



# Risk stratification, prevention and management of perioperative corneal abrasion for non-ocular surgery: Systematic Review

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**Background:** A corneal abrasion is a flaw in the cornea's epithelial surface, which is located in the front of the eye. It causes recurrent erosions, corneal inflammation, and chronic corneal defects. In a context with limited resources, the goal of this review was to provide an evidence-based procedure for perioperative risk stratification, prevention, and management of corneal abrasion during non-ocular surgery.

**Methods:** A medical search engines of PUBMED, GOOGLE SCHOLAR, COCHRANE REVIEW, and PUBMED CENTRAL to get access for current and updated evidence on procedures on risk stratification, prevention and management of corneal abrasion for non-ocular surgery. The authors formulate the key questions, scope, and articles written in English language, human study focuses on corneal abrasion, articles in the last 20 year was implemented to identify or filter high-level evidences were included. Reports contain corneal abrasion due to ocular surgery were excluded. All the research articles, which were identified from searches of electronic databases, were imported into Endnote software, duplicate were removed advanced search strategy of electronic sources from databases and websites was conducted using Boolean operators (cornea AND (abrasion OR injury OR laceration)) AND ("Perioperative Period" OR "general anesthesia"). Screening of literatures was conducted with proper appraisal checklist. This review was reported in accordance with preferred reporting items for systematic reviews and meta-analyses (PRISMA) 2020 statement.

**Results:** From 8767 identified articles, two hundred articles were removed for duplication and 7720 studies were excluded, 1205 articles were retrieved and evaluated for eligibility. Finally, 24 were included in this systematic review. Advanced age, Prominent eyes, exophthalmus, ocular surface abnormalities (dry eye), expected duration of surgery (> 1 h), the favourable position of the surgery, prone, Trendelenburg and lateral, risk of bleeding, surgical site of the surgery(head /neck) and diabetes mellitus were risk for corneal abrasion. The use of appropriate intervention with pharmacological and Non-pharmacological strategies minimizes the occurrence of perioperative corneal abrasion was crucial for the quality of care.

**Conclusion:** Preventing and managing corneal abrasion improves patients' quality of life. However, there was insufficient evidence to draw conclusions, and high-quality trials of multimodal interventions matched to risk stratification and prevention of corneal abrasion needed to provide robust evidence to guide prevention and management of perioperative corneal abrasion.

**Keywords:** corneal abrasion, management of corneal abrasion, prevention of corneal abrasion

## Introduction

Corneal abrasion (CA) is a defect in the epithelial surface of the cornea, the most anterior portion of the eye<sup>[1]</sup>.

CA may result in ocular complications such as persistent corneal defect, corneal infection, and recurrent erosions. The

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## HIGHLIGHTS

- Corneal abrasion rates ranged from 0.02 to 59%.
- Around 3–8% of malpractice cases involving anaesthesia involve ocular damage.
- General anaesthesia more frequently cause eye damage (83%).
- Use of preventive and management protocol of corneal abrasion was crucial.

American Society of Anesthesiologist's closed-claims analysis found that perioperative CA was the single most common of all perioperative ophthalmic injuries<sup>[2]</sup>.

A systematic review done in 2019 states, corneal abrasion rates ranged from 0.02 to 59% but the cumulative rate was found to be 0.64%<sup>[3]</sup>. General anaesthesia was reported to cause eye damage more frequently (83%), monitored anaesthesia care (11%), and severe conduction blocking account (7%)<sup>[4]</sup>.

Advanced age, general anaesthesia, significant estimated blood loss, same-day admission, increased length of postoperative recovery, prone position, Trendelenburg position, urologic

surgery, and oxygen administration in the PACU. In addition, Laryngoscope, Oxygen face mask, Name badge, Wristwatch band, Gauze/sponges, Surgical drapes, Instruments, Chemical solutions, Heat sources, Pressure on the globe, Eyeshields, Patient fingers are confirmed as posing a greater risk for CA<sup>[3,5,6]</sup>.

Standardized ocular protection, reporting, and education initiatives were found to maximally decrease rates of perioperative corneal abrasions after non-ocular surgery<sup>[3]</sup> and treatment of perioperative CAs should aim to prevent infection and control pain without reducing the rate of corneal healing<sup>[11]</sup>.

Topical anaesthetics are not only safe but also an effective means of pain control for corneal abrasion. When dilute topical anaesthetics are used appropriately and for a short duration, no adverse effects have been demonstrated, and potent pain control is attained<sup>[7]</sup>.

The aim of this systematic review is to review high level of evidence by using the PRISMA checklist 2020 on risk stratification, and prevention and management of perioperative corneal abrasion in resource-limited setting.

## Rational of the review

Perioperative corneal abrasion made for 35% of all ocular injuries in the American Society of Anesthesiologist closed-claims analysis, and 16% of those led to permanent ocular morbidity<sup>[8]</sup>. Therefore, we should stratify the risks, apply preventive measures, detect, and treat them early. There is no prepared working protocol to prevent and treat perioperative corneal abrasion. Therefore, this review will recommend the best and easily applicable technique and material that will decrease perioperative corneal abrasion in a resource-limited setting.

In a systematic review done in 2019, the incidence of corneal abrasion ranges from 0.02 to 59% when various ocular protective techniques are used! including 59% manual closure, 0.2% lid tape, and 0.02% bio-occlusive dressing<sup>[3]</sup>. Therefore, the incidence of corneal abrasion is high, and needs perioperative intervention protocol to prevent these complications.

## Methodology

### Search strategy

The literatures were searched from medical hunt machines of PUBMED, GOOGLE SCHOLAR, COCHRANE REVIEW, and PUBMED CENTRAL to get access for current and streamlined attestations on procedures on threat position, forestallment, and operation of corneal bruise for non-ocular surgery. Different attestations are searched by using the crucial term (cornea AND (bruise OR injury OR rent)) AND ("Perioperative Period" OR "general anesthesia"). Also collected by filtering grounded on position of significance to this guideline with proper appraisal and evaluation of study quality with different position of substantiation. The strength of substantiation and grade of recommendation was made grounded on WHO 2011 position of substantiation. This review was registered in exploration registry and was reported in agreement with the preferred reporting particulars for methodical reviews and meta- analyses (PRISMA) 2020 criteria<sup>[9]</sup> (Fig. 1). This work has been reported in line with AMSTAR (Assessing the methodological quality of systematic reviews) guideline<sup>[10]</sup>.

### Eligibility criteria

All studies related to corneal abrasion prevention and management protocols reported in the English language, with a full text available for search and conducted across the globe were included in this systematic review. Those studies that reported duplicated sources, unrelated articles, a case reports, and articles without a full text available with attempts to contact the corresponding author via an e-mail were excluded from this review.

### Study selection

Three independent authors selected the candidate articles for the study, which were exported into endnote reference manager software to remove duplicates, and independently screened the titles and abstracts any disagreement was resolved through discussions led by a fourth author.

### Study quality assessment

The two independent authors appraised the standard of the study using AMSTAR 2 methodological quality appraisal checklist. Any disagreement was discussed and resolved by the authors. The critical analysis checklist has 16 parameters<sup>[10]</sup>. The quality of this review after critical appraisal of its method was reported as high.

## Results

### Article selection and description of reviewed articles

From 8767 identified articles, two hundred articles were removed for duplication and 7817 studies were excluded after reviewing titles and abstracts. At the screening stage, 710 articles retrieved and evaluated for eligibility. Finally, 24 studies met the eligibility criteria and were included in this systematic review (Fig. 1).

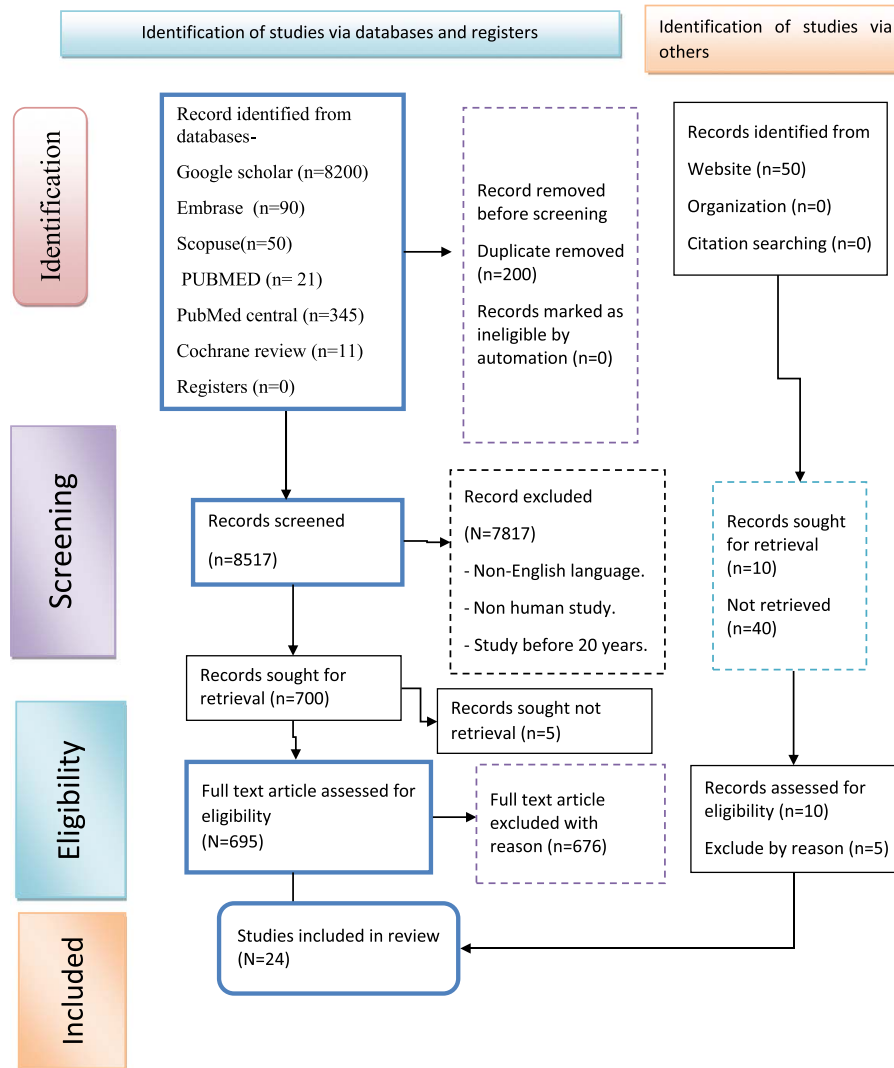
Out of 1445 articles retrieved, 24 studies met the eligibility criteria and were included in this systematic review. Out of all articles included, 13 were systematic reviews, one meta-analysis, and one were cross-sectional studies, 3 were guidelines, 6 were cohort studies, one cohort, and three were controlled trials (Fig. 1).

## Discussion

### Risk factors

A systematic review done in the USA, Long procedures (> 1 h), general anaesthesia, and advanced age were independent risk factors for CA<sup>[3]1b</sup>. In addition to this comprehensive review done in los angeles, USA, and evidence- based guideline Samaritan Hospital, Kearney, USA states that surgical site is near the eye and its environs, ocular injuries happen more frequently. General anaesthesia, head and neck operations, lengthy surgical procedures, advanced age, lateral positioning, prone positioning, and having surgery on Monday are all independent risk factors for ocular damage<sup>[1,4]1b,1a</sup>.

A systematic review done in USA and a case-control study done in Birmingham, USA on precipitating factors, and prevention of CA stated that operations in the lateral or prone position, preoperative anaemia and intraoperative deliberate hypotension were precipitating factors for eye injury<sup>[3,11]1b,2a</sup>.



**Figure 1.** The PRISMA 2020 flow diagram database showing the risk stratification, prevention, and management of perioperative corneal abrasion was used<sup>[9]</sup>.

A cross-sectional study done in Presbyterian Hospital, New York on risk factors of CA showed that advanced age, general anaesthesia, significant blood loss, and Trendelenburg or prone positioning were statically significant risk factors<sup>[6]3a</sup>. Patient risk factors like diabetes mellitus, obesity, and hypertension compromise optic nerve perfusion that may be causative of ocular injuries in non-ocular surgery and general anaesthetic duration, blood loss, position during surgery, and fluid administration are important in preventing ocular complications<sup>[2]2a</sup>.

A systematic review done by Stambough, Jeffery L in 2007 states, corneal abrasion, the most common ophthalmologic injury, is usually self-limiting. However, prolonged surgical procedures (> 7 hours) associated with acute blood loss anaemia, hypotension, and hypoxia may lead to posterior ischaemic optic neuropathies and the prognosis for visual recovery from ischaemic neuropathy and retinal artery occlusion is poor<sup>[12]1b</sup>.

A cohort study done by Ajay Sampat 2015 states, both laparoscopy and robotic assistance appear to contribute independently to increasing the risk of CA for hysterectomy. Age, having comorbidity, and race were factor influencing the risk of

CA and there was an approximately four times higher risk when laparoscopy was used for hysterectomy, and a seven times higher risk when laparoscopic hysterectomy was robotically assisted, compared with an open procedure<sup>[13]2a</sup>.

A systematic review done by Rohan Bir Singh in 2021 states, Prolonged surgical times and intraoperative blood loss can result in more considerable physiological variability and cerebral hypoperfusion thus contributing to the increased incidence of cortical blindness<sup>[14]1b</sup>.

### **Prevention and management of prooperative corneal abrasion**

A systematic review done in the USA applying eyelid taping and bio-occlusive dressing proved a successful CA prevention strategy, preoperative education dramatically reduces corneal abrasion well-informed anaesthesia providers, and decreased rates of corneal abrasions<sup>[3]1b</sup>.

A systematic review done in the USA and A case-control study done in Birmingham, USA on the prevention of CA stated that

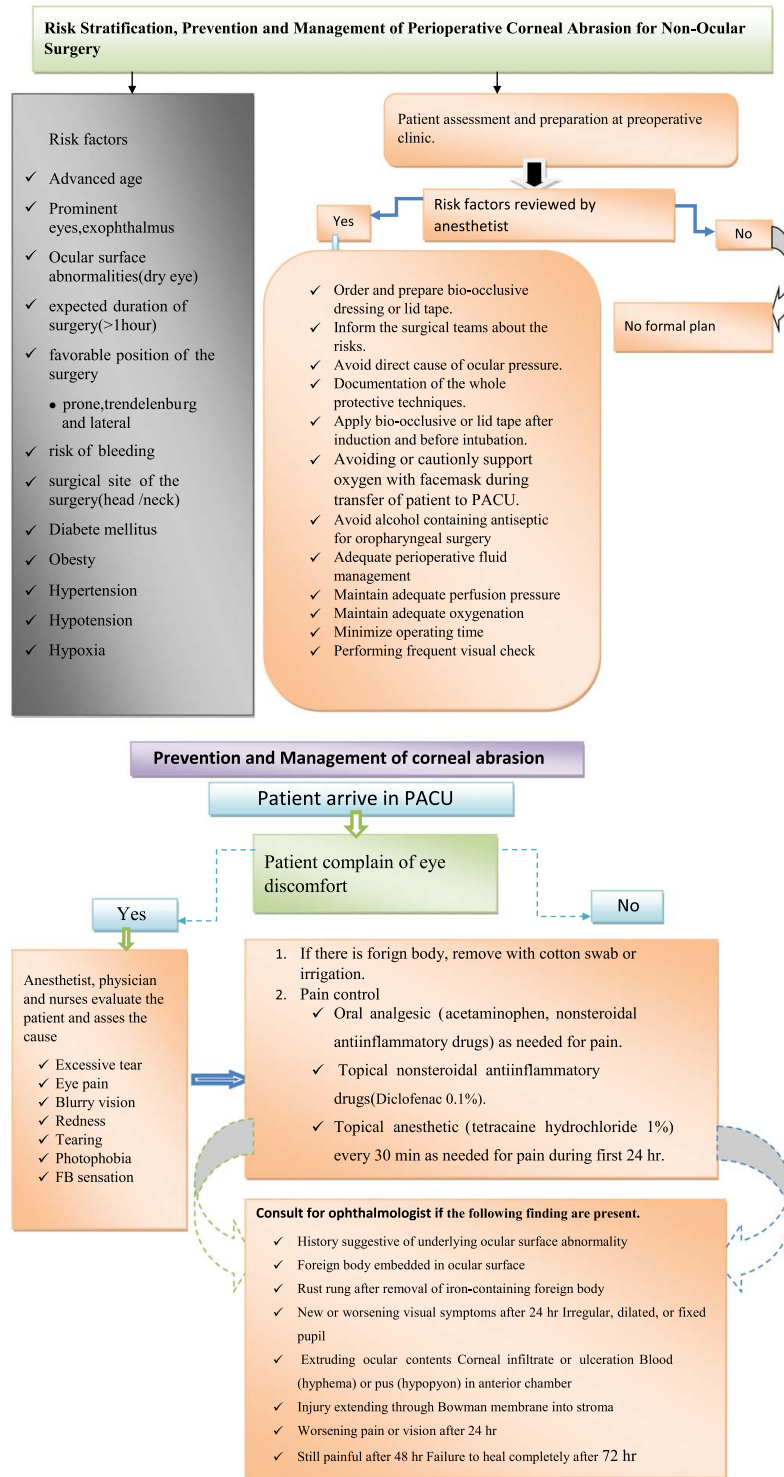


Figure 2. Risk stratification, prevention, and management protocol of perioperative corneal. abrasion for non-ocular surgery in resource-limited setting.

using standardized ocular protection, reporting, and education initiatives decreases rates of perioperative corneal abrasion. In addition, using bio-occlusive dressings are the best prevention of CAs compared to using tape with an ointment, while manual closure alone resulted in CAs 59% of the time<sup>[3,11]1b,2a</sup>.

A randomized control trial done in Seoul, Korea, CA prevention indicated that individuals with dry eye syndrome should use

preservative-free (methylparaben and chlorobutanol) ocular lubricants before taping their eyes. However, the artificial tear liquid gel that contained polyacrylic acid caused corneal epithelial abnormalities, hyperaemia, and chemosis. But the least amount of these symptoms were created with hypoallergenic tape, and The combination of an ocular lubricant pomade and an antibiotic cream (Terramycine) caused the most blurry vision<sup>[15]1c</sup>.

**Table 1****Summary of evidence**

References	Year	Study design	Study comparison	Outcome	Recommendation
Papp <i>et al.</i> <sup>[9]</sup>	2019	Systematic review	Different intervention with different studies	CA occurred at a cumulative rate of 0.64%. Longer procedures, general anaesthesia, and advanced age were risks for CA Eyelid taping with and without ointment and use of a bio-occlusive dressing were common prevention methods Two of the 16 articles evaluated educational interventions decrease in the rate of CA with the education alone.	Highly recommended
Calder <i>et al.</i> <sup>[18]</sup>	2005	Meta-analysis of randomized trials	Topical NSAIDs with placebo	Participant-reported pain intensity reduction of 50% or greater at 24 h	Strongly recommended
Kaye <i>et al.</i> <sup>[1]</sup>	2019	Comprehensive review	Incidence, risk factor and treatment	CAs was commonly occurring ocular injury in the perioperative period. Most often, the abrasions heal in 24–48 h.	Highly recommended
Grixti <i>et al.</i> <sup>[16]</sup>	2013	RCT	Ocular surface protection during anaesthesia (lid taping and bio-occlusive dressing with manual closure)	Decreased rate of corneal abrasion	Recommended
Vetter <i>et al.</i> <sup>[11]</sup>	2012	Case-control study	Age, sex, past medical history (diabetes status, pre-existing ocular disease), duration of procedure, patient positioning in the operating room, and anatomic surgical area involved (head and neck vs other procedures).	The duration of the procedure and pre-existing ocular disease are strong predictors of whether CA will occur during surgery.	Optional
Kocatürk <i>et al.</i> <sup>[15]</sup>	2012	RCT	Patients were divided into four groups of 46 using a randomization chart. Group 1: hypo allergen adhesive tape) Group 2: antibiotic ointment Group 3: artificial tear liquid gel containing Group 4: ocular lubricant pomade	All patient groups had reduced basal tear production of the eyes postoperatively. Artificial tear liquid gel produced the corneal epithelial defects, hyperaemia, and chemosis. Hypo allergen adhesive tape produced the least corneal epithelial defects, hyperaemia, and chemosis. Blurry vision occurred most with antibiotic ointment and ocular lubricant pomade	Recommended
Anderson <i>et al.</i> <sup>[25]</sup>	1995	Systematic review	Risk and prevention Eye injury during general anaesthesia for oral and maxillofacial surgery	Topical anaesthetics should be avoided because they have been shown to be toxic to the corneal epithelium and to retard healing	Strongly recommended
Kaye <i>et al.</i> <sup>[1]</sup>	2019	Review	Postoperative management of corneal abrasions and clinical implications	Use of general anaesthesia, head and neck operations, lengthy surgical procedures, advanced age, lateral positioning, prone positioning, and having surgery on Monday are all independent risk factors for ocular damage	Highly recommended
Moos <i>et al.</i> <sup>[4]</sup>	2006	Guideline	Detection and treatment of perioperative corneal abrasions.	General anaesthesia was reported to cause eye damage more frequently (83%), monitored anaesthesia care (11%), and severe conduction blocking account (7%)	Strongly recommended
Martin <i>et al.</i> <sup>[5]</sup>	2009	Case-control study	Performance improvement system and postoperative corneal injuries: incidence and risk factors	Incidence of perioperative corneal injuries was 1.51 per 1000 patients; after that, it dropped to 0.79 per 1000 and , SRNAs had greater injury rates than CRNAs	Extrapolated from other study
Segal <i>et al.</i> <sup>[6]</sup>	2014	Cross-sectional	Evaluation and treatment of perioperative corneal abrasions	advanced age, general anaesthesia, large blood loss, and Trendelenburg or prone positioning were statically significant risk factors	Extrapolated from other study
Young <i>et al.</i> <sup>[2]</sup>	2021	Systematic review of case-control	Corneal Abrasions in Total Joint Arthroplasty.	General anaesthetic duration, blood loss, position during surgery, and fluid administration are important in preventing ocular complications. Increased attention to appropriate patient positioning during procedures should be prioritized.	Extrapolated from other study
Swaminathan <i>et al.</i> <sup>[7]</sup>	2015	Review	The safety of topical anaesthetics in the treatment of corneal abrasions	Due to the different etiologies of ophthalmic complications in orthopaedic procedures, disclosure of information prior to surgery is appropriate to consider Topical anaesthetics are not only safe but also an effective means of pain control for corneal abrasion and When dilute topical anaesthetics are used appropriately and for a short duration, no adverse effects have been demonstrated, and potent pain control is attained	Highly recommended
Gild <i>et al.</i> <sup>[8]</sup>	1992	Closed claimed analysis	Eye injuries associated with anaesthesia	Perioperative corneal abrasion made for 35% of all ocular injuries in the ASA closed-claims analysis, and 16% of those led to permanent ocular morbidity	Highly recommended
Vetter <i>et al.</i> <sup>[11]</sup>	2012	Case-control	Intraoperative corneal abrasion prevention program	continuous education program and intraoperative eye protection led to a considerable drop in monthly CAs and medical expenses Alcohol-containing antiseptic agents used during orofacial surgery may cause toxic keratopathy and using alcohol-free antiseptic agents may reduce the risk of corneal injury in orofacial surgery	Extrapolated from other study

Table 1

(Continued)

References	Year	Study design	Study comparison	Outcome	Recommendation
Kocaturk <i>et al.</i> <sup>[15]</sup>	2012	RCT	The comparison of four different methods of perioperative eye protection under general anaesthesia in prone position	The artificial tear liquid gel that contained polyacrylic acid caused most corneal epithelial abnormalities, hyperaemia, and chemosis. But the least amount of these symptoms were created with hypoallergenic tape, and The combination of an ocular lubricant pomade and an antibiotic cream (Terramycine) caused the most blurry vision	Recommended
Grixti <i>et al.</i> <sup>[16]</sup>	2013	Systematic review	Corneal protection during general anaesthesia for non-ocular surgery	The best protective strategy available is lid taping, however other interventions, including the use of ointments, gels, or bandages, may offer additional measures of protection. For head and neck surgery, lengthy procedures, and surgeries performed in the prone or lateral position, recent studies have advised using bio-occlusive dressings rather than lid tape	Highly recommended
Stambough <i>et al.</i> <sup>[12]</sup>	2007	Systematic review	Ophthalmologic complications associated with prone positioning in spine surgery	Prolonged surgical procedures (> 7 h) associated with acute blood loss anaemia, hypotension, and hypoxia may lead to posterior ischaemic optic neuropathies and the prognosis for visual recovery from ischaemic neuropathy and retinal artery occlusion is poor	Highly Recommended
Sampat <i>et al.</i> <sup>[13]</sup>	2015	Cohort study	Corneal abrasion in hysterectomy and prostatectomy:role of laparoscopic and robotic assistance	Both laparoscopy and robotic assistance appear to contribute independently to increasing the risk of CA for hysterectomy. Age, comorbidity, and race were factor influencing the risk of CA and there was an approximately four times higher risk when laparoscopy was used for hysterectomy, and a seven times higher risk when laparoscopic hysterectomy was robotically assisted, compared with an open procedure	Extrapolated from other study
Singh <i>et al.</i> <sup>[14]</sup>	2021	Systematic Review	Ocular complications of perioperative anaesthesia: a review	Prolonged surgical times and intraoperative blood loss can result in more considerable physiological variability and cerebral hypoperfusion thus contributing to the increased incidence of cortical blindness ensuring adequate preoperative intravascular volume, maintaining physiological systemic perfusion pressure and oxygenation intraoperatively, minimizing operative time, and performing frequent visual checks during and after the procedure particularly in high-risk patients	Strongly recommended
Donovan <sup>[17]</sup>	2019	Review	A Critical Look at Corneal Abrasion During Non-Ocular Surgery	Ongoing quality improvement initiative to increase perioperative staff awareness of CA risk, inform on best practices for eye protection during anaesthesia and to guide future institution policy to standardize eye protection protocols and eliminate CA complications during non-ocular surgery	Highly recommended
Calder <i>et al.</i> <sup>[18]</sup>	2005	Meta-analysis of randomized trials.	Topical nonsteroidal anti-inflammatory drugs for corneal abrasions	0.1% diclofenac sodium is FDA-approved to decrease discomfort and photophobia after acute corneal abrasion. Additionally, diclofenac and ketorolac lessen discomfort following corneal abrasions and decrease normal corneal sensitivity	Strongly recommended
Kim <i>et al.</i> <sup>[19]</sup>	2010	Meta-analysis of randomized trials.	Nonsteroidal anti-inflammatory drugs in ophthalmology	0.1% diclofenac sodium is FDA-approved to decrease discomfort and photophobia after acute corneal abrasion. Additionally, diclofenac and ketorolac lessen discomfort following corneal abrasions and decrease normal corneal sensitivity	Strongly recommended
Waldman <i>et al.</i> <sup>[22]</sup>	2014	Systematic review	Topical tetracaine used for 24 h is safe and rated highly effective by patients for the treatment of pain caused by corneal abrasions	diluted topical anaesthetics for short duration not only safe but also an effective means of pain control for corneal abrasion and short term topical anaesthetics use for acute complicated corneal abrasion reduce or eliminate opioid consumption	Highly recommended
Malafa <i>et al.</i> <sup>[23]</sup>	2016	Guideline	Perioperative Corneal Abrasion: Updated Guidelines for Prevention and Management.	Topical anaesthetics on the corneal epithelium is insignificant and pain can be controlled by Oral analgesic ( acetaminophen, nonsteroidal anti-inflammatory drugs) as needed for pain, topical nonsteroidal anti-inflammatory drugs (Diclofenac 0.1%),Topical anaesthetic (tetracaine hydrochloride 1%) every 30 min as needed for pain during first 24 h	Strongly recommended

Lee et al. <sup>[24]</sup>	2016	RCT	Comparison of eye protection methods for corneal abrasion during general anaesthesia	Eye taping, eye ointment application, or taping after eye ointment application will not significantly reduce the degree of corneal epithelial damage compared to manual eye closure	Recommended
Thiel et al. <sup>[20]</sup>	2017	A systematic review	Efficacy of topical analgesics in pain control for corneal abrasions	Using NSAID significant decrease in pain experienced by the patient after CA Corneal abrasions often heal spontaneously in less than 72 hours, and treatment usually involves topical antibiotic ointment as well as both topical and oral nonsteroidal anti-inflammatory (NSAID) pain relievers	Strongly recommended
Morris et al. <sup>[21]</sup>	2018	Systematic review	Effectiveness of corneal abrasion prevention interventions for adults undergoing general anaesthesia for more than one hour	usually involves topical antibiotic ointment as well as both topical and oral nonsteroidal anti-inflammatory (NSAID) pain relievers	Strongly recommended

ASA, American Society of Anesthesiologist; CA, corneal abrasion; FDA, Food and drug administration; NSAID, nonsteroidal anti-inflammatory drug; RCT, randomized control trial.

A systematic review done at Royal Liverpool university hospital, Liverpool, UK found that the best protective strategy available is lid taping, however other interventions, including the use of ointments, gels, or bandages, might offer additional measures of protection. But for head and neck surgery, lengthy procedures, and surgeries performed in the prone or lateral position, recent studies have advised using bio-occlusive dressings rather than lid tape<sup>[16]1b</sup>.

A cross-sectional study done in Presbyterian Hospital, New York on risk factors of CA Stated that increased attention to appropriate patient positioning during procedures should be prioritized. Due to the different etiologies of ophthalmic complications in orthopaedic procedures, disclosure of information prior to surgery is appropriate to consider<sup>[2,6]3a 2a</sup>.

A case-control study done in Birmingham, USA found continuous education program and intraoperative eye protection led to a considerable drop in monthly CAs and medical expenses<sup>[11]2a</sup> Alcohol-containing antiseptic agents used during orofacial surgery may cause toxic keratopathy, and using alcohol-free antiseptic agents may reduce the risk of corneal injury in orofacial surgery.

A comprehensive review done in los angeles, USA states, early detection and evaluation of CA in the perioperative setting is important for successful treatment. Signs and symptoms of CA are typically present in the early postoperative period. These include complaints of eye pain, blurry vision, tearing, redness, photophobia, and foreign body sensation<sup>[1]1b</sup>.

A systematic review done by Rohan Bir Singh in 2021 states, Prolonged surgical times and intraoperative blood loss can result in more considerable physiological variability and cerebral hypoperfusion thus contributing to the increased incidence of cortical blindness. As treatment options are limited, the focus lies on preventing stroke onset and progression. Preventive measures include ensuring adequate preoperative intravascular volume, maintaining physiological systemic perfusion pressure and oxygenation intraoperatively, minimizing operative time, and performing frequent visual checks during and after the procedure, particularly in high-risk patients<sup>[14]1b</sup>.

There are several reasons why the prevention of perioperative corneal abrasions is important. From a patient's perspective, they are significantly painful injuries. These injuries will frequently describe the pain of the abrasion as more severe than the pain from their operative site. They often recall the pain of the abrasion vividly as part of their immediate postoperative memory. An ophthalmologic evaluation may result in a delay in discharge, and most patients end up with the expense and inconvenience of an ophthalmology consultation, extra medication, and a follow-up eye visit<sup>[17]1b</sup>.

A meta-analysis done in Ottawa Hospital; Canada demonstrates Patients with severe corneal abrasion can have good analgesia with a topical NSAID. According to a University of California, USA, evidence-based recommendation, 0.1% diclofenac sodium is FDA-approved to decrease discomfort and photophobia after acute corneal abrasion. Additionally, diclofenac and ketorolac lessen pain following corneal abrasions and decrease normal corneal sensitivity<sup>[18,19]1a</sup>.

A systematic review done at Royal Liverpool university hospital, Liverpool, the effect of NSAID on pain management, revealed that using NSAID significantly decrease in pain experienced by the patient after CA<sup>[20]1b</sup>. A systematic review done by Amanda Morris in 2018 states Corneal abrasions often heal spontaneously in less than 72 h, and treatment usually involves



topical antibiotic ointment as well as both topical and oral non-steroidal anti-inflammatory (NSAID) pain relievers<sup>[21]1b</sup>.

A systematic review done in New York, USA study on effect of topical anaesthetics stated that using appropriately diluted topical anaesthetics for short duration not only safe but also an effective means of pain control for corneal abrasion and short-term topical anaesthetics use for acute complicated corneal abrasion reduce or eliminate opioid consumption<sup>[7,22]1b,1c</sup>. A Guideline done by M. M. Malafa in 2016 states, topical anaesthetics were previously contraindicated during treatment of corneal abrasion because of concern for deleterious effects on healing and potential for patient misuse, both of which can result in serious complications. Concern for delayed epithelialization derives from early animal studies; however, more recent laboratory and clinical investigations suggest that the effect of topical anaesthetics on the corneal epithelium is insignificant and pain can be controlled by oral analgesic (acetaminophen, nonsteroidal anti-inflammatory drugs) as needed for pain, topical nonsteroidal anti-inflammatory drugs (Diclofenac 0.1%), Topical anaesthetic (tetracaine hydrochloride 1%) every 30 min as needed for pain during first 24 h<sup>[23]1a</sup>.

Guideline done by M. M. Malafa in 2016 and cross-sectional study done by Segal states ophthalmologic Consultation should be considered if history suggestive of underlying ocular surface abnormality, foreign body embedded in ocular surface, rust ring after removal of iron-containing foreign body, New or worsening visual symptoms after 24 h Irregular, dilated, or fixed pupil, Extruding ocular contents Corneal infiltrate or ulceration Blood (hyphema) or pus (hypopyon) in anterior chamber, Injury extending through Bowman membrane into stroma, Worsening pain or vision after 24 h, Still painful after 48 h and Failure to heal completely after 72 h<sup>[6,23]1a,3a</sup>.

A systematic review done in 2019 states, Eyelid taping with and without ointment and bio-occlusive dressing were found to be the most used prevention techniques. A systematic review of the aforementioned prevention strategies in comparison to manual closure. Both strategies were found to be superior to manual closure; however, the bio-occlusive dressing was found to be the best prevention technique with the lowest rate of abrasion and associated ocular injury<sup>[3]1b</sup>.

A randomized control trial done in 2016 states that, to prevent corneal abrasions in normal patients undergoing general anaesthesia, eye taping, eye ointment application, or taping after eye ointment application will not significantly reduce the degree of corneal epithelial damage compared to manual eye closure<sup>[24]1c</sup>.

In a systematic review conducted in 2015 states, topical anaesthetics are not only safe but also an effective means of pain control for corneal abrasion. When dilute topical anaesthetics are used appropriately and for a short duration, no adverse effects have been demonstrated, and potent pain control is attained<sup>[7]1b</sup>.

A systematic review done by Anderson, Topical anaesthetics should be avoided because they have been shown to be toxic to the corneal epithelium and to retard healing<sup>[25]1b</sup>.

### Summary of evidence

A systematic review done in 2019, the incidence of corneal abrasion ranges from 0.02 to 59% when various ocular protective techniques are used! including 59% manual closure, 0.2% lid tape, and 0.02% bio-occlusive dressing<sup>[3]</sup>. Perioperative corneal abrasion made for 35% of all ocular injuries in the

American Society of Anesthesiologist closed-claims analysis, and 16% of those led to permanent ocular morbidity<sup>[8]</sup>. So we should stratify the risks, apply preventive measures, detect and treat early. In this review advanced age, prominent eyes, exophthalmus, ocular surface abnormalities (dry eye), expected duration of surgery (> 1 h), favourable position of the surgery, prone, Trendelenburg and lateral, risk of bleeding, surgical site of the surgery (head/neck) and diabetes mellitus were risk for corneal abrasion. Use of appropriate intervention with pharmacological and non-pharmacological strategies like if there is foreign body, remove with cotton swab or irrigation, oral analgesic (acetaminophen, nonsteroidal anti-inflammatory drugs) as needed for pain, topical nonsteroidal anti-inflammatory drugs (Diclofenac 0.1%), topical anaesthetic (tetracaine hydrochloride 1%) every 30 min as needed for pain during first 24 h minimizes the occurrence of perioperative corneal abrasion was crucial for quality of care (Table 1). This review guides the clinicians to provide appropriate interventions for corneal abrasion by using best and easily applicable technique and material that will decrease perioperative corneal abrasion in resource-limited setting (Fig. 2). However, this review conducted from different articles that are not homogenous in methods and study type. Moreover, this work emphasizes on the qualitative review of recommendations on perioperative corneal abrasion. Therefore, we recommend future researchers to conduct a meta-analysis of studies on prevention and management of corneal abrasion.

### Conclusion

Preventing and managing corneal abrasion improves patient's quality of life. However, there was insufficient evidence to draw conclusions and high-quality trials of multimodal interventions matched to risk stratification and prevention of corneal abrasion needed to provide robust evidence to guide prevention and management of perioperative corneal abrasion.

### Ethics approval and consent to participate

Ethical clearance was obtained from the institutional ethical review committee. The aim of the study was explained to the participant, and informed consent was obtained. Anyone not volunteering for participation was informed that they had the full right not to participate or stop at any time.

### Consent for publication

Not applicable.

### Sources of funding

Not applicable.

### Author contribution

This work was carried out in collaboration among all authors T.M.L. contributed to the conception, the review, and interpreted the result. A.T.M., B.M.A., N.R.A. in commenting from conception till manuscript preparation.



## Conflicts of interest disclosure

The authors declared that they have no conflicts of interests.

## Research registration unique identifying number (UIN)

1. Name of the registry: research registry.
2. Unique Identifying number or registration ID: 1643.
3. Hyperlink to your specific registration (must be publicly accessible and will be checked): <https://www.researchregistry.com/browse-theregistry#registryofsystematicreviewsmeta-analyses/>.

## Guarantor

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## Data availability statement

The data and material used to analyze the study are available from the corresponding author on request.

## Provenance and peer review

Not commissioned, externally peer-reviewed.

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