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Interventions & Outcomes in Patients with Infectious *Pseudomonas* Scleritis: A 10-Year Perspective

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Abstract

Purpose—To identify interventional factors associated with improved visual results and faster time to resolution for patients with *pseudomonas* scleritis.

Methods—Retrospective study analyzing inciting factors, therapeutic modalities, and outcomes of patients with *pseudomonas* scleritis.

Results—Twenty-four patients were analyzed; 22 were treated as outpatients. All had resolution of infection and 58% (n=14) maintained 20/200 vision. Medical therapy included topical and oral antibiotics; 7 received additional subconjunctival injections; 2 were admitted for IV antibiotics. Patients presenting with 20/200 vision were more likely to maintain this level of vision (n=8, 80%) compared to those presenting with severe vision loss (n=5, 36%), (p=0.04). A similar proportion of patients who received (n=8, 61%) and did not receive (n=5, 39%) oral steroids achieved 20/200 vision or better once infection resolved, p=1.0.

Conclusions—*Pseudomonas* scleritis can be successfully managed in the outpatient setting. Oral steroids do not appear harmful in the treatment of this disease.

Keywords

infectious scleritis; *pseudomonas*; steroids; review

INTRODUCTION

Scleritis is a severe inflammatory process involving the sclera that can lead to permanent vision loss.^{1, 2} The primary etiology is autoimmune, accounting for 90% of all cases. Infectious scleritis is rare, representing only 5–10% of all cases, and is often a result of surgery, trauma, or hardware.^{3–6} Among cases of infectious scleritis, *Pseudomonas*

aeruginosa is the most commonly isolated pathogen, and is the causative agent of infectious scleritis in 51% to 81% of cases.^{3, 7-9} It is commonly associated with prior ocular surgery, often following pterygium surgery, and can occur years after the inciting surgery, and this has been reported in large case series in both the developing and developed world.^{7, 10, 11} Fewer studies have focused on outcomes after infectious scleritis compared to autoimmune scleritis. In general, older studies reported poor outcomes after infectious scleritis with 42–88% of patients ending up with severe vision loss (< 20/200) and 22–33% requiring enucleation or evisceration despite medical and surgical intervention.^{2, 5, 7} Other studies reported that surgical debridement combined with suitable antimicrobial therapy shortened the length of treatment and improved visual outcomes.^{4, 9, 12} However, almost all prior studies used intravenous antibiotics as part of the medical management of infectious scleritis, with 39–100% of patients receiving such administration as inpatients.^{4, 7-9, 12, 13}

Several newer developments have led to changes in the management of *pseudomonas* that may have impacted outcomes in patients with *pseudomonas* scleritis. Oral fluoroquinolones became available in the late 1960's and were implemented systemically in the late 1980's, particularly because of their excellent tissue penetration.¹⁴ These oral agents were found to be effective in treating *pseudomonas* lung infections in patients with cystic fibrosis, compared to intravenous aminoglycoside therapy.¹⁵ In a similar manner, fluoroquinolones have been similarly found to be beneficial in treating infectious conditions of the eye, particularly *pseudomonas* associated keratitis and endophthalmitis.¹⁶⁻¹⁸ If the use of these agents was successful in treating keratitis and endophthalmitis, we hypothesized that they could be applicable toward infectious scleritis as well. Another paradigm shift in the treatment of *pseudomonas* occurred after the SCUT (Steroids for Corneal Ulcers Trial) study demonstrated no adverse effects of topical corticosteroid when used in conjunction with antibiotics in non-Nocardia bacterial corneal ulcers.¹⁹ Sub-analyses of the SCUT trial found that patients with *pseudomonas* corneal ulcers had poorer presenting vision than their counterparts with other infectious etiologies and that earlier initiation of corticosteroids appeared beneficial with regards to visual acuity in non-nocardial corneal ulcers.^{20, 21} We decided to see if these findings of the SCUT trial could be applicable to the more rare entity of infectious *pseudomonas* scleritis. Finally, surgical interventions are being utilized more frequently and earlier in the course of disease based on corneal ulcer studies that demonstrated a benefit to early surgical intervention.²² Despite these data, no studies have specifically examined whether the implementation of these newer approaches have improved outcomes in the setting of *pseudomonas* scleritis. Our institution reported 56-cases of infectious scleritis over 23 years, but reported on bacterial and fungal organisms, without a focus on *pseudomonas*.⁷ As such, in this study we examined our 10-year experience with *pseudomonas* scleritis and evaluated which factors correlated with better visual outcomes and faster time to resolution. Specifically, we tested our hypothesis that the use of oral systemic fluoroquinolones, judicious use of oral and topical corticosteroids, and surgical intervention allowed for improved outcomes in the management of disease both within our cohort and compared to historical case series.

MATERIALS AND METHODS

Study methodology

This is a retrospective review of patients who had culture-proven *pseudomonas aeruginosa* scleritis from September 2006-December 2015 at the University of Miami, Bascom Palmer Eye Institute, Miami, FL. The study was reviewed and approved by the University of Miami IRB, which was conducted in accordance with the principles of the Declaration of Helsinki.

Study population

We identified sequential patients with a positive microbial culture obtained by swab, spatula, or biopsy from sclera, from 2006 to 2016 by reviewing records maintained by the Bascom Palmer Ocular Microbiology Laboratory. Cases were included if they met the Liesegang/Forster criteria for culture positivity.²³ For bacteria, this requires (1) 3+ growth on 1 solid medium, (2) 1 to 2+ growth on 2 or more media, or (3) 1+ growth on 1 solid medium and stained material and/or growth from liquid medium.

Data extracted

All data were examined via a retrospective chart review and entered into a standardized computerized database for analysis. Patient demographics and clinical characteristics included age, sex, ethnicity/race, inciting factor for scleritis, presenting visual acuity, end visual acuity, time to start and duration of topical and oral antibiotic therapy, time to start and duration of oral corticosteroids, time to resolution, and time to surgical intervention. Concurrent ocular and systemic co-morbidities and systemic diseases were recorded. Count finger (CF), hand motion (HM)/light perception (LP), and no light perception (NLP) visual acuity were converted to logMAR 1.8 and 2.3, and 2.6 respectively.²⁴

Main outcome measure

Main outcome measures included (1) visual acuity outcomes at 1 month, 3 months, 6 months, 1 year and at last follow up; (2) factors which predicted a vision better than or equal to 20/200 at three months after resolution and (3) factors which associated with a faster time to resolution.

Statistical analysis

Statistical analysis was performed using Stata software version 13.1 (Stata Corp, College Station, Texas, USA). Categorical outcome variables were compared using the χ^2 test and logistic regression analysis. Fisher's exact test was substituted for comparisons with inadequate sample size ($n < 5$). Continuous outcome variables were compared using the Student t test when the independent variable was binary, the analysis of variance test when the independent variable was categorical, and correlations (Pearson and Spearman) were the independent variable was continuous; p values < 0.05 were considered significant.

RESULTS

Patient Population

Twenty-four patients had confirmed *pseudomonas* scleritis between January 2006 and April 2016 and were followed for an average of 21.1 months (range 0.9–65 months). All patients had an identifiable risk factor for infectious scleritis, with the most common being previous surgery (n=15, 62.5%)(Table 1). Of the patients with prior surgery, the most common surgery was pterygium excision (n=9), followed by glaucoma tube shunt surgery (n=2), pars plana vitrectomy (PPV) (n=1), cataract extraction with intraocular lens implantation (IOL) (n=1), medial rectus recession (n=1), and ocular surface squamous neoplasia (OSSN) removal (n=1).

Clinical information at baseline

The mean presenting vision was logMAR 1.39 (range 20/25-hand motion). Thirteen patients (54%) presented with a visual acuity of less than 20/200. Seven patients presented with serous retinal detachments in the context of choroidal detachments, two patients presented with endophthalmitis, 8 had scleral nodules, and 7 had keratitis at presentation. Five patients had choroidal detachments without concurrent retinal detachments.

Interventions

All patients received topical fluoroquinolone therapy (Moxifloxacin if treated at our institute) and all except one received oral fluoroquinolone therapy (either Ciprofloxacin 500 mg PO BID or Levofloxacin 500 mg PO QD). Two patients were admitted as inpatients for intravenous (IV) antibiotics: one was admitted for desensitization therapy in the setting of a fluoroquinolone allergy and another was admitted for suprapalpebral lavage and given intravenous Ciprofloxacin and topical Tobramycin simultaneously. Seven patients were given subconjunctival antibiotic injections.

The average time from presentation to initiation of topical antibiotics was 1.1 days (range 0–10) and to initiation of oral antibiotics was 9.7 days (range 0–57). Patients remained on topical antibiotics for 95.7 days (range 30–189, n=23; information not available for 1 patient) and oral antibiotics for an average of 40 days (range 6–87, n=23). Eighteen patients also received topical (n=17) and oral (n=14) corticosteroids. The average time from diagnosis to initiation of topical corticosteroids was 10.3 days (range 0–53, n=17) and oral corticosteroids was 11.3 days (range 0–46, n=12). Four patients presented to clinic on topical steroids (n=4) or oral (n=3) corticosteroids; in these cases corticosteroids were not abruptly stopped but continued alongside antibiotic therapy. In general, we started topical corticosteroids if there was a definitive diagnosis of bacterial disease. Topical steroid therapy was more likely to be started in those with worse vision (60% (n=11) with VA <20/200 compared to 50% (n=3) for those who did not receive topical steroids), younger patients 71.2 SD 14 (n=18) vs 76.7 SD 2.5 (n=6), and those who had a history of keratitis (33%, n=3 vs 17%, n=1). Women were more likely than men to get oral steroids (64% n=9 vs 35% of men, n=5). No other differences were found in demographic characteristics of those patients who received oral steroid therapy versus those who did not.

Fourteen patients (58%) received adjuvant surgical intervention, consisting of cryotherapy (n=12), conjunctival resection/debridement (n=9), intravitreal antibiotics (n=1), and lavage with antibiotics (n=7). No patients underwent emergent enucleation.

Of the seven patients who presented with serous retinal detachments in the context of choroidal detachments, 5 had surgical intervention including cryotherapy and antibiotic lavage (n=3) and debridement with antibiotic lavage (n=2). Five took oral prednisone during the course of treatment, and all but one patient had resolution of the retinal detachment. This patient was then promptly treated with a retinal detachment repair once the infection resolved. Of the five patients who had choroidal detachments at presentation without a retinal detachment, four received topical steroids and 2 received oral steroids during the course of their treatment; 3 had acute surgical interventions, and all ultimately had resolution of their choroidals after their infection was treated.

Of the two patients who had endophthalmitis on presentation, both received subconjunctival injections of antibiotics, and one had an acute surgical intervention involving debridement and antibiotic lavage, and the other had a PPV after the infection had resolved. Both were treated with oral antibiotics and one received oral steroids.

Outcomes

The mean time to clinical resolution of infection was 63.4 days (range 18–168). Mean visual acuity at 1 month was 1.42 SD 0.73 (n=24), at 3 months 1.2 SD 0.72 (n=24), at 6 months 1.24 SD 0.79 (n=17), at 1 year 1.08 SD 0.71 (n=15), and at last follow up 1.05 SD 0.78 (n=24); 53% (n=15) had 20/200 or better vision at 1 year and 58% (n=14) at last follow up. The severe vision loss in 9 patients was attributed to corneal scarring in 5, retinal changes in 2, and end-stage glaucomatous damage in 2. Eleven patients (45%) had further surgical intervention after resolution of their infection; 2 underwent corneal transplantation, 6 had cataract extraction/intraocular lens implantation, 2 required a patch graft for persisting epithelial thinning, 2 required vitrectomy secondary to retinal detachment, and 1 underwent enucleation in the setting of phthisis 2 years after presentation for the infection. Of the five people that did not receive a corneal transplant but had a corneal ulcer as the cause of the scleritis, two had better than 20/200 vision and the remaining three had HM vision or worse (1/200, HM, LP).

Prognostic factors for vision

In the current study, there was a 4 fold increase of achieving 20/200 if presenting with 20/200 vision (95% CI: 0.85–18.8, p=0.04). We also found that patients with a history of pterygium or OSSN removal had a 4 fold increased chance of having 20/200 or better vision at three months after resolution compared to patients with infectious scleritis in the setting of other etiologies ([95% CI: 0.85–18.8], p=0.04). Underlying diabetes did not appear to have an impact on visual outcome (p=0.66) or time to resolution (p=0.29).

Trauma as an inciting etiology correlated with a longer time to resolution compared to a non-traumatic etiology (125 days vs. 58 days, p=0.007). Adjuvant surgery in the acute setting correlated with a longer time to resolution (75 days versus 47 days, p-value= 0.051), although this was not statistically significant. However, in those who received a surgical

intervention, faster time to surgery was correlated with a faster time to recovery ($r=0.64$, $p=0.013$; $\rho=0.54$, $p=.048$).

Case Report

Pseudomonas is known to cause a brisk inflammatory response in tissues²⁵ and scleritis is often associated with concurrent choroidal effusions or retinal detachments, which must be managed judiciously. An 89-year-old female had a history of a left eye *Pseudomonas* corneal ulcer treated 3 months prior with topical moxifloxacin. Given significant pain and scleral inflammation, she was given oral and topical corticosteroids 4 weeks after her initial presentation. A repeat corneal culture 2 months later demonstrated persistent *pseudomonas* infection that extended to the sclera. She was continued on moxifloxacin and tobramycin as well as oral corticosteroids, but later developed a serous choroidal and retinal detachment and an inflamed nasal conjunctiva, which were presumed to be autoimmune in nature. She was given another course of oral corticosteroids and referred to our institute. On presentation, vision was hand motions with severe necrotizing scleritis and a hazy view of the fundus (Figures 1, 2). The decision was made for immediate surgery, including conjunctival biopsy, scleral debridement, irrigation with fortified tobramycin, cryotherapy, and amniotic membrane placement. The biopsy demonstrated heavy growth of *Pseudomonas aeruginosa*. She was started on oral ciprofloxacin which was continued for 53-days; the oral prednisone was slowly tapered over 90 days. On resolution of infection, visual acuity was 20/125, which was stable 5 months later (Figure 3). At this visit, the serous choroidal detachments had resolved.

DISCUSSION

In this consecutive case series of culture-positive *pseudomonas* scleritis, we demonstrate that patients who were managed as outpatients with oral fluoroquinolones, adjuvant corticosteroids and surgical intervention (as needed) have similar or better visual acuity results compared to historical cases, who were mainly treated as inpatients with IV antibiotics and without adjuvant corticosteroids. None of our patients required emergent enucleation and the majority maintained 20/200 vision at last follow-up.

When comparing our present study to prior ones from our institute^{2, 7}, we found a lower frequency of severe vision loss when compared to Reynolds et al in 1991 (79%) and Hodson et al in 2013 (54%) versus this study 46%. Encouragingly, our enucleation frequency (early and late) was lower when compared to both prior studies (4% versus 23% and 33%).^{2, 7} Similar to Hodson's study, patients with poor vision at presentation were the ones most likely to have severe vision loss at follow up.⁷ There were 9 patients in our study that overlapped with Hodson's study, and may play a role in our similar findings.

Table 2 compares our data with those of prior published reports of patients with *pseudomonas* scleritis.^{3–5, 8, 12, 13, 26, 27} When comparing our series to other published reports and analyzing only cases of culture-proven *pseudomonas*, our mean visual acuity is higher than most published series and so is the percentage of patients achieving better than or equal to 20/200 vision.^{3–5, 8, 12, 13, 26} The 3 studies that reported better visual outcomes than our current study focused on those with scleritis post-ptyerygium^{4, 12, 27}, a group that

seems to do better compared to those with infectious scleritis in the setting of other etiologies. In fact, if we compare this subset of patients, our visual outcomes are slightly better than 2 of the studies with a mean logMAR vision of 0.59 for our study, compared to 0.82 and 0.69 at last follow up. One study reported better outcomes than our own, but all four cases had better than or equal to 20/60 vision at the outset, with the majority 20/25 or better (3/4) and there were no ocular co-morbidities described in the report.²⁷ Our acute enucleation frequency was similar to those who managed scleritis mostly as inpatients with IV antibiotics.^{4, 12, 13} However, the data extracted from historical studies is limited, inconsistent in outcomes measured, and often did not report on specific organisms, limiting our data further.

While many factors may play a role in our results, it is interesting that all but one of our patients received oral fluoroquinolones compared to only 5 reported patients in prior published series. All other patients in the historical comparison received IV antibiotics, and also demonstrated favorable results. Oral fluoroquinolones are known to penetrate ocular tissues both topically and systemically, and have played a major role in the treatment of infectious ocular disease, including endophthalmitis.^{16, 17, 28, 29} Furthermore, in an era of antibiotic resistance, it is encouraging that *pseudomonas* resistance to fourth generation oral fluoroquinolones has not been commonly reported in ocular disease, although a trend has been emerging in the past several years and has been found to be more common in patients with a compromised ocular surface.^{30, 31} In general, we started all patients on topical fortified antibiotics at the time of infectious scleritis diagnosis, and therapy was then tailored based on sensitivities. Oral antibiotic therapy was generally initiated within a week of diagnosis of *pseudomonas* scleritis, unless there was a contraindication. The average duration of oral therapy was 40 days, which could also result in systemic side effects, particularly in this elderly population.

The role of corticosteroids in the treatment of infectious scleritis remains controversial.³² There can be a robust inflammatory response after microbial invasion of the eye wall, which itself can cause significant damage.^{33, 34} However, the timing, dosage, and delivery of corticosteroids in scleritis is not yet known. Our study is encouraging; as similar to the SCUT trial, we found no adverse effects of oral corticosteroids in our population.^{19, 35} This is important, as to the best of our knowledge, our current study is the first to compare patients who received corticosteroids as part of infectious scleritis management against those who did not. Oral steroids were initiated after a minimum of 48 hours of antibiotic therapy with a microbiological diagnosis of *pseudomonas* and no evidence of fungal infection with severe necrosis of the sclera and/or significant posterior segment comorbidity such as choroidal and serous retinal detachment.

With respect to surgical interventions, more than half of patients underwent acute surgical intervention for diagnostic and therapeutic purposes. Patients who received surgery tended to have a longer recovery, likely due to the fact that they probably had a more severe infection. However, we also found that amongst those who did receive surgery, a faster time to surgery was correlated with a faster time to recovery, indicating a need for more clearly defined criteria requiring surgical intervention. Our report supports prior findings that surgical intervention can establish a diagnosis and at the same time therapeutically decrease the

microbial load.^{4, 9, 12, 25} In multiple cases, we used amniotic membrane after conjunctival resection and cryotherapy. The anti-inflammatory properties of amniotic membrane has been well documented,^{36, 37} and these effects may play an important role in scleral wound healing as well. Another group has reported on its role in recalcitrant scleritis,³⁸ and its effects in infectious disease may be due to its ability to act as a drug reservoir.^{39, 40} In general, we consider surgical intervention when medical therapy has failed or patients with multifocal areas of scleral abscess. We also consider scleral biopsy with debridement of necrotic tissue and irrigation with broad-spectrum antibiotics in patients with strong clinical suspicion of infectious keratitis and no microbiological diagnosis. Our study findings must be considered while keeping in mind its limitations which included its retrospective nature and a limited number of patients treated at a single institution with a variety of interventions employed at various time points. There were also various surgeons caring for these patients, which also accounts for variability in the interventions reported. Because of our small sample size and overlap in surgical and medical interventions, it is difficult to say which intervention had a greater impact on outcomes. Our small numbers precluded meaningful statistical relationships between many of our outcomes and interventions. Finally, considering the variety of indications for initial infection (trauma, corneal ulcers, pterygium surgery), these results may not be uniformly comparable.

Despite these limitations, our study is important as it examines the role of oral fluoroquinolones, oral corticosteroids and surgical intervention in the management of *Pseudomonas* scleritis. Whereas most prior studies dated before 2000 have reported primarily on IV antibiotics as a mode of treatment, we found that oral fluoroquinolones are also effective in treating this disease. Importantly, we did not find a detrimental effect of topical or oral corticosteroids in regards to visual outcomes or time to resolution, indicating that there may be a role for these agents in treatment as well. In current-day ophthalmologic practice in the developed world, where most patients are treated on an outpatient basis, it seems prudent to consider oral antibiotic and corticosteroid therapy, with surgical intervention as needed, to balance desired outcomes with cost considerations in our stressed healthcare system.

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Figure 1.
External photo demonstrated a large conjunctival defect with associated scleral thinning, uveal show and notable absence of vascularization.

Figure 2.
B scan with serous retinal and choroidal detachments.

Figure 3.
External photo after resolution of infection, demonstrating epithelialization and vascularization of the conjunctiva

Table 1

Presenting Characteristics of Patients with Pseudomonas-Positive Infectious Scleritis and Treatment Algorithms

Demographic	N (%) or mean, SD (range)	Predictor of 20/200 or better vision at 3 months Odds Ratio (95% CI), p-value	Time to resolution (days) Means (SD), p-value or Pearson/Spearman, p-value
Age (range)	72.5, 12.5 (38–89)	0.96 (0.90–1.03), p=0.36	–0.04/–0.15, p=0.47
Gender, female	11 (46%)	f/m: 0.83 (0.25–2.73), p=0.68	f/m 67 (31)/ 60 (39), p=0.62
Race, White	24 (100%)	-	-
Ethnicity, Hispanic (H)	15 (62.5%)	H/non-H: 1.50 (0.53–4.21), p=0.67	H/non-H: 61 (31) / 67 (44), p=0.71
Inciting Factor		Factor of interest/all other variables	Factor of interest/all other variables
Corneal Ulcer	7 (29.2%)	0.40 (0.08–2.06), p=0.18	68 (39) / 51 (25), p=0.29
Previous Surgery	15 (62.5%)	2 (0.68–5.85), p=0.20	61 (30) / 68 (44), p=0.65
Pterygium or OSSN Surgery	10 (41.2%)	4.0 (0.85–18.83), p=0.04	60 (25) / 66 (42), p=0.72
Trauma	2 (8.3%)	1.0 (0.06–15.9), p=1.0	125 (61) / 58 (28), p=0.007
Underlying Medical Conditions			
Diabetes Mellitus type 2	7 (29%)	Yes/no: 0.75 (0.16–3.35), p=0.66	Yes/no: 51 (21) vs 68 (39), p=0.29
Visual acuity 20/200	10 (41.2%)	4 (0.85–18.8), p=0.04	Yes/no 66 (25.7) / 61(42), p=0.76
Sub-conjunctival injections	7 (29.2%)	yes/no 1.0 (0.20–4.94), p=1.0	Yes/no 78 (60) / 58 (23), p=0.27
Time to starting oral antibiotics (days)	9.7, 13.6 (0–57)	0.97 (0.91–1.04), p=0.48	0.02/0.052, p=0.81
Topical corticosteroids	18 (75%)	yes/no 1.0 (0.39–2.5), p=0.65	yes/no 62 (29) / 69 (52), p=0.69
Oral corticosteroids	14 (58%)	yes/no 1.33 (0.46–3.8), p=1.0	yes/no 68 (31) / 57 (43), p=0.48
Acute surgical intervention	14 (58%)	yes/no 1.0 (0.35–2.85), p=0.69	yes/no 75 (39) / 47 (21), p=0.051

CI=confidence interval, OSSN=ocular surface squamous neoplasia;

Table 2

Comparison of Outcomes of Pseudomonas Scleritis

Study	Inciting Factor (years of data collection)	Acute surgery n/N (%)	Oral steroids n (%)	Topical steroids n (%)	Systemic antibiotics n (%) (oral, IV)	Time to resolution, days mean (range)	Vision 20/200 n (%)	Final vision in logMAR mean (range)	Acute Enucleation n (%)
Present study	All causes	14/24 58.3%	13/24 (54%)	18/24 (75%)	23/24 (95.8%) (2 IV, 23 oral)	63 (18–168)	58% (14/24)	1.1 (0–2.6)	0/24 (0%)
Present study	Pterygium or OSSN only	4/10 (40%)	5/10 (50%)	6/10 (60%)	9/10 (90%) (2 IV, 10 oral)	60.2 (22–105)	8/10 (80%)	0.59 (0–1.8)	0
Cunningham et al	Pterygium or OSSN (1999–2009)	2/2 (100%)	0	0	2/2 (100%) (oral)	NR	1/2 (50%)	1.4 (20/60, 1/200)	0
Hsaio et al	Pterygium (1988–1995)	13/15 (86%)	0	0	15/15 (100%) (IV)	NR	8/15 (53%)	1.41 (20/30–NLP)	3/15 (20%)
Huang et al (1999)	Pterygium (1999)	3/3 (100%)	1/3 (33%)	0	3/3 (100%) (IV)	29 days (21–42)	2/3 (67%)	1.0 (20/120–20/400)	0
Huang et al (2000)	Pterygium (1989–1998)	7/13 (54%)	0	0	13/13 (100%) (IV)	NR	6/11 (55%)	1.24 (20/20–NLP)	1/13 (7.7%)
Jain et al	All causes (2000–2005)	1/2 (50%)	0	0	2/2 (100%) (oral)	NR	0/2 (0%)	2.05 (CF, LP)	0
Su et al	Pterygium (1999–2001)	100% (13/13)	0	0	13/13 100% (IV)	NR	4/13 (30.8%)	1.45 (20/30–LP)	0
Tittler et al.	Pterygium (1999–2009)	7/7 (100%)	0	3/7 (42.9%)	7/7 (100%) (6 IV, 3 oral)	NR	5/7 (71.4%)	0.82 (20/20–CF)	0 (0%)
Yoo et al	Pterygium (2011–2012)	4/4 (100%)	0	0	4/4 (100%) (IV)	NR	4/4 (100%)	0.05(20/20–20/25)	0

CF= count fingers; IV=intravenous; LP= light perception; NLP=no light perception; NR= not reported; OSSN=ocular surface squamous neoplasia

Only patients with pseudomonas scleritis were used for the purpose of this table.