

Corneal Staining and Hot Black Tea Compresses

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ABSTRACT: **Background:** Warm compresses are widely touted as an effective treatment for ocular surface disorders. Black tea compresses are a common household remedy, although there is no evidence in the medical literature proving their effect and their use may lead to harmful side effects.

Objectives: To describe a case in which the application of black tea to an eye with a corneal epithelial defect led to anterior stromal discoloration; evaluate the prevalence of hot tea compress use; and analyze, in vitro, the discoloring effect of tea compresses on a model of a porcine eye.

Methods: We assessed the prevalence of hot tea compresses in our community and explored the effect of warm tea compresses on the cornea when the corneal epithelium's integrity is disrupted. An in vitro experiment in which warm compresses were applied to 18 fresh porcine eyes was performed. In half the eyes a corneal epithelial defect was created and in the other half the epithelium was intact. Both groups were divided into subgroups of three eyes each and treated experimentally with warm black tea compresses, pure water, or chamomile tea compresses.

Results: Brown discoloration of the anterior stroma appeared only in the porcine corneas that had an epithelial defect and were treated with black tea compresses. No other eyes from any group showed discoloration. Of the patients included in our survey, approximately 50% had applied some sort of tea ingredient as a solid compressor or as the hot liquid.

Conclusions: An intact corneal epithelium serves as an effective barrier against tea-stain discoloration. Only when this layer is disrupted does the damage occur. Therefore, direct application of black tea (*Camellia sinensis*) to a cornea with an epithelial defect should be avoided.

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KEY WORDS: corneal discoloration, warm compresses, corneal erosion, black tea

Many methods of delivering heat to eyelids have been described, including the application of warm hard-boiled eggs, electronic devices and moist chambers [2]. The use of tea compresses has not been studied in the ophthalmic literature but is widely used and recommended by physicians as well as non-medical individuals. An internet search yielded many websites recommending this treatment. Tea is considered to be a decongestant as well as useful in reducing eyelid swelling due to its caffeine content and antioxidant properties. Tea compresses are recommended by plastic surgeons for facial application in the postoperative period after facelift operations. They are also recommended as a treatment for sore nipples while breastfeeding [3,4].

Potential harmful effects of treatment with tea compresses was suspected after an 89 year old woman presented at our clinic after suffering a minor trauma to her left eye. She had a corneal erosion and dark discoloration of the corneal stroma. The case is fully described in the results section.

In this study, we assessed the prevalence of hot tea compresses in our community and explored, in vitro, the effect of warm tea compresses on the cornea when the corneal epithelium's integrity is disrupted.

PATIENTS AND METHODS

During August 2015, patients and their family members visiting our clinic were asked to complete a questionnaire regarding the type, frequency, and liquid type of the compresses they used, as well as the indication for their use. Only subjects with a history of compress use were included in this study. Data collection was performed by two certified ophthalmic nurses, and oral translations (Russian and Amharic) were provided for non-Hebrew-speaking subjects. The local institutional review board approved the questionnaire. All analyses were conducted with Excel 2010 using descriptive statistics.

IN VITRO EXPERIMENT

Eighteen fresh porcine eyes were obtained from an abattoir. In nine eyes, an 8 x 8 mm square of corneal epithelium was removed with a crescent knife. In the other nine eyes the epithelium was left intact. Eyes were treated with warm gauze compresses for 10 minutes at 50°C; three eyes from each group were treated with black tea, three with chamomile tea, and three

Application of warm compresses to the eye is a common treatment for several eyelid diseases, including meibomian gland dysfunction, chalazion and blepharitis [1]. Warm compresses heat the eyelid above the melting point of the meibomian lipids, enhancing the delivery of lipids to the tear film.

with pure water. The black tea was a commercially available, pre-packaged combination of pure tea leaves from Indonesia, Kenya and Zimbabwe. The tea leaves did not undergo an industrial extraction process. Chamomile tea and pure water were chosen as controls because they are also commonly used as warm compresses. Two independent ophthalmologists evaluated the corneas for evidence of staining, by gross observation. In cases of disagreement, a third expert was brought in.

RESULTS

CASE REPORT

Our attention to the potential harmful effect of tea compress treatment was raised when an 89 year old woman came to the clinic after suffering a minor trauma to her left eye. The incident caused mild pain and blurred vision. A staff member at her senior home recommended applying warm tea bags as compresses to the injured eye. After one week of treatment, there was no improvement in her condition and she was referred to our clinic. Upon examination, visual acuity in the left eye was counting fingers from 2 meters, and conjunctival injection was +3. There was a corneal epithelial defect of 4 x 5 mm, corneal edema, and Descemet membrane folds, but no infiltrate. The anterior corneal stroma underlying the area of the epithelial defect was stained brown [Figure 1A].

Because the findings suggested a non-infective cause, we suspected that the discoloration was caused by an exogenous agent. The patient denied having used topical iodine, hair dye or outdated eye drops, but admitted that she had applied black tea compresses directly to the eye's surface. Corneal cultures were negative. Our prescribed treatment included the frequent

application of lubricating agents and 20% diluted autologous serum drops. The epithelial defect shrank slowly and eventually closed. The brown discoloration, however, remained unchanged for more than a year of follow-up [Figure 1B]. Her visual acuity improved to 6/12.

PATTERNS OF COMPRESS USE

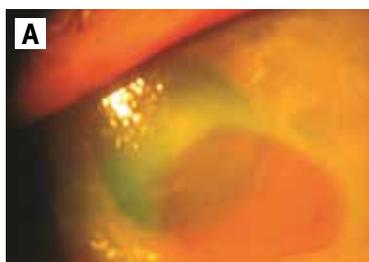
Included in this study were 32 subjects (19 females and 13 males, mean age 56.7 ± 19.1 years) with a history of compress use. Data on frequency, type, and reason for compress use are summarized in Table 1. In this cohort, 78% of the subjects used warm liquid for the compress. Specifically, 12.5% of the subjects used black tea as a base for their compress and 25% used other types of tea for that purpose. When asked about the material serving as the compress, 6 of the subjects (18.8%) reported using a tea bag directly as the compress. As shown in Table 2, only two subjects reported using both tea bag and tea liquid. A total of 16 subjects (50.0%) were exposed to warm tea compresses in this group.

IN VITRO EXPERIMENT

None of the porcine eyes with an intact corneal epithelium showed corneal discoloration. Brown discoloration was shown in three of the eyes with an induced corneal epithelial defect. All of these eyes were soaked in black tea [Figure 2]. The six eyes with an induced corneal epithelial defect that were treated with chamomile tea or pure water did not show any discoloration. There was total agreement among the observers (inter-rater reliability: $\kappa = 1, P < 0.001$).

Figure 1. Slit-lamp photo of the patient's cornea

[A] Epithelial defect and brown discoloration of the anterior corneal stroma



[B] The epithelial defect is closed but the brown discoloration remained unchanged



Table 1. Summary of compress use

	N	%
Frequency		
Occasionally	26	81.3
Once a week	4	12.5
Daily	2	6.3
Type		
Tea bag	6	18.8
Boiled egg	5	15.6
Pad	5	15.6
Hot towel	8	25.0
Warm pillow	5	15.6
Cotton wool	1	3.1
Other	2	6.3
Hot liquid		
Water	13	40.6
None	7	21.9
Hot black tea	4	12.5
Other tea	8	25.0
Indication		
Blepharitis	10	31.3
Stye	11	34.4
Dry eye	7	21.9
Red eye	4	12.5

Table 2. Compress use by patients

Patient #	Hot liquids	Type	Indication	Frequency
1	Black tea	Hot towel	Stye	Occasionally
2	Black tea	Other	Red eye	Occasionally
3	Black tea	Tea bag	Dry eye	Occasionally
4	Black tea	Warm pillow	Blepharitis	Occasionally
5	Other tea	Boiled egg	Blepharitis	Occasionally
6	Other tea	Boiled egg	Blepharitis	Occasionally
7	Other tea	Boiled egg	Blepharitis	Occasionally
8	Other tea	Boiled egg	Blepharitis	Occasionally
9	Other tea	Cotton wool	Stye	Occasionally
10	Other tea	Tea bag	Stye	Occasionally
11	Other tea	Warm pillow	Blepharitis	Occasionally
12	Other tea	Warm pillow	Stye	Once a week
13	Water	Boiled egg	Blepharitis	Occasionally
14	Water	Hot towel	Dry eye	Occasionally
15	Water	Hot towel	Dry eye	Occasionally
16	Water	Hot towel	Red eye	Daily
17	Water	Hot towel	Stye	Occasionally
18	Water	Hot towel	Stye	Occasionally
19	Water	Pad	Blepharitis	Occasionally
20	Water	Pad	Dry eye	Occasionally
21	Water	Pad	Dry eye	Once a week
22	Water	Tea bag	Blepharitis	Occasionally
23	Water	Tea bag	Stye	Occasionally
24	Water	Tea bag	Stye	Once a week
25	Water	Warm pillow	Blepharitis	Occasionally
26	Not using liquids	Hot towel	Dry eye	Occasionally
27	Not using liquids	Hot towel	Red eye	Occasionally
28	Not using liquids	Other	Red eye	Daily
29	Not using liquids	Pad	Stye	Occasionally
30	Not using liquids	Pad	Stye	Once a week
31	Not using liquids	Tea bag	Dry eye	Occasionally
32	Not using liquids	Warm pillow	Stye	Occasionally

DISCUSSION

In this study we explored the patterns of eye compress use in our community. Treatment with black tea compresses seemed to be common. Half our responders reported using either a tea bag as the compress or tea water as the hot liquid.

We demonstrated in an in vitro experiment that only black tea compresses resulted in corneal staining when the epithelium was damaged. There is limited discussion in the literature on the effect of tea on corneal clarity. One of the most important functions of the ocular surface epithelium is acting as a barrier, maintained by intact tight junctions. In

Figure 2. Brown discoloration of porcine cornea after a 10 minute application of warm black tea compresses



our experiment, we show that mechanical damage to epithelial integrity allows black tea molecules to penetrate and stain the corneal stroma.

Tea is an infusion of processed leaves of several varieties of the evergreen shrub *Camellia sinensis* L [5]. The leaves may be fermented (black tea) or left unfermented (green tea). Tea was found to have many beneficial effects: antibacterial, antioxidant, and protective against cancer and cardiovascular diseases [6]. It has also long been used as a natural dye for textiles. A high content of tannins keeps the dye from washing and does not require a mordant. The characteristic color of black tea is generated during its manufacturing process. During this process, the colorless polyphenolic compounds (major constituents of black tea leaves affecting its flavor, aroma and color) are oxidized both enzymatically and chemically to create two major groups of pigments: theaflavins and thearubigins, which are rich in hydroxyl groups (OH) [7].

Further laboratory experiments are needed to elucidate the exact method by which black tea constituents bond to the corneal stromal particles, but it is possible that the tea's polyphenolic compounds form hydrogen bonds with the hydroxyl group-rich collagen fibrils and/or proteoglycans in the corneal stroma.

Corneal staining might also occur when certain common disease processes, such as dry eye and atopic dermatitis, cause damage to the epithelial cellular integrity. In addition, systemic use of clofazimine, gold, immunoglobulins, indomethacin, phenothiazines, retinoids, isotretinoin, and silver is also known to cause corneal discoloration. Lengthy topical ciprofloxacin and epinephrine therapy may leave deposits in an epithelial defect [8]. However, corneal deposits left by drugs typically resolve with discontinuation of the drug, unlike the permanent staining caused by black tea, as seen in our case.

CONCLUSIONS

The use of black tea as a warm compress is common in lay medicine. Roughly 50% of patients who were included in our survey had applied some sort of tea ingredient as a solid compress or as the hot liquid. We believe our study provides reason and evidence to suggest that general and ophthalmic physicians should discourage the use of black tea compresses.

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