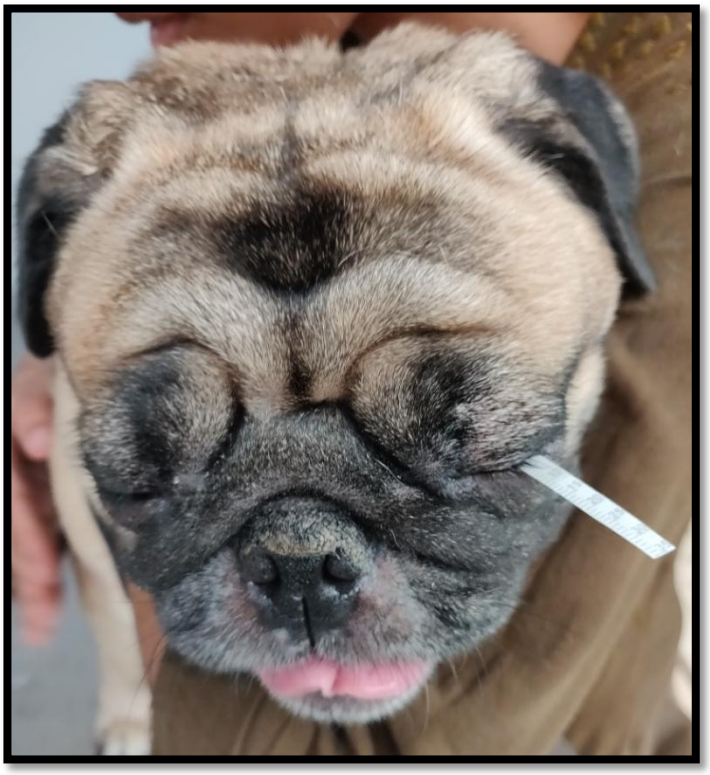


Plate no. 2: Schirmer's tear test measurement

Plate no. 3: Fluorescein strip

Plate no. 4: Fluorescein staining

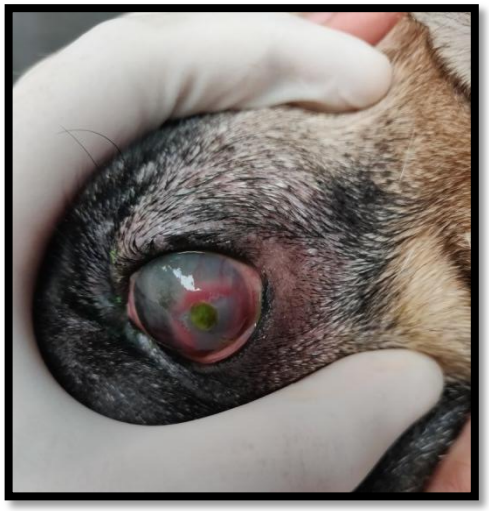


Plate no. 5: Stained corneal ulcer

Plate no. 6: Direct Ophthalmoscope

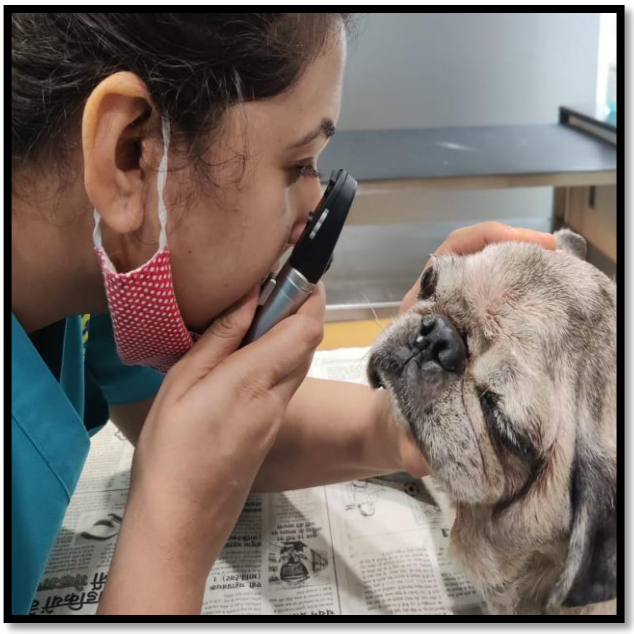


Plate no. 7: Direct Ophthalmoscopy

Plate no. 8: Tropicamide eye drops

Plate no. 9: Proparacaine eye drops

Plate no. 10: Sterile swab

Plate no. 11: Ciprofloxacin eye drops

Plate no. 12: Artificial tears eye drops

Plate no. 13: Multipara monitor

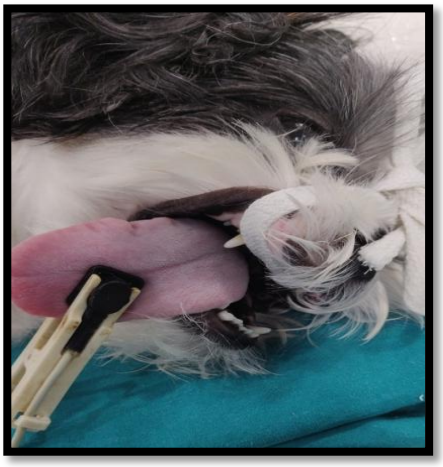


Plate no. 14: Pulse oximeter on tongue

Plate no. 15: Positioning of the head using soft padding

Plate no. 16: Glycopyrrolate injection

Plate no. 17: Diazepam injection

Plate no. 18: Butorphanol injection

Plate no. 19: Propofol injection

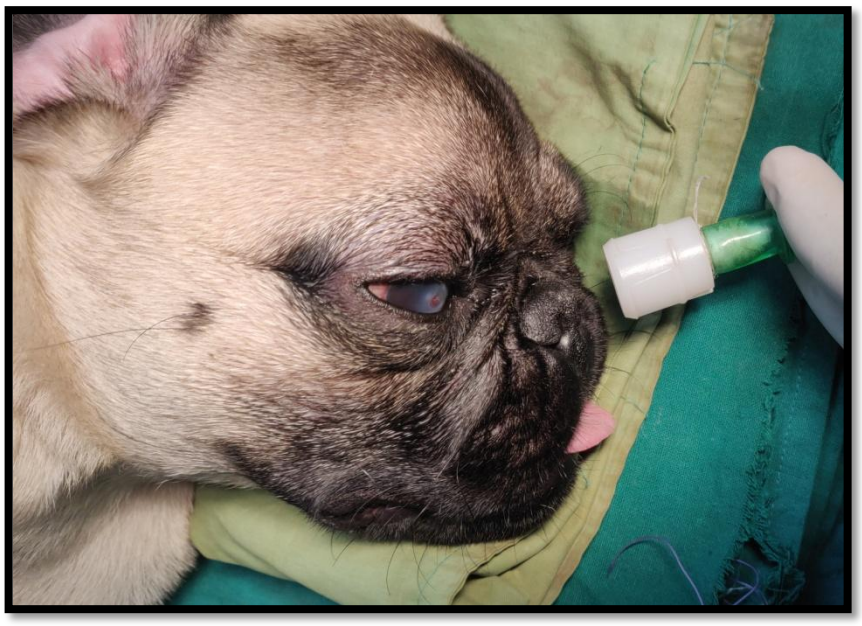


Plate no. 20: Pre-oxygenation of the patient

Plate no. 21: Placement of IV cannula in cephalic vein and induction of anaesthesia with propofol

Plate no. 22: Endotracheal tube

Plate no. 23: Endotracheal intubation procedure

Plate no. 24: Isoflurane USP

Plate no. 25: Isoflurane vaporizer

Plate no. 26: Lavage of conjunctival sac with dilute povidone iodine solution

Plate no. 27: Draping of the eye

Plate no. 28: Algerbrush

Plate no. 29: Soft contact bandage lens

Plate no. 30: Diamond burr debridement of the corneal ulcer using Algerbrush

Plate no. 31: Soft contact bandage lens in hand

Plate no. 32: Application of soft contact bandage lens

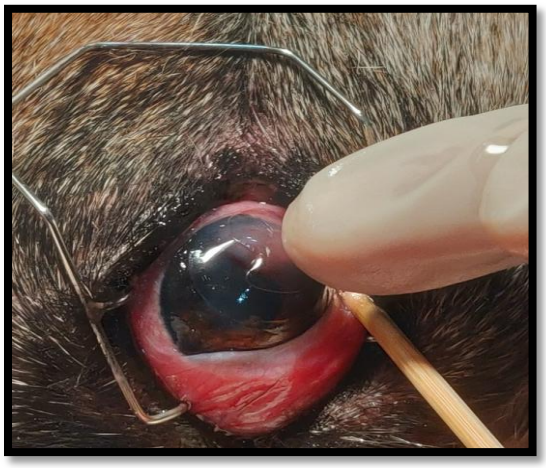


Plate no 33: Soft contact bandage lens on the cornea

Plate no. 34: Instruments used for surgery (from left to right)

A) Artery forcep C) Needle holder micro curved E) Straight iris scissor G) Castroviejo corneal forcep I) Barraquer eyelid speculum

B) Catroviejo caliper D) Catroviejo corneal scissor F) Mcpherson tying forcep H) Suture cutting scissor J) Crescent blade

Plate no. 35: 6x Binocular loupe

Plate no. 36: LED headlight

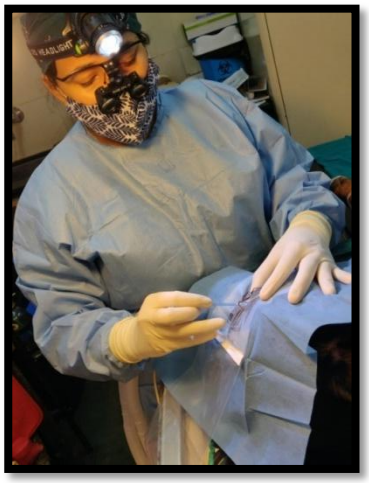


Plate no. 37: Seated position of the surgeon

Plate no. 38: 4-0 Polyglactin suture

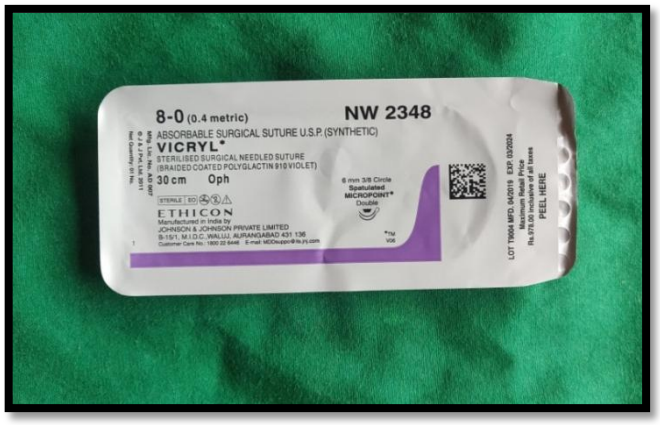


Plate no. 39: 8-0 Polyglactin suture

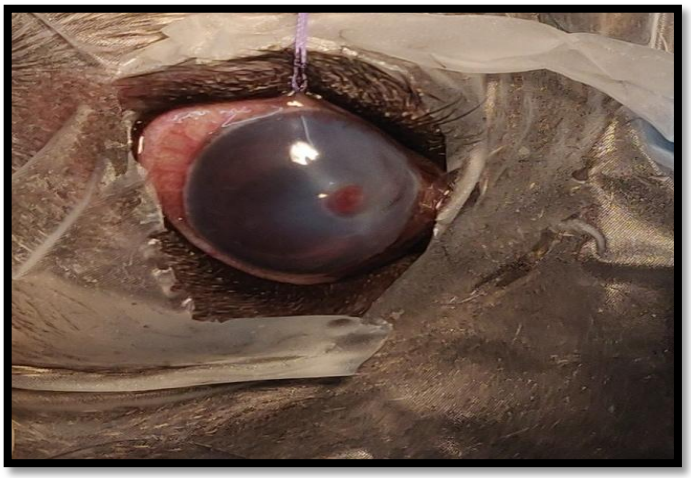


Plate no. 40: Stay suture through limbus to position the eye ball

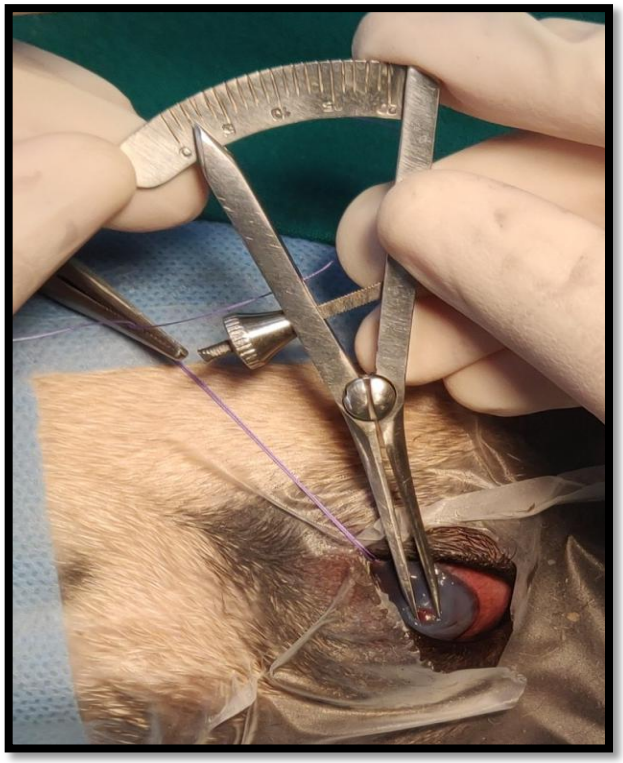


Plate no. 41: Measurement of size of the corneal ulcer

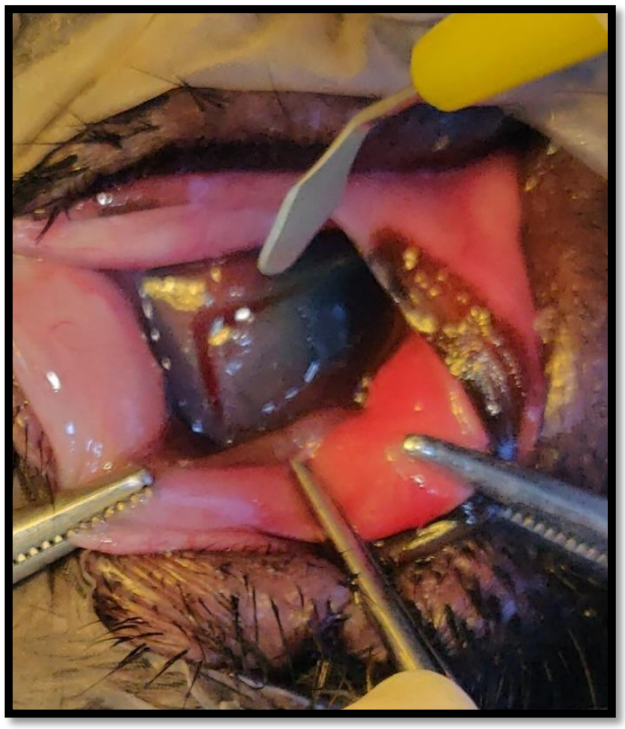


Plate no. 42: Initial incision on the cornea

Plate no. 43: Insertion of blade under the cornea

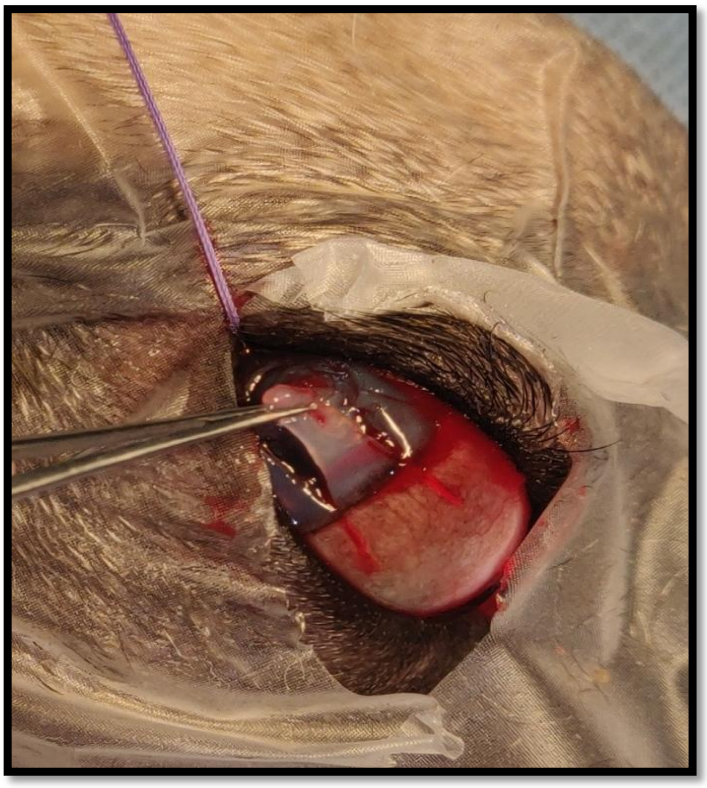


Plate no. 44: Incision on the bulbar conjunctiva

Plate no. 45: Insertion of corneal forcep under the bulbar conjunctiva

Plate no. 46: Cutting of the limbal attachment

Plate no. 47: Corneo-conjunctival graft

Plate no. 48: Transposition of the corneo-conjunctival graft on the corneal ulcer

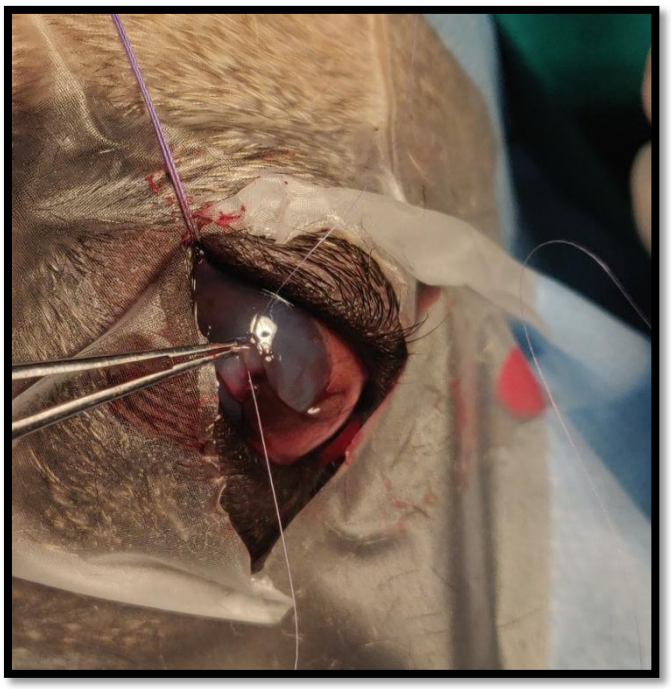


Plate no. 49: First stay suture on the cornea

Plate no. 50: Second stay suture on the cornea

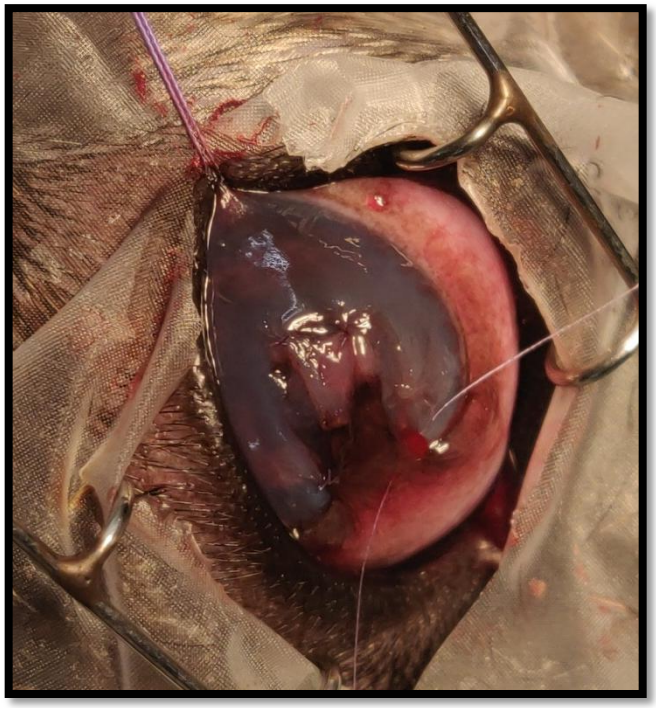


Plate no. 51: Third and fourth stay sutures on the cornea

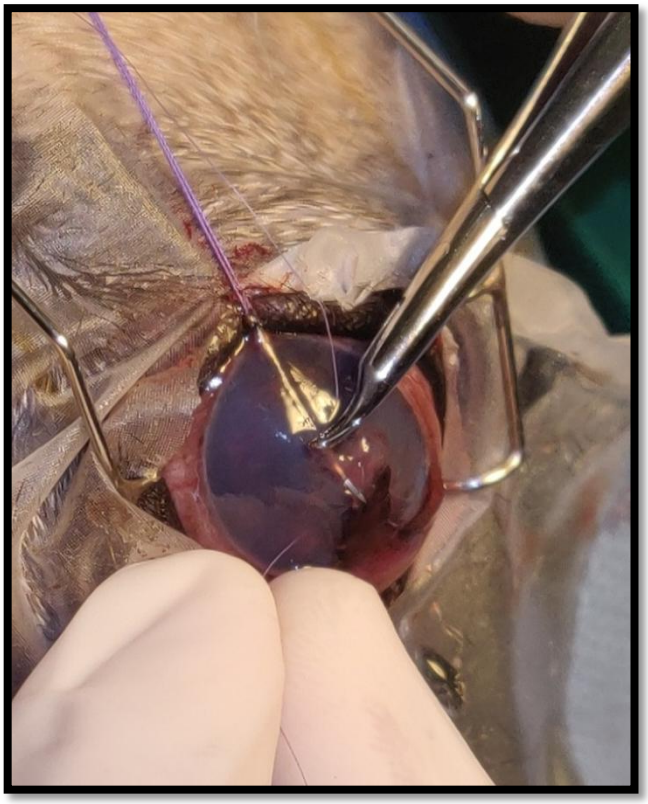


Plate no. 52: Simple continuous sutures on the cornea

Plate no. 53: Completed corneo-conjunctival transposition

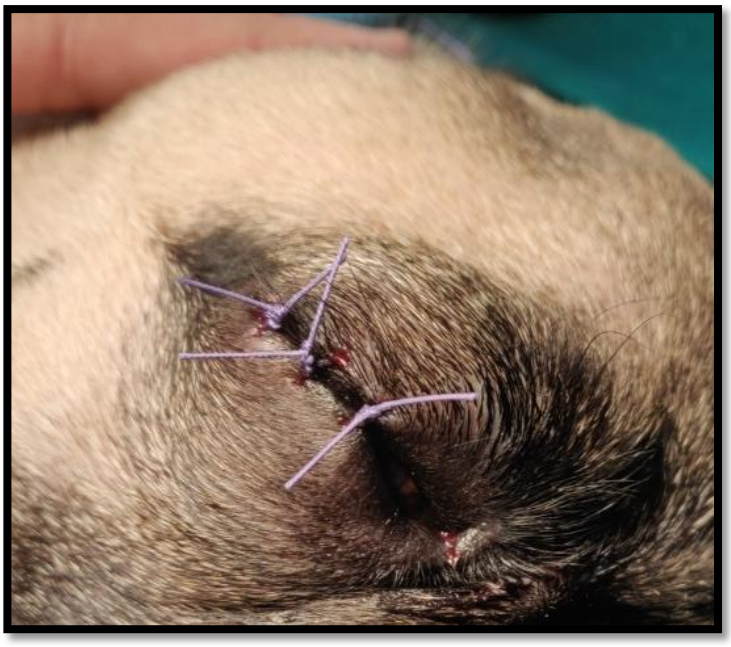


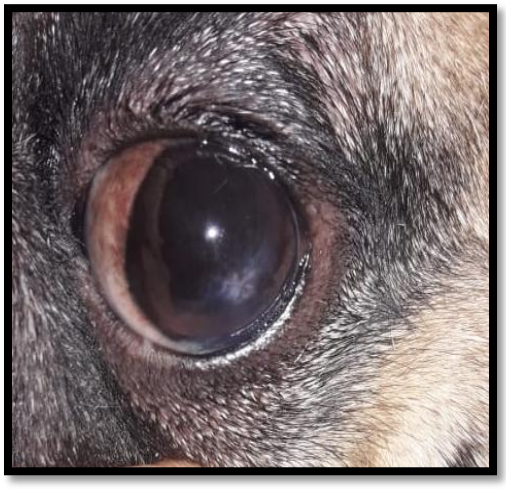
Plate no. 54: Temporary tarsorrhaphy using simple interrupted sutures

Plate no. 55: Post operative appearance of the affected cornea of group A (Case 2)

Day 0- Before the surgery

Day 5- Post operatively

Day 15- Post operatively

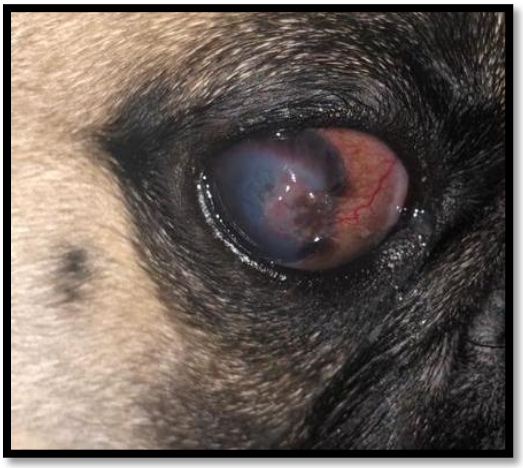


Day 30- Post operatively

Plate no. 56: Post operative appearance of the affected cornea of group B (Case 1)

Day 0- Before the surgery

Day 5- Post operatively



Day 15- Post operatively

Day 30- Post operatively

Plate no. 57: Post operative complication in group B (Case 2- developed a melting ulcer)

Day 0- Before surgery

Day 5- Post operatively

Day 10- Post operatively

Day 20- Post operatively

Day 30- Post operatively

VITA

Dr. Nirali Milind Kamat was born on 27th May, 1994. She has completed her Secondary School Certificate Examination with a Distinction in the year 2010 from St. Anthony's Girl High School, Chembur after which she attended S.I.E.S College, Sion for the completion of her Higher Secondary Certification in the year 2012. She secured admission into Mumbai Veterinary College, Parel to pursue a bachelor's degree in B.V.Sc and A.H and passed with First class in the year 2018.

Apart from academics, she has taken part in several N.S.S camps and always had an active participation in college gatherings. She has also represented M.A.F.S.U in Indradhanushya at Inter University level for singing.

She is currently completing her post graduate degree in Veterinary Surgery and Radiology from Mumbai Veterinary College, Parel. She is an avid lover of animals and the Veterinary profession brings her immense joy and a sense of satisfaction. She has a keen interest in Small Animal Soft Tissue Surgery and is navigating her way through her new found intrigue in Veterinary Ophthalmology. This thesis is a step in the direction of nurturing that interest.

Appendix-G

THESIS ABSTRACT

a)	Title of the thesis (in Capital letters)	**:**	**COMPARISON OF DIAMOND BURR DEBRIDEMENT WITH SOFT CONTACT BANDAGE LENS AND CORNEO-CONJUNCTIVAL TRANSPOSITION FOR TREATMENT OF CORNEAL ULCER IN DOG.**
b)	Full name of student	**:**	**Ms. Kamat Nirali Milind**
c)	Name and address of Major Advisor	**:**	**Dr. G. S. Khandekar** Dept. of Veterinary Surgery and Radiology, Mumbai Veterinary College, Parel, Mumbai-12
d)	Degree to be awarded	**:**	M.V.Sc.
e)	Year of award of degree	**:**	2021
f)	Major subject	**:**	Veterinary Surgery and Radiology
g)	Total number of pages in the thesis	**:**	109
h)	Number of words in the abstract	**:**	300
i)	Signature of Student	**:**	
j)	Signature, Name and address of forwarding authority (HOD / SH)	**:**	**Dr. D. U. Lokhande** Dept. of Veterinary Surgery and Radiology, Mumbai Veterinary College, Parel, Mumbai-12
h)	Signature of the Associate Dean	**:**	

ABSTRACT

The research project entitled "**Comparison of diamond burr debridement with soft contact bandage lens with corneo-conjunctival transposition for treatment for corneal ulcer in dog**" was undertaken to evaluate the efficacy of diamond burr debridement with soft contact bandage lens compared to corneo-conjunctival transposition in the treatment of corneal ulcers in dogs. A total of 12 dogs, divided randomly into two groups viz Group A (n=6) in which diamond burr debridement with soft contact bandage lens was performed and Group B (n=6) in which corneo-conjunctival transposition was performed.

All cases were subjected to detailed ophthalmic examination by evaluating various neuro-ophthalmic reflexes. Anesthetic protocol used included premedication with glycopyrrolate @ 0.01 mg/kg b.wt, diazepam @ 0.5 mg/kg b.wt and butorphanol @ 0.2 mg/kg b.wt intravenously. Induction of aneasthesia was done using propofol @ 4mg/kg b.wt intravenously and all patients were maintained using isoflurane USP 2.5% with oxygen delivery.

Surgery was performed in lateral recumbency. In group A, the ulcer was debrided in an area 1-2 mm surrounding the lesion using the Algerbrush. A soft contact bandage lens was placed on the cornea. In group B, a thin autologous lamellar sliding graft was prepared using some part of the cornea and bulbar conjunctiva, width and length of which was decided according to the size of the lesion. The graft was sutured to the ulcer bed using 8-0 polyglactin suture material. A temporary tarsorraphy was performed to prevent trauma in the first few days postoperatively.

Surgical, physiological, haemato-biochemical parameters and complications were studied. There was no significant alteration noted in physiological and haemato-biochemcal parameters within and between groups before and 24 hours after surgery.

Results of the study indicated that diamond burr debridement with soft contact bandage lens and corneo-conjunctival transposition were safe, feasible and effective for the treatment of corneal ulcers in dogs.

प्रबंध सारांश

a)	प्रबंधाचे शीर्षक	:	श्वानाच्या डोळ्याच्या बाह्लीच्या पारदर्शक पडद्याच्या व्रणावरील उपचारात,हिर्यारच्या खरीसरखा पृष्ठभाग असलेले यंत्रव मऊ संपर्क पट्टी वापरुन केलेले उपचार आणि पारदर्शक पडदा व नेत्रश्लेष्मलाचे स्थानांतरण या दोन उपचार पद्धतींचीतुलना
b)	विद्यार्थ्याचे नाव	:	कामत निराली मिलींद
c)	मार्गदर्शकाचे नाव आणि पत्ता	:	**डॉ. जी. एस. खांडेकर** प्राध्यापक, पशु शल्यचिकित्साशास्त्र व क्ष-किरण शास्त्र विभाग, मुंबई पशुवैद्यकीय महाविद्यालय, परळ, मुंबई - ४०००१२
d)	पदवी	:	पदव्युत्तर पदवी
e)	पदवी प्रदान करण्याचे वर्ष	:	२०२१
f)	मुख्य विषय	:	पशुवैद्यकीय शस्त्रक्रिया आणि क्ष-किरण शास्त्र
g)	प्रबंधातील एकूण पानांची संख्या	:	१०९
h)	प्रबंध सारांशातील एकूण शब्दांची संख्या	:	३००
i)	विद्यार्थ्याची सही	:	
j)	विभागप्रमुखाचे नाव, सही आणि पत्ता	:	**डॉ. डी. यू. लोखंडे,** प्राध्यापक, पशु शल्यचिकित्साशास्त्र व क्ष-किरण शास्त्र विभाग, मुंबई पशुवैद्यकीय महाविद्यालय, परळ, मुंबई - ४०००१२
k)	सहयोगी अधिष्ठाता, मुंबई पशुवैद्यक महाविद्यालय, परेल, मुंबई ४०००१२.	:	

प्रबंध सारांश

"श्वानाच्या डोळ्याच्या बाहुली च्या पारदर्शक पड द्याच्या व्रणावरील उपचारात,हिर्याळच्या खरीसरखा पृष्ठभाग असलेले यंत्रव मऊ संपर्क पट्टी वापरुन केलेले उपचार आणि पारदर्शक पड दा व नेत्रश्लेष्मलाचे स्थानांतरण या दोन उपचार पद्ध तींचीतुलना" हे शीर्षक असलेले संशोधन , पशुवैद्यकीय शल्यचिकित्सा व क्ष किरणचिकित्सा विभाग विभाग, मुंबई पशुवैद्य कीय महाविद्यालय, परळ, येथे करण्यात आले.

डोळ्याच्या बाहुलीच्या पारदर्शक पड द्यावर व्रण असलेले 12 श्वान दोन उपचार गटात विभागले.गट अ मध्ये (n=६) हिर्या च्या खरीसरखा पृष्ठभाग असलेले यंत्रव मऊ संपर्क पट्टी वापरुन केलेले उपचार तर गट ब मध्ये (n=६) पारदर्शक पडदा व नेत्रश्लेष्मलाचे स्थानांतरण करून उपचारकरण्यात आले॰

सर्व श्वानांच्या डोळ्या च्या विविध न्युरो-नेत्ररोग तपासण्या करण्यात आल्या. भुलपुर्व औषोधोपचारात ग्लायकोपायरोलेट @१ मि. ग्रॅ./किलो, डाईझेपाम @०.५ मि. ग्रॅ. /किलो आणि ब्युटोरफेनोल@०.२ मि. ग्रॅ. /किलो शिरेतूनदेण्यात आले. भूल देण्यासाठी प्रोपोफोल @४ मि. ग्रॅ. /किलो शिरेतून आणि प्राणवायू व आयसोफ्लूरेन वायूची वाफ २% यांचे मिश्रण वापरण्यात आले.

श्वानास एका बाजूवर झोपवून शस्त्रक्रिया करण्यात आली. गट अ मध्ये अल्जरब्रशच्या सहाय्याने व्रणाच्या भोवतालचा १-२ मि.मी. भाग खरवडल्यावर,बाहुलीच्या पारदर्शक पड द्यावर मऊ संपर्क पट्टी लावण्यात आली. गट ब मध्ये व्रणावर, व्रणाचा आकार लक्षात घेऊन पारदर्शक पड द्याचा काही भाग व नेत्रश्लेष्मल यांच्यापासून बनविलेला पातळ पडदा ,९.०नंबरचे पोलीग्लाकटीनटाके वापरून शिवण्यात आला , तसेच काहीकाळासाठी

आघातापासून संरक्षण देण्यासाठी ,बाधित डोळ्यांच्या पापण्या शस्त्रक्रिये ने बंद केल्या.

शल्यचिकित्सा ,शरीरक्रिया, रक्तघटकासंबंधित मापदंड आणि शस्त्रक्रियेतील गुंतागुंत यांचा अभ्यास केला असता , शस्त्रक्रियेनंतरच्या २४ तासात वरील मापदंडात दोन्ही गटामधे विशेष फरक आणि गुंतागुंत आढळली नाही.

परीक्षणांती ,श्वानाच्याडोळ्याच्या बाहुलीच्या पारदर्शक पड द्याच्या व्रणाच्या उपचारात, दोन्ही उपचार पद्धती सुरक्षित ,व्यवहार्यआणि परिणामकारक असल्याचे आढळून आले.