Abnormal tear dynamics and symptoms of eyestrain in operators of visual display terminals

Hitoshi Nakaishi, Yuichi Yamada

Abstract

Objectives—To clarify the relation between the prevalence of dry eye syndrome and subjective symptoms of asthenopia in visual display terminal (VDT) operators.

Method—722 VDT workers (242 subject workers with symptoms of asthenopia and 480 controls without such symptoms) received an ophthalmological examination consisting of refractometry and a tear function (phenol red thread) test.

Results—More than 30% of symptomatic workers were found to meet the criteria of dry eye, and the odds ratio compared with the controls was 4.61 (p<0.001). This odds ratio was significantly greater than that obtained for refractive errors (2.31).

Conclusions—Although this cross sectional study could not prove that dry eyes are the cause of asthenopia, the profound association of dry eyes with symptoms of asthenopia could be verified. It would be useful to carry out function tests in workers with symptoms of asthenopia.

Keywords: visual display terminal; work; dry eye syndrome; asthenopia

Numerous studies have found a higher prevalence of symptoms of uncomfortable eyes among visual display terminal (VDT) operators compared with office workers doing comparative jobs not involving VDTs. Although the absolute values reported vary among authors, many report that >50% of VDT workers complain of eye discomfort. Therefore, VDT work is recognised as a high risk factor for eye discomfort or asthenopia.

There are many factors which affect the visual comfort of VDT operators. Extrinsic factors include ergonomics of the VDT itself and the desk and chair with which it is used, sources of glare such as windows or lighting, ill defined job related pressures, and others. In case these factors play the major part in asthenopia of VDT workers, they should be ergonomically improved. On the other hand, factors related to the visual system of each person, such as accommodation (accommodation means the dynamic refraction by which the refractive power of the lens is changed so that a clear image of various objects is formed on the retina), discomfort related to vergence (vergence are binocular, conjugate movements of the eyes allowing the lines of sight to move in a parallel direction), anisometropia (anisometropia is a condition in which there is a difference in the refractive error of the two eyes), or refractive miscorrection are also important. We have determined the refractive error to be probably the most common cause of symptoms of asthenopia among VDT operators and also have established an “expert system” for analysing the optimal visual conditions, especially the refractive conditions, for VDT operators.

A reduced blinking rate and widening of the ocular surface due to the raising the viewing angle could cause symptoms of asthenopia among these workers, as could reduction of the stability of the precorneal tear film. Toda et al reported that dry eyes comprise most of the symptoms of ocular fatigue. However, these reports are based on the clinical data of patients presenting to a certain hospital, and as far as we could tell there are no reports that assess the relation between tear status and symptoms of asthenopia in many VDT workers.

Therefore, in the present study, we investigated the proportion of abnormal tear dynamics in VDT operators with symptoms of asthenopia with the cotton thread test.

Subjects and methods

All the employees belonging to one computer manufacturing company were asked to answer the questionnaire. In that company at the time of this study there were 3274 employees, of whom 1756 were men (mean age 33.4) and 1518 were women (mean age 28.3). In Japan there are no large scale computer manufacturing plants, so most of the employees work either in research and development or sales departments.

The questionnaire was distributed at the time of the periodic general physical check up carried out by the company for our study. It asked about (a) the status of visual correction, (b) the content of VDT work, (c) total working hours and average hours spent in VDT work each day during the past month, (d) previous and present illnesses or symptoms diagnosed by physicians and any current medications, (e) complaints about working conditions (table 1), and (f) occurrence and intensity of ocular and other physical discomforts during the past month (table 2).

In (b), the classification of VDT work was based on the recommendation in a report from the National Academy of Science in the United States, which was composed of data entry, data acquisition, interactive communication—that is, a combination of data entry and data acquisition—word processing, and programming. The employees who answered to (b) that
A flow chart of this study is shown in the figure.
Table 3. Prevalence (n (%)) of dry eye and refractive errors among 242 subjects and 480 controls, and their odds ratios (ORs)

<table>
<thead>
<tr>
<th></th>
<th>Asthenopia (+)</th>
<th>Asthenopia (−)</th>
</tr>
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<tbody>
<tr>
<td>Dry eye (+)</td>
<td>82 (33.9)</td>
<td>48 (10.0)</td>
</tr>
<tr>
<td>Dry eye (−)</td>
<td>160 (66.1)</td>
<td>432 (90.0)</td>
</tr>
<tr>
<td>OR</td>
<td>4.61</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>p Value</td>
<td>&lt;0.01</td>
<td></td>
</tr>
<tr>
<td>Refractive error (+)</td>
<td>60 (24.8)</td>
<td>60 (12.5)</td>
</tr>
<tr>
<td>Refractive error (−)</td>
<td>182 (75.2)</td>
<td>420 (87.5)</td>
</tr>
<tr>
<td>OR</td>
<td>2.31</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>p Value</td>
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No clear relation between prevalence of dry eyes and age, sex, or corrective status (use of glasses, contact lenses, or no correction) was found.

On the other hand, only 48 of 480 controls satisfied the criteria of dry eyes (10.0%) with 60 people satisfying those of refractive errors (12.5%); the odds ratio was 4.61 (p<0.001) for dry eyes and 2.31 (p<0.001) for refractive errors (table 3).

The finding of a higher prevalence and thus high odds ratio of dry eyes among the subjects with symptoms of asthenopia compared with controls strongly suggests that we must take dry eye syndrome into consideration when we as occupational health practitioners encounter complaints among VDT workers (because in our study controls were selected to match working condition for every subject, bias due to the differences in the working environment can be ignored). Our data suggest that dry eyes might be a more common cause of, or at least more associated with, symptoms of asthenopia than refractive errors among VDT workers. As other researchers have mentioned, our results indicate that dry eye syndrome and refractive errors might both be causes of asthenopia in VDT workers, rather than being mutually exclusive, for we found some degree of overlap between these conditions in the subjects (11 people) as well as in the controls (16 people).

There have been much experimental data supporting an increase in the prevalence of dry eyes during work at VDT workplace. Lighting conditions and visual impairment. Ergonomics. 1981;24:933–44.


12 Nakaishi H, Miyao Y. Establishment of an expert system for visual display terminals (VDT) workers’ ocular discomfort as percutaneous symptoms in an actual working population.

One of the difficulties in analysing dry eye syndrome is that the definition of dry eye itself differs depending on the researcher, at least here in Japan; in 1992, dry eye syndrome was defined as a “quantitative or qualitative abnormality of tear irrespective of keratoconjunctival disorder” at a clinical conference held at Keio University. One author specified that disregard for keratoconjunctival lesions is unique to Japan. However, in 1995, the Japan Dry Eye Research Group stated that the term dry eyes must include keratoconjunctival lesions; the group classified those with only decreased tear secretion without any keratoconjunctival disorder as incomplete dry eyes or intermittent dry eyes and remarked that such a type of dry eyes may be associated with VDT work or use of contact lenses. Our data relate to the conventional or incomplete type of dry eyes, because we did not confirm the corneal condition by slit lamp observation but only checked the condition of the tears.

Our data also support the general concept that ocular symptoms are associated with small refractive errors. However, the odds ratio was smaller than that for dry eyes in our study. So we recommend investigation of not only refractive errors but also tear conditions when we encounter VDT workers with symptoms of asthenopia, or for the first stage of prevention, before they start VDT work. At least correction status and tear condition should be checked. For high risk prospective VDT workers (those with corrective errors or dry eyes), specific precautions should be taken—for example, making them wear more suitable glasses during VDT work or apply artificial tear solution as well as the usual action from the aspect of industrial health, to prevent the health problems of VDT work—such as, controlling working time, adjustment of ergonomic variables at the work stations, and controlling workplace humidity, temperature, and lighting.
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