

# The Effect of Artificial Tear Treatment on Central Corneal Thickness in Dry Eye

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**Abstract:** Purpose: To evaluate the effect of artificial tear treatment on central corneal thickness in dry eye patients using corneal topography. Materials and Methods: In this before and after study, central corneal thickness measurements using corneal topography (SIRIUS CSO ITALIA) were performed on 192 eyes of 96 patients with dry eye at the ophthalmology department of Tishreen University Hospital/Lattakia from August 2020 to August 2021. Patients underwent ocular examinations, including Schirmer test, slit lamp examination for tear break-up time (BUT), and central corneal thickness (CCT) measurements using corneal topography before and after artificial tear treatment (carboxymethylcellulose and sodium hyaluronate 0,5% eye drop formulations) 3-4 times a day for one month, patients were examined again at a second visit and the results were compared. Results: The mean CCT was (545.79±10.5) before treatment and (571.30±11.3) after treatment ( $p=0.0001$ ,  $p=0.0001$ ). CCT statistically significantly increases of 4,7% from baseline ( $p=0.000$ ) 1. The mean tear BUT and Schirmer-1 tests revealed significant improvement after treatment. Conclusion: Artificial tear treatment in dry eye patients significantly increases the central corneal thickness. This increase could be used as a criterion in the diagnosis and follow up of dry eyes, and this increase in thickness should be considered in intra ocular pressure measurements as well as in refractive surgical procedures.

**Keywords:** Artificial Tears, Central Corneal Thickness, Dry Eye, Corneal Topography

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## 1. Introduction

Dry eye is a disorder of the tear film due to tear deficiency or excessive tear evaporation, which causes damage to the interpalpebral ocular surface and is associated with symptoms of ocular irritation [1, 2]. Dry eye is very common and its prevalence increases with age as aqueous production decreases. Diagnosis and treatment of dry eye have proven extremely challenging to ophthalmologists. There is no single and readily available diagnostic test for dry eye which has a high degree of sensitivity and specificity, and that could be considered as a gold standard) [3-5] The diagnosis of dry eye is usually made on the basis of symptom questionnaires combined with clinical examination and a battery of diagnostic tests, whose results are not always consistent. [6-10] The aqueous layer of the tear film is normally isotonic or slightly hypotonic. In all forms of dry eye (either tear deficient or evaporative), there is an increase in the osmolarity of the tear film, and the hypertonic tear film

causes a decrease in corneal thickness [11-17] This study was designed to see if this decrease in corneal thickness could be used as a diagnostic criterion in the diagnosis of dry eye. Central corneal thickness (CCT) of patients with dry eyes and of normal controls was measured before and after artificial tear application to determine if any changes occur [18]. Changes were observed and analysed, and the possible role of CCT in the diagnosis and treatment of dry eye was determined [19].

## 2. Materials and Methods

In this before and after study, central corneal thickness measurements using corneal topography (SIRIUS CSO ITALIA) were performed on 192 eyes of 96 patients with dry eye at the ophthalmology department of Tishreen University Hospital/Lattakia from August 2020 to August 2021. Patients underwent ocular examinations, including Schirmer test, slit lamp examination for tear break-up time (BUT), and central

corneal thickness (CCT) measurements using corneal topography before and after artificial tear treatment (carboxymethylcellulose and sodium hyaluronate 0.5% eye drop formulations) 3-4 times a day for one month, patients were examined again at a second visit and the results were compared.

Tear film stability was determined with fluorescein BUT, and results shorter than 10 s were considered pathological [20]. To determine BUT, the patient was asked to look up and a fluorescein strip was applied lightly to the inferior tarsal conjunctiva as the lower lid was retracted gently. After several blinks, the tear film was examined, using the broad beam of the slit lamp with a blue filter, recording the time it took for the first black spot or line to appear. The test was repeated three times and the average was recorded. Patients with any irregularity of the corneal surface such as a corneal scar that could impede tear film stability, and patients with a history of ocular surgery were not included in the study. Fluorescein staining of the interpalpebral cornea was graded as 0) no staining, 1 (mild staining with a few disseminated stains limited to less than one-third of the corneal surface), 2 (moderate staining in severity between grade 1 and 3), or 3 (severe staining with confluent stains occupying at least half of the corneal surface [21]).

In the diagnosis of dry eye, patients with symptoms who had at least two positive pathological diagnostic tests were included as dry eye patients.

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### 3. Results

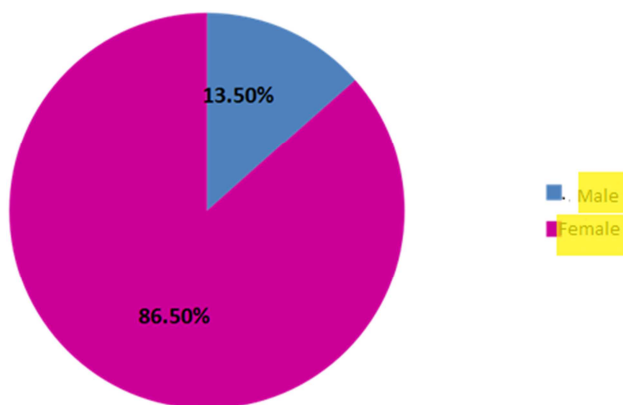


Figure 1. Patients gender.

83 female patient and 13 male patients were included.

The mean CCT was (545.79±10.5) before treatment and (571.30±11.3) after treatment ( $p=0.0001$ ,  $p=0.0001$ ). 86.50% of patients were females and 13.50% were males.

Table 1. CCT before and after treatment.

P value	Min-max	Mean±sd cct	
0.0001	520-560	545.79±10.5	before
0.0001	544.44-588.65	571.30±11.3	after

### 4. Conclusion

Artificial tear treatment in dry eye patients significantly increases the central corneal thickness. This increase could be used as a criterion in the diagnosis and follow up of dry eyes, and this increase in thickness should be considered in intra ocular pressure measurements as well as in refractive surgical procedures.

### References

- [1] Lemp, M. A. Report of the National Eye Institute/Industry workshop on Clinical Trials in Dry Eyes. CLAO J. 1995; 21: 221–232.
- [2] Craig JP, Nichols KK, Akpek EK, Caffery B, Dua HS, Ki Joo C, Liu Z, Nelson JD, Nichols JJ, Tsubota K, Stapleton F. TFOS DEWS II Definition and Classification Report. Ocul Surf. July 2017; 267-283.
- [3] Pflugfelder SC. Tear dysfunction and the cornea: LXVIII Edward Jackson Memorial Lecture. Am J Ophthalmol 2011; 152: 900-9.
- [4] Aragona P, Papa V, Micali A, Santocono M, Milazzo G. Long-term treatment with sodium hyaluronate-containing artificial tears reduces ocular surface damage in patients with dry eye. Br J Ophthalmol 2002; 86: 181–4.
- [5] Lee JH, Ahn HS, Kim EK, Kim TI. Efficacy of sodium hyaluronate and carboxymethylcellulose in treating mild to moderate dry eye disease. Cornea 2011; 30: 175–9.
- [6] Baudouin C, Cochener B, Pisella PJ, Girard B, Pouliquen P, Cooper H, Creuzot-Garcher C. Randomized, phase III study comparing osmo protective carboxymethylcellulose with sodium hyaluronate in dry eye disease. Eur J Ophthalmol 2012; 22: 751–61.
- [7] Mencucci R, Boccalini C, Caputo R, Favuzza E. Effect of a hyaluronic acid and carboxymethylcellulose ophthalmic solution on ocular comfort and tear-film instability after cataract surgery. J Cataract Refract Surg 2015; 41: 1699–704.
- [8] Brignole F, Pisella PJ, Dupas B, Baeyens V, Baudouin C. Efficacy and safety of 0.18% sodium hyaluronate in patients with moderate dry eye syndrome and superficial keratitis. Graefes Arch Clin Exp Ophthalmol 2005; 243: 531–8.
- [9] Green, K. and Downs, S. (1973) Reduction of corneal thickness with hypertonic solutions. Am. J. Ophthalmol. 75, 507–510.
- [10] Cohen, S. R., Polse, K. A., Brand, R. J. and Mandell, R. B. Humidity effects on corneal hydration. Invest. Ophthalmol. Vis. Sci. 1990; 31: 1282–1287.

- [11] Liu, Z. and Pflugfelder, S. C. Corneal thickness is reduced in dry eye. *Cornea*. 1990; 18: 403–407.
- [12] Lemp, M. A. (2002) Diagnosis and the treatment of tear deficiencies. In: *Duane's Ophthalmology CD-ROM* (eds W. Tasman and E. A. Jaeger), Lippincott Williams & Wilkins, Philadelphia, PA.
- [13] Dayanir V, Sakarya V, Ozcura F, Kir, E, Aktunc T, Ozkan B. S. and Okyay P. (2004) Effect of corneal drying on central corneal thickness. *J. Glaucoma*. 2004; 13: 6–8.
- [14] Nichols K. K, Nichols J. J. and Zadnik K. Frequency of dry eye diagnostic test procedures used in various modes of ophthalmic practice. *Cornea* 2000; 19: 477–482.
- [15] Forrester JA, Dick A. Anatomy of ocular appendages. *The Eye*, 1996; 113–115.
- [16] Snell R. *Clinical Anatomy of the eye*. Blackwell Publication. 1989, PP: 82–111.
- [17] DelMonte D, Kim T. Anatomy and physiology of the cornea. *J Cataract Refract Surg*. 2011; 37: 588–598.
- [18] Rufer F, Schroder A, Erb C. White-to-white corneal diameter; normal values in healthy humans obtained with the Orbscan II topography system. *Cornea*. 2005; 24: 259–261.
- [19] Muller LJ, Pels E, Vrensen GFJM. The specific architecture of the anterior stroma accounts for maintenance of corneal curvature. *Br J Ophthalmol*. 2001; 85: 437–443.
- [20] Simon G, Ren Q. Biomechanical behavior of the cornea and its response to radial keratotomies. *J Refract Corneal Surg*. 1994; 10: 343–351; comments by RK Maloney, ST Feldman, K Buzard, G Simon, Q Ren, 351–356.
- [21] Maurice DM. The transparency of the corneal stroma. *Vision Res*. 1970; 10: 107–108.
- [22] Muller LJ, Marfurt CF, Kruse F, Tervo TM. Corneal nerves: structure, contents and function. *Exp Eye Res*. 2003; 76 (5): 521–42.
- [23] Millodot M. A review of research on the sensitivity of the cornea. *Ophthalmic Physiol Opt*. 1984; 4 (4): 305–18.
- [24] Rosa AJ, Beuerman RW. Density and organization of free nerve endings in the corneal epithelium of the rabbit. *Pain*. 1982; 14: 105–120.
- [25] Hogan MJ, Alvarado JA, Weddell JE. *Histology of the human eye*, 1<sup>st</sup> ed. WB Saunders: Philadelphia; 1971, 687.
- [26] Oliveira-Soto L, Efron N. Morphology of corneal nerves using confocal microscopy. *Cornea*. 2001; 20: 274–384.
- [27] Kanski, Jack J. 2011-Clinical Ophthalmology, 7<sup>th</sup> Edition, pp: 122–124.
- [28] Ang RT, Dartt DA, Tsubota K (2001). Dry eye after refractive surgery. *Curr Opin Ophthalmol*. 2001; 12 (4): 318–322.
- [29] External Disease and Cornea. Basic and Clinical Science Course, Section 8, American Academy of Ophthalmology 2014–2015.
- [30] TFOS report of the international dry eye workshop (DEWS). *Ocul Surf*. 2007; 65–204.
- [31] Yao W, Davidson RS, Durairaj VD, Gelston CD. Dry-eye syndrome: an update in office management. *Am. J. Med*. 2011; 124 (11): 1016–1018.
- [32] Wolffsohn JS, Arita R, Chalmers R, Djalilian A, Dogru M, Dumbleton K, et al. TFOS DEWS II diagnostic methodology report. *Ocul Surf*. 2017; 15: 629–49.
- [33] Walt JG, Rowe MM. Evaluating the functional impact of dry eye: The Ocular Surface Disease Index. *Drug Inf J*. 1997; 31: 1436.
- [34] Rand AL, Asbell PA. Nutritional supplements for dry eye syndrome. *Curr Opin Ophthalmol*. 2011; 22 (4): 279–282.
- [35] Kim EC, Choi J, Joo CK. A comparison of vitamin A and cyclosporine A 0.05% eye drops for treatment of dry eye syndrome. *Am. J. Ophthalmol*. 2009; 147 (2): 206–213.
- [36] Arita R, Honda N, Maeda S, Maeda K, Kuchibe A, Yamaguchi T, Yanagihara Y, Suzuti H, Amano S. Caffeine increases tear volume depending on polymorphisms within the adenosine A2a receptor gene and cytochrome P450 1A2. *Ophthalmology*. 2012; 119 (5): 972–978.
- [37] Agarwal A. Dry eye: A Practical Guide to Ocular Surface Disorders and Stem Cell Surgery. Agarwal A (Ed). SLACK Inc, NJ, USA. 2006; 70: 115–149, 183–193.
- [38] Pflugfelder SC, Stern ME. *Dry eye and Ocular Surface Disorders* Marcel Dekker, NY, USA. 2004; 309–324.
- [39] Byun YS, Yoo YS, Kwon JY, Joo JS, Lim SA, Whang WJ, Mok JW, Choi JS, Joo CK. Diquafosol promotes corneal epithelial healing via intracellular calcium-mediated ERK activation. *Exp Eye Res*. 2016; 143: 89–97.
- [40] Swartz, T; Marten, L; Wang, M. Measuring the cornea: the latest developments in corneal topography. *Curr Opin Ophthalmol*, USA, 2007; 18/4: 325–333.