

Petroleum Jelly Versus Tea Tree Oil and Tea Tree Facial Wash Lid Scrub in Patients with Blepharitis Associated with Above-normal *Demodex* Count

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Disclosure: The authors have no proprietary or financial interest in any product used or cited in this study.

ABSTRACT

Purpose: To determine the effectiveness of lid scrub with petroleum jelly versus lid scrub with tea tree oil and tea tree facial wash in patients with symptomatic blepharitis associated with above-normal *Demodex* counts

Methods: Patients with symptomatic anterior blepharitis (AB), meibomian gland dysfunction (MGD), or mixed blepharitis (MB) were recruited into the study. Pertinent data, including ocular symptoms and findings, were recorded. Digital photographs of the lid margins were taken. Lash sampling was done using the modified Coston method for lash epilation. Patients with below-normal *Demodex* counts (DC <5) were excluded while those with DC ≥5 were randomly assigned to one of either treatment regimen: (1) lid scrub with tea tree oil and tea tree facial wash (The Body Wash[®], control group), or (2) lid scrub with petroleum jelly (Apollo Pure Petroleum Jelly[®], study drug). Lid scrub with the tea tree oil (TTO) or petroleum jelly was administered at the clinic during the initial visit and at 2-week intervals thereafter for 6 weeks. Patients were instructed to apply tea tree (TT) facial wash or petroleum jelly at home on specified intervals daily. DC posttreatment was recorded, and digital photographs of the eyelids were taken at the end of treatment.

Results: Thirteen patients were included in the study; 5 in the TTO and 8 petroleum jelly. In the TTO group, 3 patients had decrease in DC and 2 an increase, but all patients reported decrease in the severity and frequency of ocular symptoms. In the petroleum jelly group, 5 patients had decrease in DC after 6 weeks, while the remaining 3 had opposite results. All reported a general improvement in their symptoms. No adverse reactions were observed in either treatment groups.

Conclusion: Lid scrub with petroleum jelly caused a significant reduction ($p < 0.05$) in *Demodex* counts compared to lid scrub with tea tree oil and tea tree facial wash. Petroleum jelly may have some effect in the eradication of *Demodex* mites in cases of *Demodex*-induced blepharitis. Although lid scrub with petroleum jelly and tea tree oil and tea tree facial wash both produced a decrease in *Demodex* counts and a decrease in the frequency and severity of ocular symptoms after 6 weeks of treatment, the presence of some conflicting results suggests that further studies with more patients should be initiated.

Keywords: *Demodex*, meibomian gland dysfunction, anterior blepharitis, mixed blepharitis, petroleum jelly, tea tree oil

Blepharitis is a common, often chronic, and recurrent ocular disease characterized by inflammation of the eyelid margin.^{1,2} The most common parasitic infection causing blepharitis is due to *Demodex folliculorum*.¹

The *Demodex folliculorum* mite of class Arachnida and order Acarina is a microscopic, transparent, obligate, parasitic organism that thrives in the pilosebaceous units of human beings.^{3,4,5} They grow most favorably in the sebaceous glands and hair follicles of the face, eyelids, forehead, cheeks, and nose.¹ *Demodex* infestation produces allergic and inflammatory reactions to the skin, such as redness, hair loss, and scarring, and gives rise to a variety of skin conditions collectively termed as demodicosis or demodicidosis.^{3,4} Although *Demodex* mites are frequently found in patients with chronic blepharitis, they are also believed to be common inhabitants of the normal eyelash follicle and sebaceous glands.¹ In a study by Arici in 2005, the prevalence of *Demodex* mites in individuals with blepharitis was found to be as high as in the normal population.¹ Pathogenicity is thought to occur when these mites are present in excessive numbers or when they begin to penetrate into the dermis, especially in immunocompromised hosts.^{3,4,5}

Alejo and Valenton in 1972 studied 200 eyes of Filipino patients at the Philippine General Hospital. They found *Demodex folliculorum* in the lids of 50% of cases, 88% of whom were diagnosed with blepharitis.⁶

De Venecia and Lim Bon Siong in 2010 studied the incidence and density of *Demodex* mites in patients with normal eyelids, meibomian gland dysfunction, anterior blepharitis, and mixed blepharitis. Results showed that *Demodex* density count was directly proportional to the degree of blepharitis, with the highest number of mites found in patients with mixed blepharitis. A maximum *Demodex* count of 5 was found in patients with normal eyelids, confirming that *Demodex* may be present in the normal population as well.⁷

In cases of treatment-resistant chronic blepharitis, investigation for the presence of *Demodex* mites is suggested because demodectic blepharitis does not respond well to conventional therapeutic measures.⁸ Recent studies have focused on the use of essential oils, such as tea tree oil, and their effectivity against mites.⁹

Tea tree oil is a naturally-occurring essential oil distilled from the leaf of *Melaleuca alternifolia*, recognized for its anti-inflammatory, antibacterial, antifungal, and acaricidal effects.^{2,3,10,11,12} A study by Williamson in 2007 showed maximum effects with the use of tea tree oil, producing 100% immobilization of the mites at 30 minutes and 100% mortality at 2 hours.⁹ A recent study by Gao showed that *Demodex* mites, resistant to several different antiseptic solutions, were susceptible to tea tree oil in a dose-dependent manner in vitro. Weekly lid scrub regimen with 50% tea tree oil and daily lid scrub with tea tree shampoo was shown to effectively eradicate ocular *Demodex* both in vivo and in vitro.¹¹

Petroleum jelly is a translucent, semi-solid mixture of hydrocarbons that has a melting point above body temperature.¹³ It often serves as the vehicle or base of numerous cosmetic creams and ointments, including those which are used for the eyes.¹⁴ For years, there have been numerous anecdotal reports suggesting its use in suffocating head lice. Takano-Lee et al found that live lice treated with petroleum jelly had significantly less survival than those subjected to other home remedies. Lice eggs treated with petroleum jelly were less likely to hatch than those treated with water.¹⁵ A local study (Lipana, et al. Efficacy and safety of petroleum jelly versus permethrin 1% shampoo in the treatment of pediculosis capitis; unpublished.) done in 2009 concluded that petroleum jelly scalp occlusion had comparable cure rates to permethrin 1% shampoo when used once weekly for 3 weeks in the treatment of head lice.

Petroleum jelly has also been shown to be effective in the treatment of blepharitis caused by pediculosis palpebrarum, an infestation of the eyelids

due to head lice. Application of Vaseline (petroleum jelly) to the base of the eyelids was done twice daily for one week with subsequent complete eradication of the nits and lice.¹⁶ No studies have been done using petroleum jelly as a possible treatment for *Demodex*-induced blepharitis.

In this study, we determined the effectiveness of lid scrub with petroleum jelly versus lid scrub with tea tree oil and tea tree facial wash in patients with symptomatic blepharitis associated with above-normal *Demodex* counts. Specifically, we determined the effectiveness of every 2-week lid scrub with tea tree oil and daily lid scrub with tea tree facial wash versus daily lid scrub with petroleum jelly. We compared the clinical signs and symptoms of these patients before and after treatment and determined any adverse effects from the treatment regimen.

METHODOLOGY

This study was reviewed and approved by the ethics review board of the University of the Philippines-Philippine General Hospital (ERB Approval # OVS 2011-05-27-075). An informed consent was signed by each patient prior to inclusion into the study.

Patients aged 18 to 90 years old, of any gender, who consulted at the General Clinic of the Department of Ophthalmology and Visual Sciences, Philippine General Hospital, over a period of 3 months, and with symptomatic anterior blepharitis (AB), meibomian gland dysfunction (MGD), or mixed blepharitis (MB), were recruited into the study. Patients with active ocular infection or inflammation other than blepharitis, with eyelid or eyelash abnormalities, with previous history of eyelid trauma or surgery, ocular chemical burn, Steven Johnson syndrome, ocular cicatricial pemphigoid, and similar conditions, and patients on any form of ocular topical medications except for artificial tears within the last 3 months, with known allergy to any component of the study drugs, with any form of limitations that will interfere with the application of treatment, and who cannot complete the entire follow-up period were immediately excluded from the study. The patients' general information, ocular symptomatology, and clinical findings were recorded in a standard data collection form. Digital photographs of the lid margins were also taken.

Lash sampling was done using the modified Coston method for lash epilation. One or two drops of proparacaine hydrochloride 0.5% (Alcaine, Alcon

Inc, TX, USA) were instilled in each eye prior to collection. Both the upper and lower lids were divided into 2 halves, nasal and temporal. Using epilation forceps, two non-adjacent lashes were randomly picked from the nasal and temporal halves of the upper and lower lids, for a total sample of 8 lashes per eye. When possible, lashes with collarettes/cylindrical dandruff were epilated. Lashes from both eyes were mounted on a glass slide: lashes of the upper and lower lids of the right eye were placed on the left side of the glass slide, and those of the left eye on the right side. A fluorescein solution, made from dissolving fluorescein strips in 0.9 saline solution, was adequately applied on the glass slide until all the lashes were completely immersed. A cover slip was placed on top of the mounted specimen.

The number of *Demodex* mites was determined based on its morphology (Figures 1A and 1B) and manually counted using a light microscope (Nikon YS100). Patients with *Demodex* counts (DC) of <5 were excluded from the study, while those with DC ≥5 were randomly assigned one of two specific treatment regimens: (1) lid scrub with tea tree oil (TTO) and tea tree (TT) facial wash (control group, The Body Shop[®]), or (2) lid scrub with petroleum jelly (study drug, Apollo Pure Petroleum Jelly[®]). Randomization was achieved by an internet-based randomizer program (Research Randomizer, <http://www.randomizer.org/>)

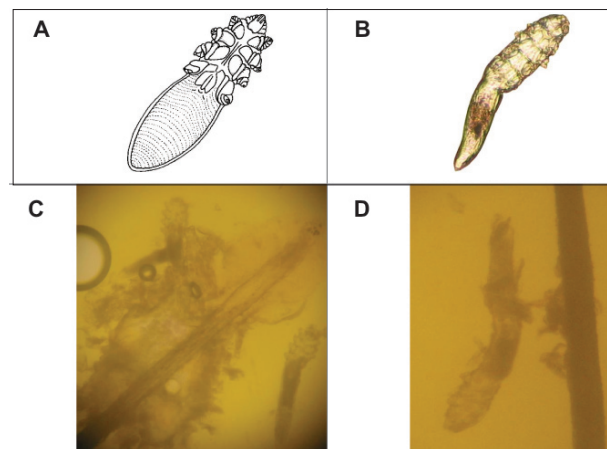


Figure 1. Morphology of the *Demodex folliculorum*. The diagnosis of *Demodex*-induced blepharitis may be suspected when these mites are isolated from epilated lashes and identified under the light microscope. (A) Diagram and (B) actual microscopic picture of *Demodex folliculorum*, a parasite approximately 0.1-0.4 mm in length, with a body-tail part and a head-neck part and 8 stumpy legs and a mouth with a biting apparatus. (C) *Demodex* mites are usually found clustered around hair follicles embedded in cylindrical dandruff or collarettes in the base of eyelashes. (D) They can migrate out of the follicles and be found in areas of dandruff-like material in lash shafts.

form.htm) and treatment groups were assigned by a co-investigator (EBI) to ensure blinding of the study.

Ocular symptomatology and lash findings were recorded every 2 weeks. Lid scrub with TTO or petroleum jelly was administered by a co-investigator (EBI) at the clinic during the initial visit and at 2-week intervals thereafter for 6 weeks. Patients were instructed to apply TT facial wash or petroleum jelly at home on specified intervals daily and advised to fill up a diary indicating the date and times when treatments were applied. This treatment diary was brought to the clinic on every follow-up and shown to the co-investigator (EBI).

At the end of 6 weeks, lash sampling using the same modified Coston method was done. DC post-treatment was recorded, and digital photographs of the eyelids were taken.

Main outcome measures were *Demodex* counts pre- and posttreatment. Secondary outcome measures included symptom scores pre- and posttreatment and any adverse events noted during and after treatment. Successful treatment was confirmed with any decrease in *Demodex* counts after 6 weeks of treatment. Treatment failure, on the other hand, was declared when *Demodex* counts remained the same or increased after treatment.

Lid scrub with tea tree oil (TTO)

Lid scrub with tea tree oil (TTO) was administered at the clinic during the initial visit and at 2-week intervals thereafter for 6 weeks. After instilling a drop of 0.5% proparacaine hydrochloride (Alcaine®) in the patient's eye, a sterile cotton-tipped applicator wetted in TTO was used to scrub the lashes, from the roots to the tips, for a total of 6 strokes. After 5 minutes, a dry cotton-tipped applicator was used to remove excess TTO and any cylindrical dandruff seen on the lashes. After another 5 minutes, the second TTO lid scrub was applied in a similar manner. The eye was rinsed with 0.9 NaCl solution if any eye irritation was noted during the entire procedure.

Lid scrub with tea tree (TT) facial wash

Patients were instructed to mix 0.5 mL of TT facial wash with tap water at home. With both eyes closed and using their middle fingers, the eyelids were massaged with medium pressure for 3-5 minutes. The skin was then rinsed with tap water and dried with a towel. This regimen was applied twice daily for 6 weeks.

Lid scrub with petroleum jelly

Lid scrub with petroleum jelly was administered by the co-investigator (EBI) at the clinic during the initial visit and at 2-week intervals thereafter for 6 weeks. After instilling a drop of 0.5% proparacaine hydrochloride (Alcaine®) in the patient's eye, a sterile cotton-tipped applicator with petroleum jelly was used to scrub the lashes, from the roots to the tips, for a total of 6 strokes. After 5 minutes, a dry cotton-tipped applicator was used to remove excess petroleum jelly and any cylindrical dandruff seen on the lashes. After another 5 minutes, the second petroleum jelly lid scrub was applied in a similar manner. Following 10 minutes of rest, the third lid scrub with petroleum jelly was applied. The eye was rinsed with 0.9 NaCl solution if any eye irritation was noted during the entire procedure.

Patients were instructed to do lid scrub with petroleum jelly at home after 15 minutes of warm eyelid compresses. This regimen was done three times daily for 6 weeks.

The data between the two groups were evaluated by t-test where $p < 0.05$ was considered statistically significant.

RESULTS

Twenty-seven (27) patients were initially recruited to the study; 12 had DC < 5 , and were excluded from receiving any of the treatment. Instead, they were advised standard treatment. The 15 remaining patients were randomly assigned to one of the treatment groups. Thirteen (13) completed the 6-week follow-up while two (2) belonging to the tea tree group dropped out of the study due to concurrent medical conditions.

Of the 13 patients who completed their follow-up, 5 were from the tea tree group while 8 were from the petroleum jelly group. These 8 patients included 2 men and 11 women, with ages ranging from 40 to 74.

Lid scrub with tea tree oil (TTO) and tea tree (TT) facial wash

All 5 patients assigned to the TTO and TT facial wash group presented clinically with lashes having dandruff-like material scattered from the base to the different parts of the shaft. Diffuse collarettes or cylindrical dandruff and scurfs were also noticeably present. Two of these patients (Case 2 and 3) had

some plugged meibomian gland orifices, which produced a turbid cheese-like secretion upon pressure on the eyelids.

Prior to any treatment, all patients had eye irritation, itchiness, and foreign body sensation. Additional symptoms of eyelid heaviness, transient blurring of vision, redness, and tearing were experienced by some of the patients. After 6 weeks of daily lid scrub with TT facial wash and clinic application of TTO every 2 weeks, all patients in the group noted a generalized improvement of their symptoms characterized by subjective decrease in the severity and frequency (Table 1). Symptoms, however, persisted in 4 out of the 5 patients despite treatment, particularly eye irritation, itchiness, and foreign body sensation. One patient (Case 3) reported complete disappearance of all eye symptoms after 6 weeks of treatment.

Table 1. Patients With Ocular Demodecosis Before and After TTO and TT Facial Wash Treatment.

Case	Age (yr)	Sex	Diagnosis	DC		Complaints		Reaction to Treatment
				Before	After	Before	After	
1	70	F	Anterior Blepharitis	5	8	Irritation, itchiness, eyelid heaviness, foreign body sensation	Itchiness, foreign body sensation (decreased severity)	Redness, stinging sensation
2	52	M	Mixed Blepharitis	8	1	Irritation, itchiness, eyelid heaviness, foreign body sensation, transient blurring of vision, redness, tearing	Irritation, itchiness, eyelid heaviness, foreign body sensation, transient blurring of vision (decreased severity)	Redness, stinging sensation
3	45	M	Mixed Blepharitis	6	5	Irritation, itchiness, eyelid heaviness, foreign body sensation, transient blurring of vision, redness (OS>OD)	None	None
4	60	F	Anterior Blepharitis	33	22	Itchiness, sticky sensation of lids, mucous discharge, foreign body sensation, redness, tearing	Irritation, itchiness, foreign body sensation, transient blurring of vision	None
5	59	F	Anterior Blepharitis	9	14	Irritation, itchiness, foreign body sensation, transient blurring of vision, tearing	Irritation, foreign body sensation, transient blurring of vision	None

Table 2. Patients With Ocular Demodecosis Before and After Petroleum Jelly Treatment.

Case	Age (yr)	Sex	Diagnosis	DC		Complaints		Reaction to Treatment
				Before	After	Before	After	
6	55	F	Mixed Blepharitis	5	0	Irritation, itchiness, eyelid heaviness, sticky sensation of lids, mucous discharge, foreign body sensation, transient blurring of vision, redness, tearing	Irritation, itchiness, redness, tearing (decreased severity)	Redness, sticky sensation
7	60	F	Mixed Blepharitis	16	6	Irritation, itchiness, eyelid heaviness, foreign body sensation, transient blurring of vision, tearing (OD>OS)	Irritation, itchiness, eyelid heaviness, tearing (decreased severity, OD>OS)	Sticky sensation
8	59	F	Anterior Blepharitis	8	1	Irritation, itchiness, sticky sensation of lids, mucous discharge, foreign body sensation, tearing (OS>OD)	Itchiness, foreign body sensation (decreased frequency)	None
9	74	F	Anterior Blepharitis	6	9	Irritation, itchiness, eyelid heaviness, sticky sensation of lids, foreign body sensation, transient blurring of vision	None	None
10	45	F	Mixed Blepharitis	13	11	Irritation, itchiness, eyelid heaviness, foreign body sensation, transient blurring of vision, redness, tearing	Itchiness, foreign body sensation (decreased severity)	None
11	74	F	Anterior Blepharitis	8	8	Sticky sensation of lids, mucous discharge, transient blurring of vision	Foreign body sensation (decreased severity)	Stinging sensation
12	57	F	Mixed Blepharitis	5	3	Irritation, itchiness, foreign body sensation, transient blurring of vision, tearing	None	None
13	71	F	Mixed Blepharitis	23	15	Irritation, itchiness, eyelid heaviness, sticky sensation of lids, foreign body sensation, transient blurring of vision, tearing	Sticky sensation of lids, tearing (decreased frequency)	None

Lash sampling after 6 weeks of lid scrub with TTO and TT facial wash showed an increase of the DC of Case 1 from a pretreatment count of 5 to a DC of 8, and also an increase of the DC of Case 5 from 9 to 14. Cases 2, 3, and 4 showed opposite results, with DC decreasing posttreatment (Figure 2). Complete eradication of *Demodex* mites was not seen in any of the patients treated with TTO and TT facial wash.

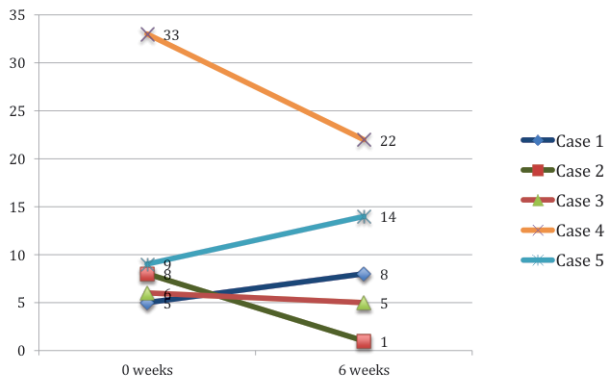


Figure 2. *Demodex* counts (DC) pre- and post-TTO and TT facial wash treatment.

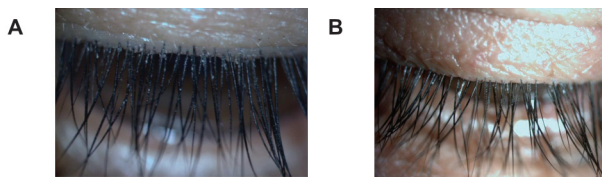


Figure 3. Pretreatment (A) showing diffuse collarettes or cylindrical dandruff and scurfs and posttreatment (B) with tea tree oil and tea tree facial wash lid scrub with resolution of blepharitis.

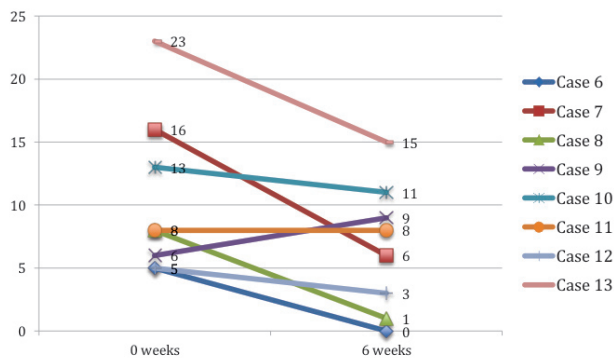


Figure 4. *Demodex* counts (DC) pre- and postpetroleum jelly treatment.

On slit lamp biomicroscopy, the eyelashes of Cases 1, 4, and 5 still presented with some dandruff-like material and sporadic collarettes or cylindrical

dandruff, while scurfs were no longer appreciated. Despite complaining of some ocular symptoms, the eyelashes of Case 2 showed no signs of blepharitis by the end of 6 weeks, and the meibomian gland orifices looked clean and clear by the 4th week of treatment. Case 3 had normal eyelashes by the end of the 6-week treatment period (Figure 3).

Lid scrub with TTO done at the clinic at 2-week intervals resulted in mild irritation in one of the patients during one of the visits. This was promptly relieved by continuous saline irrigation. On subsequent follow-ups, no eye irritation was observed. The application of TTO in the other patients was generally well tolerated with no complication.

Daily lid scrub with TT facial wash done three times a day for six weeks did not result in any severe adverse reaction. However, 2 of the 5 patients reported eye redness and a stinging sensation immediately after lid scrub, that spontaneously resolved without further complication.

Lid scrub with petroleum jelly

On initial examination, the 3 patients diagnosed with anterior blepharitis (Cases 8, 9, and 11) showed flaky dandruff-like material and scurfs diffusely scattered over the eyelashes. Whitish to yellowish cylindrical dandruffs were seen on the base of numerous lashes. The 5 other patients with mixed blepharitis (Cases 6, 7, 10, 12, and 13) had additional findings of plugged meibomian gland orifices.

Prior to treatment with petroleum jelly, 7 out of 8 patients complained of eyelid irritation, itchiness, transient blurring of vision, and tearing. Additional symptoms included a combination of the following: eyelid heaviness, sticky sensation of the lids, mucous discharge, and redness. After daily lid scrub twice a day with petroleum jelly and application of the same treatment at 2-week intervals at the clinic, all patients experienced a reduction in the number, frequency, or severity of symptoms (Table 2). Symptoms that persisted in these patients even after treatment for 6 weeks included eye irritation (n=2), foreign body sensation (n=3), tearing (n=3), and itchiness (n=4). Case 6 still reported occasional redness, and Case 7 still complained of eyelid heaviness despite treatment, although severity and frequency of these symptoms have also decreased. Case 9 reported no symptoms of blepharitis after treatment.

Epilation of lashes after 6 weeks on petroleum jelly lid scrub showed a DC of zero for Case 6. One patient had the same DC of 8 pre- and posttreatment (Case 11), and another had an increase in DC from a pretreatment count of 6 to a posttreatment DC of 9. The rest of the patients (Cases 7, 8, 9, 10, 12, and 13) had varying degrees of decrease in DC after 6 weeks of treatment (Figure 4).

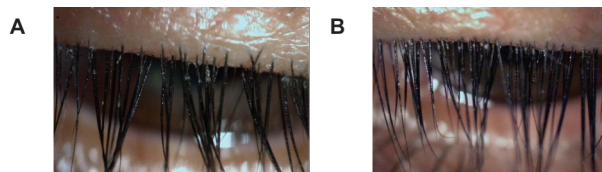


Figure 5. Pretreatment (A) showing diffuse collarettes or cylindrical dandruff and scurfs and posttreatment (B) with petroleum jelly lid scrub showing residual blepharitis with reduced *Demodex* count.

Examination of their eyelashes still showed cylindrical dandruff and scurfs ($n=7$) (Figure 5). Although most patients remained symptomatic, the decrease in DC after treatment (or, as in Case 6, a total eradication of the mites) may have resulted in the general improvement of their symptoms. Only one patient (Case 8) had normal-looking eyelids at the end of treatment. All patients initially diagnosed with mixed blepharitis had clear meibomian gland orifices after 6 weeks of treatment.

Lid scrub with petroleum jelly did not produce any significant adverse reactions. Two patients (Case 6 and 7) reported a sticky sensation immediately after lid scrub, which continued to be felt even minutes after application. Case 6 also complained of occasional redness, and Case 11 experienced some stinging sensation, both of which spontaneously resolved without further complications.

Lid scrub with TTO and TT facial wash versus petroleum jelly

The average difference of *Demodex* counts before and after treatment with TTO and TT facial wash was significantly different from that with petroleum jelly (t-value 3.384 > 2.447; $p < 0.05$), taking into consideration the unequal sample sizes between the two groups. Further analysis showed that the use of lid scrub with petroleum jelly caused a statistically significant decrease in *Demodex* counts after 6 weeks of treatment compared with lid scrub using TTO and TT facial wash (t-value 3.384 > 1.943, $p < 0.05$).

DISCUSSION

In cases of treatment-resistant chronic blepharitis, investigation for the presence of *Demodex* mites is suggested because demodectic blepharitis does not respond well to conventional therapeutic measures.⁸ Treatment for anterior and posterior blepharitis usually includes the application of warm compresses, eyelid hygiene with vertical eyelid massage, and scrubbing with diluted baby shampoo or commercially available facial cleansers, and the use of topical antibiotics, such as erythromycin or bacitracin, or anti-inflammatory agents like corticosteroids and cyclosporine.² In *Demodex*-induced blepharitis, successful treatment may be more difficult to achieve. Suggested modes of therapy include application of topical acaricides, such as 4% pilocarpine HCl, 2% metronidazole, and 1% mercury oxide ointment, which have been proven effective in diminishing symptoms of blepharitis and decreasing *Demodex* count. In a study by Inceboz in 2009⁸, however, management with these medications did not improve symptoms in a small group of patients. Thus, new treatment modalities and further investigations are needed.

Although the use of tea tree oil and tea tree shampoo has been widely proven to be effective in the treatment of *Demodex*-related blepharitis, it is still not being used in the Philippines as the standard of care in chronic cases of blepharitis where *Demodex* infestation is suspected. This may largely be attributed to tea tree oil products being too costly and not widely available in the market. Epilation of eyelashes to check for possible *Demodex* infestation is also not part of the standard protocol in chronic or recalcitrant cases of blepharitis. Thus, the usual treatment for any form of blepharitis (warm compresses, eyelid massages with antibiotic ointment applications) is still commonly prescribed to patients despite unsatisfactory results in past experiences. In the study by Gao, the *Demodex* counts of seven patients who practiced lid scrub with diluted baby shampoo did not reach zero after 40-350 days. Two of these cases even showed an increase in *Demodex* counts.¹¹

Patients with chronic blepharitis caused by *Demodex* may have signs and symptoms typical of any form of blepharitis, such as redness, pruritus, trichiasis, madarosis, foreign body sensation, epiphora, and photophobia.³ In the 13 cases we reported in this study, all of the patients complained of eyelid irritation and itchiness, which persisted in varying degrees even after treatment with lid scrub with tea tree oil and

facial wash or petroleum jelly. The study by De Venecia and Lim Bon Siong found that among all the ocular symptoms investigated, only lid irritation correlated with a high *Demodex* count, which was defined as having a mean *Demodex* count of more than 9 mites.⁷ How *Demodex* mites cause lid irritation is believed to be due to a variety of factors. It is generally thought that allergic and inflammatory responses of the eyelid skin to excretions and eggs laid by the mites give rise to lid irritation in demodectic blepharitis. The biting apparatus of the *Demodex* may also be enough to produce lid irritation. These mites release lipolytic enzymes which aid in digestion of sebum that cause blockage in the sebaceous glands. This may then lead to the development of secondary infection and mounting of the host's normal immune responses.¹⁷

Although all of the patients in this study reported a general improvement in their symptoms after treatment, symptoms still persisted in most patients at the end of 6 weeks due to several reasons. First, neither tea tree nor petroleum jelly successfully eradicated all of the *Demodex* mites. Second, other etiologic agents other than these parasites may be present. Third, non-strict adherence to therapy may not have allowed the medications to take full effect. Lastly, our empirical dosage or scheduling of application may have resulted in inadequate treatment.

Tea tree oil has been proven to be effective in the eradication of *Demodex* mites. Gao et al demonstrated that weekly lid scrub regimen with 50% tea tree oil and daily lid scrub with tea tree shampoo was shown to effectively eradicate ocular *Demodex* both in vivo and in vitro.^{10,12} Lid scrub with tea tree oil loosens cylindrical dandruff and stimulates *Demodex* mites to migrate from these cylindrical dandruff embedded in the eyelid skin.¹² This practice has also been shown to reduce conjunctival inflammation and corneal manifestations associated with *Demodex*-related blepharitis, such as corneal infiltration and vascularization, and phlyctenule-like lesions. In the same study by Gao, five patients treated with the same tea tree regimen had *Demodex* counts which dropped to zero within 3 weeks. In another 2 patients, the *Demodex* counts dropped to zero within 4 weeks of receiving the same treatment.¹² Williamson et al. determined that tea tree oil produced 100% immobilization of mites at 30 minutes and 100% mortality at 2 hours in vitro.⁹

The 5 patients who did lid scrub with TTO and TT facial wash had opposing results in terms

of *Demodex* counts. Only 3 of these patients had a decrease in *Demodex* counts: a DC from 8 to 1 (87.5% decrease) for Case 2, a DC from 6 to 5 (16.67% decrease), and a DC from 33 to 22 (33.33% decrease) for Case 4. On the other hand, *Demodex* counts in 2 patients increased after lid scrub with the tea tree regimen: DC increased from 5 to 8 for Case 1, from 5 to 6 for Case 3, and from 9 to 14 for Case 5. Although this increase in *Demodex* counts was objectively noted, these patients still showed improvement both symptomatically and clinically. These patients showed up on the given scheduled application of TTO at the clinic every 2 weeks, and claimed strict adherence to the daily lid scrub regimen with TT facial wash, as evidenced by entries in their treatment diaries. Although less than ideal compliance may still be a possible explanation, this finding may have been the result of an interplay of other factors. Previous studies on the use of tea tree oil in the eradication of ocular *Demodex* in vivo advocated the use of tea tree shampoo, which may have a different composition or be more concentrated than the formulation of the TT facial wash that we used in this study. The TT facial wash (The Body Shop[®]) used contained 5% tea tree oil, which may or may not be less than what was used in previous studies, but which was the most widely available of its kind in the current market. If concentrations used were less, it may be postulated that complete eradication may be achieved longer than 3 to 4 weeks, as shown by Gao.

Previous studies advocated weekly office lid scrub with TTO to loosen the flaky dandruff-like material and to stimulate *Demodex* mites to migrate out of the lash follicles.¹² In this study, applications of TTO at the clinic were done only at 2-week intervals to decrease the potential for drop outs. This may also have affected the DC of these patients.

Cylindrical dandruff (CD), which are lipid and keratin accumulations that form distinct cuffs surrounding lash roots, are characteristic of demodectic blepharitis. Sleeves subsequently form when these fibrinous, scaly cuffs have extended to involve the lash shaft.^{2,10} Gao found that patients with diffuse cylindrical dandruff (CD found in >10 lashes) had a *Demodex* count significantly higher than those with sporadic cylindrical dandruff (CD in <10 lashes), suggesting that the presence of CD may be pathognomonic of *Demodex*-induced blepharitis.¹⁰

The modified Coston method of lash sampling allowed adequate sampling of the *Demodex* mites

by selecting lashes with significant CD both pre- and posttreatment. It also permitted ample visualization of the parasites under the light microscope by using fluorescein dye to provide a yellowish and semitranslucent contrast against the mites. Fluorescein dye also induced expansion and dissolution of compact and opaque CD, making the mites more easily identifiable. Indeed, sampling of lashes with CD in this study usually revealed at least 1 mite within or adjacent to the epilated lash follicle (Figures 1C and 1D). Although this method of lash sampling was employed in this study, undercounting of *Demodex* mites may still be one factor to explain the increase in DC after treatment with the tea tree regimen.¹⁸

Only 1 patient (Case 6) had complete eradication of *Demodex*, as evidenced by a drop of DC from 5 to 0 (100%) after treatment with petroleum jelly for 6 weeks. Five out of the eight patients treated with petroleum jelly had *Demodex* counts decreased in varying degrees after 6 weeks: Case 7 from 16 to 6 (62.5%), Case 8 from 8 to 1 (87.5%), Case 10 from 13 to 11 (15.38%), Case 12 from 5 to 3 (40%), and Case 13 from 23 to 15 (34.78%). Conflicting results in this group could be seen in Case 11, who maintained the same *Demodex* count of 8 mites even after treatment, and in Case 9 whose *Demodex* count increased slightly from 6 to 9. These results showed that petroleum jelly may have some acaricidal effect, but it is premature to state any final conclusions at this point with only 8 cases in the study and conflicting results in terms of posttreatment *Demodex* counts. Lash sampling may again come into play with these results. Since no previous studies have attempted to use petroleum jelly in the treatment of demodectic blepharitis, its proper dosing schedule may have to be determined. Perhaps, *in vitro* studies may be done to further establish its exact pathogenicity on mites, and the possible duration it may take for it to exert its acaricidal effects. Takano-Lee postulated the suffocating effect of petroleum jelly on lice, as well as its ability to lessen hatching in lice eggs.¹⁵ If the same effect is to be assumed in mites, only *Demodex* present in the lash shafts could be eliminated. Its ability to penetrate deep into the lash follicle, where most of the *Demodex* mites thrive and proliferate, remains unknown. This is clearly the advantage of clinic applications of TTO, which has been proven to stimulate migration of the parasite from the lash roots, thus making them more accessible.¹⁴

A study by Tsubota demonstrated the efficacy of water-free petrolatum in the management of dry eye.

Application of the ointment onto the lower eyelid twice a day with a cotton-tipped applicator resulted in a decrease in the tear evaporation rate, improvement in blink rates, and overall better subjective grading scores.¹⁹ This may explain why patients in the petroleum jelly group, who initially complained of foreign body sensation and/or transient blurring of vision prior to initiation of petroleum jelly lid scrub, observed a reduction of the severity or complete disappearance of these symptoms. Since petroleum jelly is essentially lipophilic, its interaction with the tear lipid layer may have contributed to stability of the tear film, thus decreasing symptoms of blepharitis associated with dry eyes, such as foreign body sensation and transient blurring of vision.

Persistence of ocular signs and symptoms of blepharitis despite treatment with petroleum jelly and the tea tree regimen is proof that blepharitis can be caused by not just one but possibly simultaneous and concurrent infections. The study of De Venecia and Lim Bon Siong showed that over 90% of patients with anterior and mixed blepharitis were positive for *Staphylococcus aureus* and *epidermidis* on cultures.⁷

In summary, lid scrub with petroleum jelly caused a significant reduction in *Demodex* counts compared to lid scrub with tea tree oil and tea tree facial wash (*t*-value 3.384 >1.943, *p*<0.05). Petroleum jelly may have some effect in the eradication of *Demodex* mites in cases of *Demodex*-induced blepharitis. Its ability to induce killing of lice and nits in previous research may have similar effects on mites. However, its capacity to stimulate the migration of these mites from deep within the lash follicles, as can be observed with application of tea tree oil, remains unknown. Although lid scrub with petroleum jelly and lid scrub with tea tree oil and tea tree facial wash both produced a decrease in *Demodex* counts and a decrease in the frequency and severity of ocular symptoms after 6 weeks of treatment, the presence of some conflicting data highly suggests that further studies with more patients should be initiated to further test the strength of these results. No severe adverse reactions were observed with either treatment regimen.

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