

# Importance of the Parasympathetic Nervous System for Controlling Dry Eye

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## ABSTRACT

Tear secretion is very unique to humans but the regulation of tear secretion has remained a mystery for many years. It has been described that the parasympathetic control and the sympathetic control work together to control tear secretion. However, we did not know which of the two is more important. Recently, we have shown that the parasympathetic nervous system in mouse model is more important than the sympathetic nervous system for tearing. In order to prevent dry eye, modern society should emphasize the importance of the parasympathetic nervous system.

**Keywords:** Dry eye; Parasympathetic nervous system; Sympathetic nervous system; Blood pressure; Diabetes; Insomnia

## DESCRIPTION

Tear secretion is very unique to humans but the regulation of tear secretion has remained a mystery for many years. It has been described that the parasympathetic control and the sympathetic control work together to control tear secretion [1]; however, we did not know which of the two is more important. Previously, we have shown that the parasympathetic nervous system is activated just by breathing with relaxation, such as abdominal breathing [2]. This is phenomenal because if you practice this technique for just three minutes, people can increase tearing in modern society. The study suggested that relaxation or stimulation of the parasympathetic nervous system increases tearing through abdominal breathing.

Dry eye has been increasing in modern society and many people are suffering from the lack of tearing. Why? Are humans losing tears? Historically, the Schirmer test, which is a well known test to measure tears, was developed by Otto Schirmer [3]. The normal value was 15 mm of tearing at that time. Henrik Sjogren published on low secretion of the lacrimal and salivary glands and keratoconjunctivitis sicca [4]. It was determined that 15 mm was too high of a result since using that value as a base; everyone could be diagnosed with dry eye. The borderline was changed to 10 mm. Now dry eye societies around the world have determined that a Schirmer test of  $\leq 5$  mm is the new standard to diagnosis dry eye. It seems that humans are losing tears.

My team published a paper in American Journal of Pathology which shows the local control of the lacrimal gland by either parasympathetic or sympathetic innervation using antagonist and agonist of innervation [5]. Our research described that the parasympathetic nervous system control is more important than the sympathetic nervous system control. That means in our very stressful modern society lifestyle, when the sympathetic nervous system becomes more dominant, then we may not be able to produce enough tears. We need to activate parasympathetic system stimulation.

Many lifestyle disorders, such as high blood pressure, diabetes, and insomnia, are also considered to be caused by excessive activation of the sympathetic nervous system. The increasing prevalence of dry eye shows a stressful society and that parasympathetic system activation, such as relaxation, is necessary for the control of dry eye and possibly for healthy aging. With aging, some people tend to lose tearing or some people have too much tearing, so the balance is disrupted. This trend of research may clarify the effect of aging on tearing in the future.

## FINANCIAL INTEREST STATEMENT

Outside the submitted work, Dr. Tsubota reports he is CEO of Tsubota Laboratory, Inc., a company working on treatment, prevention and medical devices for dry eye.

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**Received:** April 05, 2021; **Accepted:** April 19, 2021; **Published:** April 26, 2021

**Citation:** Tsubota K (2021) Importance of the Parasympathetic Nervous System for Controlling Dry Eye. *J Aging Sci*. 9: 252.

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