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**Case Report**

# Blepharokeratoconjunctivitis Presumably Caused by *Paederus fuscipes*, a Beetle: A Case Report

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Case report · Insect toxin · Keratitis · Ocular trauma · Persistent corneal epithelial defect

**Abstract**
Toxicity of *Paederus* species to eyes has scarcely been reported. This report presents a case of chemical blepharokeratoconjunctivitis with delayed re-epithelialization caused by *Paederus fuscipes* in a patient with dry eye after laser-assisted in situ keratomileusis (LASIK). A 47-year-old woman who had undergone LASIK for myopia 10 years prior experienced visual disturbance and pain in her left eye after being hit by a *P. fuscipes* insect in her eye 1 day prior to evaluation. At the initial presentation, dermatitis around the patient's left eye, eyelid oedema, conjunctival chemosis, corneal epithelial defects, and a best corrected visual acuity (BCVA) of 20/200 were noted. No gram-positive/negative bacteria or indication of cellulitis/elevated inflammation was detected. Administration of topical steroids (betamethasone) and antibiotics (topical: cefmenoxime and levofloxacin; intravenous: ceftriaxone) improved the non-infectious chemical blepharokeratoconjunctivitis; however, the large corneal epithelial defect remained for 10 days. Switching from betamethasone to a preservative-free form facilitated re-epithelialization, and the patient's BCVA improved to 20/16 after 2 months. Ophthalmologists should consider the toxicity of the *Paederus* species on the ocular surface and eyelid.



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## Introduction

*Paederus fuscipes* is a small insect that is approximately 1.5 mm wide and 7–10 mm long [1]. It has a characteristic colouration: the head and abdomen are black, and the remaining parts are yellow. The *Paederus* genus includes more than 600 species, and its members live in warm and moist areas worldwide [1], including numerous Asian countries. *P. fuscipes* causes contact linear dermatitis, called *Paederus* dermatitis [2, 3] due to the presence of a cytotoxic substance, pederin ($C_{25}H_{45}NO_9$) in its haemolymph, which is released when the insect is crushed. The name of this toxin originates from the name of the insect genus. Symptoms typically appear after a moderate interval of 12–48 h from contact with pederin, making it challenging for doctors to identify the underlying cause of a patients' dermatitis [1]. Many cases of contact dermatitis caused by *P. fuscipes* have been reported because of its broad prevalence [2–5]. However, few reports have described the ocular toxicity of the *Paederus* species, which presents as conjunctivitis and keratitis [6–9]. Moreover, there have been no previous reports that have investigated *P. fuscipes*-associated chemical blepharokeratoconjunctivitis in cases of severe dry eye following laser-assisted in situ keratomileusis (LASIK). Thus, we present a rare case of refractory, non-infectious chemical blepharokeratoconjunctivitis presumably caused by a beetle, *P. fuscipes,* which demonstrated delayed corneal re-epithelialization in a patient with dry eye post-LASIK. The CARE checklist has been completed by the authors for this case report and submitted as supplementary material (for all online suppl. material, see https://doi.org/10.1159/000533711).

## Case Report

A 47-year-old Japanese woman presented at the authors' hospital with the chief complaint of decreased visual acuity and intense pain in her left eye. She reported that a small insect had hit her eye the previous day and that she had subsequently visited a local hospital, where she was diagnosed with keratitis. She was referred to our hospital for further evaluation on the day following the injury. She had undergone LASIK 10 years prior for myopia and had been treated with topical instillations of 0.1% fluorometholone, 3% diquafosol sodium ophthalmic solution, and 2% rebamipide eye drops for dry eye, in addition to a punctal plug installation.

*Investigation*

On initial presentation, blepharitis, strong oedema of the eyelid, conjunctival chemosis, and hyperaemia were observed in the left eye (Fig. 1a, b). Fluorescein staining confirmed that corneal epithelium defects were present in almost all areas accompanied by cell infiltration (Fig. 1c). Strong opacification of the central cornea and copious discharge were observed. However, the corneal flap created during LASIK appeared intact. The patient's best corrected visual acuity (BCVA) was 20/200 in the left eye. However, her intraocular pressure (16 mm Hg) remained within the normal range. Gram staining of the corneal scrape demonstrated numerous neutrophils and epithelial cells, but no bacteria, including gram-positive cocci or gram-negative rods/cocci (Fig. 1d). Systemic symptoms such as fever or headache were not present. In the patient's right eye, the breakup time was 3 s, superficial punctual keratopathy was observed, and tear meniscus was low with a punctal plug. Therefore, the right eye also required the following eye drops for dry eye after LASIK: 0.1% fluorometholone, 3% diquafosol sodium ophthalmic solution, and 2% rebamipide eye drops.

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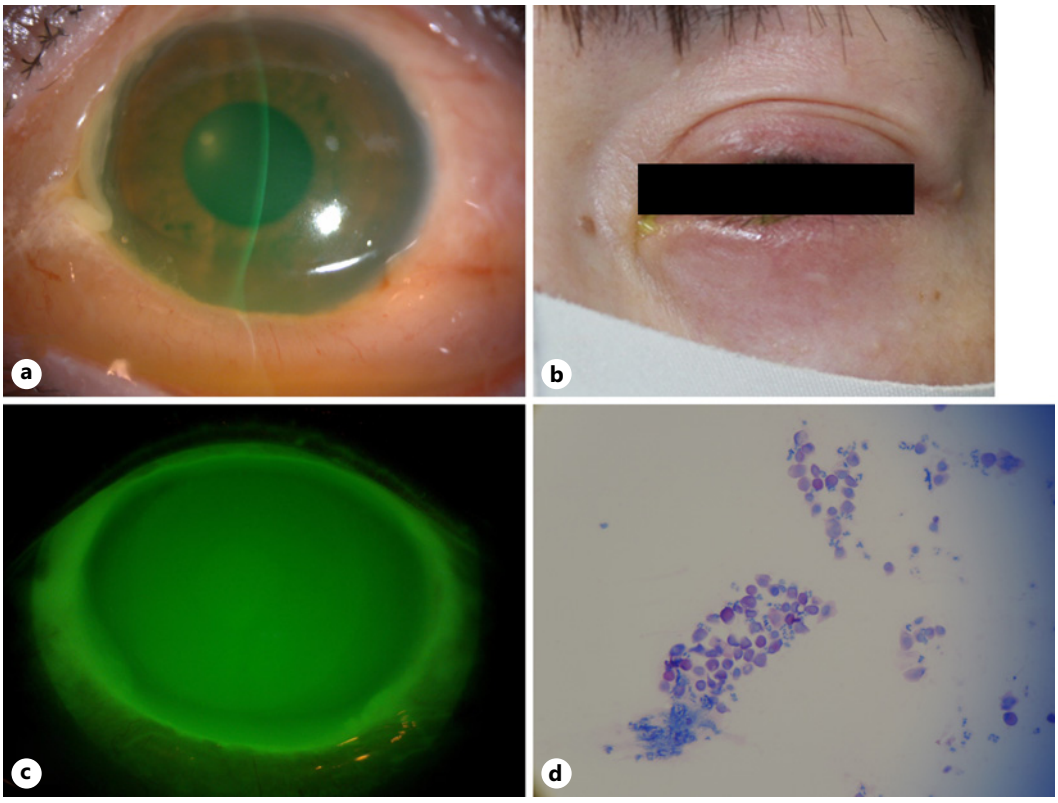


**Fig. 1.** Anterior eye segment of the patient with keratitis caused by *Paederus fuscipes* at initial presentation. **a** Image of the anterior segment using slit-lamp microscopy at the initial presentation. Corneal oedema, hyperaemia, and conjunctival chemosis with discharge are observed. **b** Image of the face of the patient at initial presentation. Blepharitis with oedema is noted. **c** Image of the cornea after fluorescein staining. Almost all corneal epithelial defects can be identified. **d** Gram staining of the corneal scrape. Although there are numerous neutrophils and epithelial cells, no gram-positive cocci or gram-negative bacteria can be observed.

*Differential Diagnosis*

Based on the initial presentation, cellulitis around the left eye was considered as a possible differential diagnosis. However, head computed tomography was performed, which revealed no abnormalities around the eyes, except for orbital oedematous changes. Blood tests revealed that the patient's white blood cell count was 5,500/mm$^3$, and C-reactive protein level was 0.2 mg/dL, suggesting no systemic inflammation. No other abnormalities were detected.

Cellulitis was ruled out, and local inflammation, limited to areas around the left eye, was considered. In a detailed interview, the patient described the insect as yellow and black in colour, with a shape resembling that of ants. *P. fuscipes* is a common beetle found in the rural areas of Japan, where our hospital is located. It is known to cause focal dermatitis and is referred to as "burn insect" by the local inhabitants. Therefore, most inhabitants in the area know the name and shape of the insect. Thus, a detailed interview implicated *P. fuscipes* as the causative insect, and *P. fuscipes*-induced keratitis was suspected.

*Treatment*

Based on these findings, the eye was washed with saline to remove the toxin, and intravenous injections of ceftriaxone (1 g) were started with the hourly instillation of topical 0.5% cefmenoxime. On day 3, after confirming systemic inflammation had not occurred and

ruling out cellulitis, topical treatment with 1.5% levofloxacin and 0.5% cefmenoxime every 2 h, 0.1% betamethasone four times a day, and 0.3% ofloxacin eye ointment once a day was initiated.

Although there was no conjunctival foreign body or pseudomembrane, corneal epithelial defects did not improve for 1 week. Meanwhile, the patient reported gradually decreasing pain along with reduced eyelid oedema, hyperaemia, and conjunctival chemosis without need for the oral non-steroid anti-inflammatory drugs or opioid agonists.

Ten days after injury, the patient's corneal epithelial defect persisted, but her BCVA improved to 20/80. The 0.1% betamethasone was switched to a preservative-free form, considering the toxicity of benzalkonium. The resistance for various antibiotics could not be assessed because the culture examination of the eye discharge demonstrated no microorganisms, such as bacteria or fungi.

The eye was responsive to changes in topical instillation, and the corneal epithelial defect improved 2 weeks after injury; however, the epithelial adhesion appeared rough, and the ocular surface was not smooth with a persistent strong opacity of the corneal stroma. The patient's BCVA was 20/40 at this stage. Therefore, administration of betamethasone 4 times a day, gatifloxacin twice a day, and ofloxacin eye ointment once daily was continued. Subsequently, the opacity in the corneal superficial stroma gradually faded after 1 week, and the patient's BCVA improved to 20/25. The topical instillation was switched to 0.1% fluorometholone twice a day with 3% diquafosol sodium ophthalmic solution 6 times a day to stabilize the corneal epithelium.

*Outcome and Follow-Up*

Two months after the patient's initial visit, the corneal opacity had resolved completely, and a visual acuity of 20/16 was achieved (Fig. 2a, b). Corneal topography demonstrated that irregular astigmatism of the anterior cornea was not higher (Fig. 2c) than it had been 4 years prior (Fig. 2d). The intraocular pressure did not increase during the clinical course. The topical instillation for dry eye continued, and no recurrence of corneal opacity was confirmed.

## Discussion

This report described a case of non-infectious chemical blepharokeratoconjunctivitis caused by *P. fuscipes*-associated ocular injury. Corneal epithelial defects persisted for 10 days despite topical antibiotics and steroids, in addition to intravenous antibiotics. The clinical course suggested that the corneal epithelial defect was caused by toxins released by *P. fuscipes,* which affected the course of the disease. Dermatitis was evident 12–48 h after contact with the toxin [10], as endosymbiotic gram-negative bacteria in the *P. fuscipes* contribute to the synthesis of pederin [11]. Similarly, in the present case, ocular symptoms presented 1 day after the injury, conforming with the delayed appearance of blepharokeratoconjunctivitis. We believe the total epithelial defect was caused by two main factors: first, the strong toxicity of *Paederus fuscipes*, and second, the corneal epithelium being compromised due to severe dry eye. The patient required intensive treatment for dry eye, which included the use of topical fluorometholone, diquafosol sodium ophthalmic solution, and rebamipide, along with a punctal plug. The combination of these two factors complicated the patient's condition.

Pederin is a non-proteinaceous toxin produced by the genus *Paederus* as a defence mechanism. Out of the more than 600 species within the genus, approximately 30 have the potential to cause dermatitis, suggesting that these insects have the potential to cause blepharokeratoconjunctivitis. In the genus *Paederus*, it is primarily female insects that produce this toxin, and production of the toxin may be associated with the reproductive system [12]. Pederin blocks mitosis by inhibiting DNA synthesis, and clinical effects could be noted at low concentrations [12].

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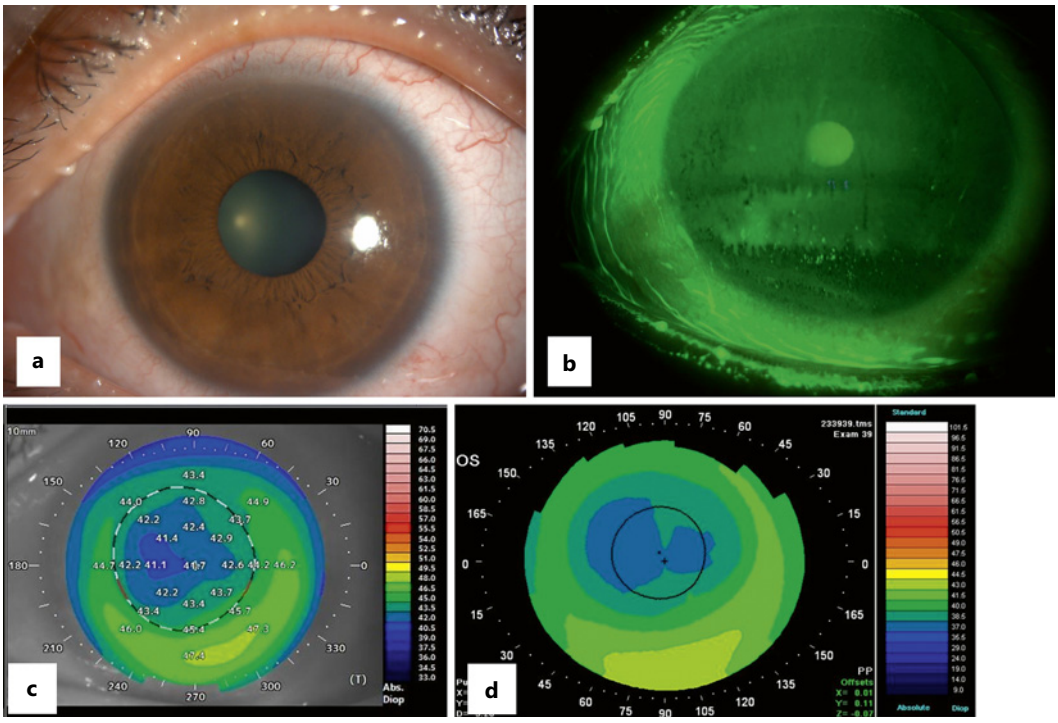


**Fig. 2.** Anterior eye segment of the patient with *Paederus fuscipes*-induced keratitis 2 months after injury. **a** Image of the anterior segment using slit-lamp microscopy 2 months after the injury. Keratitis has been completely treated, and the cornea is clear. **b** Image of the cornea after fluorescein staining. The corneal epithelium is intact. A topographic image of the anterior cornea evaluated 2 months after the injury (**c**) and a topographic image of the cornea 4 years before the injury (**d**). Corneal irregularity is not higher than that noted 4 years prior.

Although the cellular infiltration in the corneal scraps demonstrated numerous neutrophils, no microorganisms were identified. Furthermore, bacterial cultures did not confirm the presence of any microorganisms, indicating that the insect toxin itself was responsible for the keratitis. Microbiological tests are needed to rule out microorganisms because contact with wild insects can lead to fungal or bacterial keratitis. A characteristic of *Paederus*-associated keratitis is delayed corneal epithelialization, and the use of autologous serum eye drops to facilitate re-epithelialization has been described [6]. In the current case, a persistent epithelial defect was observed, and treatment with a preservative-free steroid and antibiotics improved the condition. Efficacy of steroids suggested that an immunological reaction was related to the condition, similar to chemical keratitis. After the LASIK procedure, dry eye is a common complication. Our patient also experienced severe dry eye following LASIK. Fortunately, the LASIK flap was intact in the patient. However, the toxic substance of the insect resulted in a corneal epithelial defect, and the combination of post-LASIK dry eye and delayed epithelialization led to delayed wound healing. Further, there was a possibility that the neurotrophic factor after LASIK was related to the delay of re-epithelialization, although its degree was not evaluated. Although there is still no clear guideline for the treatment of conjunctivitis with persistent corneal epithelial defect, if these treatments are unsuccessful, topical autologous serum eye drops should be used.

Finally, corneal topography did not reveal an increase in corneal irregularity (Fig. 2c, d). It is also essential to consider irregular corneal astigmatism for the follow-up of patients after LASIK, regardless of the amount of time that has elapsed since LASIK was performed.

Additionally, dry eye, a common complication of LASIK, could have contributed to the delayed re-epithelialization [13]. In addition, some patients who had dry eye before refractive surgery can present with severe dry eye postoperatively [13, 14]. This patient had been using topical fluorometholone, diquafosol sodium ophthalmic solution, and rebamipide with a punctal plug for dry eye treatment. Intensive treatment is considered essential for keratitis with epithelial defects after LASIK. Although this patient had undergone LASIK, there was no corneal flap infection or residual opacity. After LASIK, patients generally prefer not to wear glasses; however, it is important for such patients to use protective glasses during outdoor activities.

The patient initially presented with severe blepharitis in the left eye. A previous report has demonstrated the efficacy of wound dressing material containing silver sulfadiazine in managing *Paederus*-associated dermatitis [15]. Topical antibiotics and a combination ointment with a steroid and antibiotic were prescribed, resulting in resolution of the blepharitis within 2 weeks and improvement in the keratitis. After discontinuation of the ointments, there was no recurrence of dermatitis. A previously reported case demonstrated severe *Paederus*-associated keratitis requiring corneal transplantation, with poor prognosis (6/60) [4]. Thus, an accurate initial diagnosis and proper usage of steroids with adequate clinical examinations and investigations are necessary for achieving a better visual outcome, as steroid use may inhibit corneal epithelization.

The diagnosis of the present case was based on a detailed patient interview. Because the insect body was not found in the conjunctival sac, her diagnosis could not be confirmed by the presence of a genuine insect body. However, as *P. fuscipes* is endemic to the area, inhabitants around the authors' hospital know the name and shape of this insect well. It is also useful to allot sufficient time to interview patients with ocular trauma and understand the aetiology. Additionally, it is essential to advise patients not to rub the affected eye to prevent dispersing the haemolymph from the crushed insect body around the eyes and exacerbating the dermatitis and keratitis, leading to an ophthalmologic emergency.

Ocular injury due to *P. fuscipes* is uncommonly reported. However, based on the high prevalence of this insect, there may be undiagnosed cases among conjunctivitis with an unknown causative organism. Therefore, the diagnostic process for severe conjunctivitis should include a detailed patient interview. Future clinical research including more cases is necessary to understand the pathology of this toxic substance.

## Conclusion

Ophthalmologists should be aware of the possibility of blepharokeratoconjunctivitis in patients with ocular injuries caused by insects, particularly *P. fuscipes.* Additionally, special attention should be given to patients with a history of severe dry eye following LASIK who present with ocular injuries.

## Statement of Ethics

This report was approved by the Institutional Review Board of Miyata Eye Hospital (Miyazaki, Japan) (Identifier: CS-349) and prepared in accordance with the tenets of the Declaration of Helsinki. Written informed consent was obtained from the patient prior to drafting this case report. Written informed consent was obtained from the patient for publication of this case report and any accompanying images. A copy of the written consent is available for review by the editor-in-chief of this journal.

## Conflict of Interest Statement

The authors have no conflicts of interest to declare.

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## Author Contributions

T.O. conceptualized this study and collected the data. R.N. collected the data, evaluated the results, and drafted the manuscript. K.K. collected the data and drafted the manuscript. Y.M. and S.O. collected the data and reviewed the results. T.M. and K.M. evaluated the results and supervised the manuscript. T.I. collected the data, evaluated the results, and supervised the manuscript. All the authors read and approved the final manuscript.

## Data Availability Statement

All data generated or analysed during this study are included in this article. Further enquiries can be directed to the corresponding author.

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