

ORIGINAL ARTICLE

Knowledge and Use of Tear Film Evaluation Tests by Spanish Practitioners

Genís Cardona*, Carme Serés†, Lluïsa Quevedo*, and Montserrat Augé†

ABSTRACT

Purpose. The present study aimed at investigating the use and knowledge of tear film and dry eye evaluation tests by a representative sample of Spanish optometrists and ophthalmologists.

Methods. A simple on-line survey was designed to explore the preferred tests for tear film evaluation and dry eye diagnosis. Additional questions surveyed knowledge of basic tear film evaluation concepts, attitude (proactive or reactive) toward patient symptoms and use of standardized dry eye questionnaires. Respondents also provided information regarding academic background, continuing education and training courses, and weekly number of tear film examinations.

Results. A total of 140 optometrists and 103 ophthalmologists responded to the survey. The tear break-up time test was the first preference of optometrists and ophthalmologists, whereas the Schirmer test and the non-invasive break-up time were frequently reported by ophthalmologists and optometrists, respectively, to supplement a first test. Optometrists and ophthalmologists were similar in terms of continuing education, knowledge of basic tear film concepts, and attitude regarding symptoms. Continuing education was found to positively influence knowledge, attitude toward symptoms and use of more sophisticated tear film evaluation tests. Standardized dry eye questionnaires were rarely used. A strong positive statistically significant correlation was encountered between the number of continuing education and training courses and the number of weekly tear film examinations.

Conclusions. Continuing education is an invaluable tool for practitioners to increase their self-confidence and improve their clinical practice when conducting tear film evaluations and dry eye diagnosis.

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Key Words: break-up time, dry eye, dry eye questionnaire, Schirmer test, tear film

Dry eye has been defined as a multifactorial disease of the tears and ocular surface leading to discomfort, visual loss, and disruption of the integrity of the tear film, with potential damage to the ocular surface.¹ Although dry eye is more commonly diagnosed in women and in the elderly population, the wide range in overall reported dry eye prevalence, which varies from 0.39 to 33.7%,²⁻⁶ may be explained by the combination of two factors: the absence of objective diagnostic tests offering both high sensitivity and specificity and the extensively documented lack of agreement between symptoms and clinical signs.⁷⁻¹⁰ Indeed, with the notable exception of tear fluorescein clearance,^{11, 12} the fact that no other single diagnostic test for dry eye has been found to present abnormal results in all patients complaining of eye irritation,¹³ often referred to as the lack of a “gold standard” test for dry eye,¹⁴ has led some clinicians to acknowledge the patient’s self-reported symptoms as the primary element in the diag-

nosis and treatment of dry eye.¹⁵ This situation has resulted in a lack of consensus regarding the perceived usefulness, and therefore the frequency of use, of tear film evaluation tests.

Only three published studies aim at exploring the frequency of use of dry eye diagnostic tests in optometric and ophthalmic practices.¹⁵⁻¹⁷ Nichols and co-workers¹⁶ undertook a retrospective chart review to evaluate which diagnostic tests had been used to detect dry eye in four different clinical settings, including an optometry clinic, a university hospital ophthalmology clinic, a health maintenance organization, and an eye clinic for war veterans. These authors reported significant disagreement between clinical settings in their preference of dry eye diagnostic tests, which they attributed to individual differences in clinical decision making, recording and clinical training, and to the type of patients attending each clinic. Overall, symptoms evaluation, fluorescein staining and tear break-up time (BUT) were the most frequently used diagnostic tests, both in general and as a three-test combination. Korb¹⁷ used a very simple questionnaire to interview a selected group of 36 optometrists and 41 ophthalmologists with a keen

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interest in tear film regarding their order of preference in the utilization of tear film and dry eye evaluation tests. The results of his survey disclosed that whereas optometrists reported BUT, case history, fluorescein staining, and the Schirmer test as their top four preferred tests, the surveyed ophthalmologists favored the Schirmer test, Rose Bengal staining, BUT, and fluorescein staining. In addition, many respondents reflected the need to perform multiple tests to ascertain an accurate diagnosis. Finally, Smith et al.¹⁵ presented the case histories of four patients previously diagnosed with dry eye of diverse severity and etiology to a panel of 16 well-recognized experts and researchers in the field of dry eye and tear film, and evaluated the ensuing discussion regarding the suitability of the different dry eye tests as diagnostic tools for each case. All participants acknowledged the need to perform multiple tests, as no single test was deemed sufficient for a diagnosis of dry eye, and advocated for symptoms assessment, BUT, tear film evaluation and staining as a recommended combination of tests to ensure an accurate diagnosis.

The aim of the present study was to investigate the knowledge and use of tear film and dry eye evaluation tests in the optometric and ophthalmic practices of Spain. A simple, user-friendly on-line survey was designed with the purpose of exploring the preferences of Spanish optometrists and ophthalmologists regarding tear film evaluation tests, including normalized and informal dry eye questionnaires (DEQ), as well as evaluating their actual knowledge of basic tear film assessment concepts. The results of the present

survey were analyzed in the context of the self-reported weekly number of conducted tear film explorations and of the awareness of each respondent to the need of frequent continuing education and training (CET) courses.

METHODS

Participants

Given the on-line delivery of the present survey, an on-line approach to our call for participation was considered appropriate. Therefore, a link to our survey page was provided in the monthly newsletter published by the Catalan College of Optometrists, which has an estimated potential readership of over 2000 registered optometrists. In addition, a call for participation was sent to several associations of Spanish ophthalmologists (there are about 3500 practicing ophthalmologists in Spain) and published on the wall of Spanish ophthalmology and optometry interest groups and communities on Facebook. Only the responses of currently practicing optometrists and ophthalmologists were included in the survey results.

Survey Design

A simple, user-friendly, anonymous on-line survey was developed, which could be completed in <2 min (Fig. 1). The survey

*1) Si sólo pudiera realizar una prueba para evaluar la película lagrimal de sus pacientes, ¿Cuál sería?

*2) Si pudiera utilizar una segunda prueba para comprobar sus resultados, ¿Cuál sería?

*3) Una tercera prueba:

*4) Una cuarta prueba:

*5) En la conversación con sus pacientes, ¿toma la iniciativa referente a la indagación de los síntomas relacionados con sequedad ocular o espera que sea el paciente quién, si se da el caso, manifieste su sintomatología?

Favor de seleccionar

*6) ¿Cuál de las siguientes pruebas utiliza con mayor frecuencia para evaluar el **volumen** de la película lagrimal de sus pacientes? (marque una sola respuesta)

*7) ¿Cuál de las siguientes pruebas utiliza con mayor frecuencia para evaluar la **calidad** de la película lagrimal de sus pacientes? (marque una sola respuesta)

8) En caso de utilizar un cuestionario normalizado de ojo seco, indique, por favor, de cuál se trata

*9) Indique, por favor, el número aproximado de pacientes a los que evalúa la película lagrimal (en una semana)

10) Indique, por favor, el número aproximado de sesiones de formación continuada (presencial o virtual) a las que ha asistido en los últimos 3 años

*11) ¿Cuál es su formación académica?

FIGURE 1.

Screen capture of the on-line survey used to assess use and knowledge of tear film and dry eye diagnostic tests. A color version of this figure is available on-line at www.optvissci.com.

form consisted of a total of 11 questions that were sequentially presented to the respondents, who were not allowed to revisit previous questions to review or change their answers. Four different aspects were investigated: frequency of use of tear film and dry eye evaluation tests, knowledge of basic tear film evaluation concepts, practitioner attitude regarding patient symptoms (proactive vs. reactive), and academic and professional details.

The frequency of use of tear film and dry eye evaluation tests was explored with the aid of four questions based on the survey form developed by Korb.¹⁷ Participants were first posed the question: “If you could use only one test for diagnosis of the tear film and dry eye, what would that test be?”, and then were asked to list their second, third, and fourth choices. These were open questions, that is, no specific test was mentioned to aid respondents in their answers.

Knowledge of basic tear film evaluation concepts was investigated by supplying a comprehensive list of tear film evaluation tests and by asking participants to select one test commonly used to assess tear volume and, from a second complete list, another test of tear film quality or stability. Participants were classified as knowledgeable of tear film evaluation concepts when they provided correct answers to both questions.

Attitude regarding dry eye symptoms was explored by asking participants whether they took the initiative when interviewing patients about their symptoms (proactive attitude) or, on the contrary, they only raised the topic by following a previous patient remark (reactive attitude). In addition, the use of any standardized DEQ was examined by means of an open question where participants could cite their preferred DEQ.

Finally, three additional questions aimed at gaining information regarding the academic background of the respondents (academic degree in optometry or ophthalmology and postgraduate courses), the number of weekly tear film evaluations performed at their clinical practices and the number of CET courses followed during the previous 3 years. For statistical purposes, all respondents were classified into three academic groups according to their academic progress and the quality and relevance of the postgraduate courses they had completed, with group 1 comprising basic academic degrees and group 3 corresponding to highly advanced and specialized optometric or ophthalmic curriculums. A CET course was defined as a 10 h face-to-face or distance learning session.

Data Analysis

Statistical analysis of the data was performed with the SPSS software version 17.0 for Windows. Descriptive statistics were used to determine frequency of use of the preferred tests, basic knowledge of tear film evaluation tests, use of DEQs, attitude on patient symptoms, and academic background. Data regarding weekly tear film evaluations and number of CET courses are presented as median and range values. The non-parametric Mann-Whitney test was used to evaluate differences between optometrists and ophthalmologists in terms of academic background, CET courses, number of weekly tear film evaluations, knowledge, and attitude regarding symptoms, and to investigate the effect of academic background and number of CET courses on knowledge and attitude regarding symptoms. In addition, the Spearman's rho test of correlation was used to explore the association between the

TABLE 1.

Academic background (groups 1 to 3), number of continuing education and training (CET) courses (previous 3 years) and number of tear film evaluations (1 week)

	Optometrists (n = 140)	Ophthalmologists (n = 103)
Academic background	Group 1: 72.1% Group 2: 12.6% Group 3: 15.3%	Group 1: 68.0% Group 2: 18.4% Group 3: 13.6%
CET (median; range)	19; 4–60	23; 0–65
Tear film evaluations (median; range)	12; 3–41	15; 1–25
Correlation between CET and number of tear film evaluations	$\rho = 0.705$ $p < 0.001$	$\rho = 0.656$ $p < 0.001$

number of CET courses and the number of tear film evaluations. A p value of 0.05 or less was considered to denote statistical significance throughout the study.

RESULTS

A total of 140 optometrists and 103 ophthalmologists responded the present survey over a period of 3 months from July to September 2010. Table 1 provides a summary of the academic background, number of CET courses followed during the previous 3 years and number of weekly tear film evaluations for both optometrists and ophthalmologists. The Mann-Whitney test for independent samples failed to reveal any statistically significant difference between optometrists and ophthalmologists in academic background, number of CET courses and number of weekly tear film evaluations.

Table 2 provides a description of the frequency of use of tear film and dry eye evaluation tests as first, second, third, and fourth diagnostic tools. Tear BUT was selected as a first preference by both optometrists (56.4%) and ophthalmologist (41.8%), with the non-invasive break-up time (NIBUT) test and the Schirmer test being mentioned as an alternative option for a first test by 21.4% of optometrists and 26.2% of ophthalmologists, respectively. As a second diagnostic or tear evaluation test, the BUT test was selected by 39.3% of optometrists (participants were not allowed to select the same test twice), whereas the Schirmer test was preferred by 35.0% of ophthalmologists. Finally, whereas the Schirmer test and the observation of interference fringes were mentioned by 33.6 and 22.1% of optometrists as the third and fourth tests they would use to evaluate tear film, ophthalmologists opted for the Schirmer test (31.1%) and Rose Bengal staining evaluation (15.8%) as their third and fourth preferred tests. It should be observed that 50.7% of optometrists and 41.8% of ophthalmologists considered a fourth test to be clinically unnecessary.

Optometrists and ophthalmologists had a similar knowledge of tear film evaluation procedures. Indeed, 52.9% of optometrists and 49.5% of ophthalmologists provided correct answers to both knowledge questions. The Mann-Whitney test for independent samples revealed a statistically significant difference between participants with good and poor knowledge of tear film procedures in terms of academic background and number of CET courses, both

TABLE 2.

Frequency of use of tear film and dry eye evaluation tests (%) as a first, second, third or fourth preference

	Optometrists				Ophthalmologists				
	1	2	3	4	1	2	3	4	
BUT	56.4	39.3	0	0	41.8	28.2	12.6	0	
NIBUT	21.4	6.4	7.9	7.1	18.4	10.7	5.8	6.8	
Meniscus	15	8.6	14.3	0	12.6	8.7	13.6	4.9	
Schirmer	7.1	32.4	33.6	0	26.2	35.0	31.1	0	
Phenol red thread	0	7.1	7.1	3.6	1.0	7.8	9.7	1.9	
Lissamine green	0	0	5.7	3.6	0	1.0	3.9	8.0	
Rose Bengal	0	0	0	7.9	0	0	0	15.8	
Interference fringes	0	0	7.9	22.1	0	1.0	4.9	10.2	
Symptoms	0	0	7.9	0	0	2.9	4.9	4.9	
Osmolarity evaluation	0	0	0	4.3	0	0	0	5.8	
Ph evaluation	0	0	0	0.7	0	0	0	0	
No other test	0	7.1	15.7	50.7	0	4.9	13.6	41.8	

TABLE 3.

Use of standardized dry eye questionnaires (in number of respondents)

	Optometrists	Ophthalmologists
Ocular surface disease index	8	5
McMonnies dry eye index	5	3
Dry eye questionnaire	4	4
Total	17	12

for optometrists ($Z = -6.828$; $p < 0.001$ and $Z = -6.289$; $p < 0.001$, respectively) and ophthalmologists ($Z = -5.674$; $p < 0.001$ and $Z = -5.864$; $p < 0.001$, respectively), with those respondents with a higher academic specialization and continuing education presenting better knowledge scores than their counterparts.

Only 42.9% of optometrists and 46.6% of ophthalmologists reported a proactive attitude toward dry eye and ocular discomfort symptoms, whereas the rest of respondents probed their patients' symptoms only in response to a remark by the patient. Statistical analysis of the attitude of participants regarding symptoms revealed that, whereas no statistically significant difference was discovered between optometrists and ophthalmologists, academic background and number of CET courses were found to be associated with a more proactive attitude regarding symptoms for both optometrists ($Z = -8.348$; $p < 0.001$ and $Z = -5.715$; $p < 0.001$, respectively) and ophthalmologists ($Z = -5.727$; $p < 0.001$ and $Z = -4.223$; $p < 0.001$, respectively).

A very small number of practitioners (17 optometrists and 12 ophthalmologists) reported using standardized DEQs for symptoms evaluation. The Ocular Surface Disease Index¹⁸ was the most frequently used questionnaire, although practitioners also mentioned the McMonnies Dry Eye Index¹⁹ and the DEQ²⁰ (Table 3).

DISCUSSION

The present study aimed at exploring the knowledge and use by Spanish optometrists and ophthalmologists of tear film evaluation and dry eye diagnosis tests. As such, an on-line survey was devel-

oped to try and reach as wide a range of practitioners as possible, from the most experienced practitioners to those recently graduated and relatively new to clinical practice, and to include all possible modes of practice and types of patients examined. In this regard, the present study differs from published literature,^{15–17} which investigates the preferences of either experts in the field of dry eye and tear film or of optometrists and ophthalmologists from very specific and relatively circumscribed clinical settings.

Although the number of respondents is relatively small when compared with the large diffusion ensured by the on-line distribution of our survey (about 5% of ophthalmologists and <10% of optometrists), the fact that all academic backgrounds were encountered and the wide range in the reported number of CET courses and weekly tear film examinations suggested that the present sample of respondents was representative of the population of Spanish optometrists and ophthalmologists. This was one of the goals of our study. Besides, we believe that, nowadays, an on-line survey of health professionals should not necessarily suffer from selection bias.

The present sample of optometrists and ophthalmologists was similar in terms of academic background and number of CET courses. However, a basic degree in optometry or ophthalmology consists of a clearly different academic program and number of years of education. Indeed, until 2008 optometry in Spain was a three-course diploma, without continuity to postgraduate degrees such as MSc and PhD. Therefore, even though some graduated optometrists decided to follow postgraduate courses abroad, many opted for registration to the Spanish College of Optometrists and for starting their own private optometric practice or joining an optometric or ophthalmic clinic, later resorting to continuing education courses to further their training.

It may be relevant to mention that in Spain, hospitals cost calculations are mostly based on a full costing approach, as opposite to other systems like direct costing or activity-based costing. Regarding public reimbursement systems, the impression is that unit costs are ignored, except for certain type of high technology processes and treatments.²¹ The dichotomy between public and private optometric or ophthalmic practices may partially account for the intersubject variability in the answers to the present survey.

Both optometrists and ophthalmologists mentioned the BUT test as their first diagnostic and tear film evaluation test of choice. A high percentage of ophthalmologists reported using the Schirmer test (with or without anesthetic) as their first or second preferred test, whereas optometrists resorted to the NIBUT test, only mentioning the Schirmer test as a third preference. In general, these results are in agreement with previous surveys,^{15–17} although a direct comparison between studies is probably not useful given the mentioned differences in sample selection. In addition, these findings may be interpreted by taking into account that Spanish registered optometrists are not legally permitted to administer diagnostic eyedrops such as cycloplegic or anesthetic drops, and thus limiting the use of the Schirmer test to its first (without anesthetic) variation.

It is interesting to note that none of the respondents mentioned fluorescein staining as a diagnostic test they would normally use in their clinical routine. This finding, which is in apparent disagreement with published literature,^{15–17} may probably be explained by the fact that, given the combined or simultaneous nature of BUT and fluorescein staining examination, all respondents mentioning BUT as their test of preference were actually referring to a combined BUT and fluorescein staining exploration. However, this interpretation may be approached with caution as BUT relies on the observation of the tear film, whereas corneal staining observes the tissue, that is, both tests have a clearly distinct basis. In retrospect, it would have been relevant to include a supplementary question in our survey to investigate this point.

Symptoms were mentioned by only 7.9% of optometrists and 12.7% of ophthalmologists, and never as a first preference. This result, which may have originated in the fact that many participants may have not considered symptoms evaluation a dry eye diagnostic tool when asked the open question “If you could use only one test for diagnosis of the tear film and dry eye, what would that test be?”, is nevertheless reflected in the relatively low percentage of practitioners taking a proactive attitude regarding symptoms (42.9% of optometrists and 46.6% of ophthalmologists), and in the anecdotal use of standardized DEQs. The lack of normalized Spanish DEQs, or generally accepted and used translations of commonly used English language DEQs such as the McMonnies Dry Eye Index,¹⁹ the DEQ²⁰ (or its shorter form DEQ-5²²) the Ocular Surface Disease Index,¹⁸ the CANDEES,⁴ or the subjective evaluation of symptom of dryness,²³ may partially account for this finding, which should be further investigated by verifying the current inclusion of symptoms evaluation as a tear film and dry eye diagnostic tool in Spanish optometric and ophthalmic academic programs. Given the importance which is traditionally attributed to the patient’s self-reported symptoms in the diagnosis and treatment of dry eye¹⁵ and the previously reported finding that clinicians often underestimate the severity of their patients’ self-assessment of dry eye,²⁴ the present results should be taken into account when designing and implementing future academic programs and CET courses to increase the awareness of Spanish practitioners regarding symptoms evaluation.

In effect, training and education, either as part of an academic program or as CET courses was associated not only with a proactive attitude toward symptoms but also with a better knowledge of tear film and dry eye diagnostic tools, use (or knowledge) of less common, more sophisticated tests (pH and osmolarity evaluation

or observation of interference fringes), and overall increase in self-confidence resulting in a positive impact on clinical practice. Indeed, the number of CET courses had a statistically significant strong positive correlation with the number of weekly tear film examinations, both for optometrists and ophthalmologists, probably as a direct consequence of the increase in self-confidence provided by good, continuing and highly specialized training and education.

In conclusion, although BUT was found to be the first preference of optometrists and ophthalmologists, multiple tests were mentioned by our survey respondents, reflecting the lack of consensus on the most appropriate diagnostic and evaluation tool for tear film and dry eye. The present on-line survey has proved useful in detecting international differences in knowledge and attitude of practitioners regarding tear film and dry eye and in identifying weak points in this knowledge and attitude which could be easily rectified through specially designed continuing training and education programs. Spanish optometrists and ophthalmologists may benefit from an increased awareness of the importance of the evaluation of symptoms as a diagnostic tool, reinforcing the need for normalized Spanish DEQs and/or adequate translations of English language questionnaires.

Although this research was conducted in Spain, we think that the reported findings are relevant not only to Spanish vision care practitioners. Optometry (and in a lesser extent ophthalmology) training and clinical practice is far from ideal in many developed countries around the world, and a wide range of legal regulations apply. Recent years have witnessed a significant international research effort directed toward understanding the dynamics of the tear film and the mechanisms leading to dry eye. Non-profit organizations such as the Tear Film & Ocular Surface Society are promoting advancement in these areas through both international and local meetings, workshops and seminars, and thus increasing global awareness of the important role played by the tear film to ensure a good quality of vision and ocular health. One of the goals of this type of organizations is to contribute to the design of continuing training and education programs. We believe that the present findings may prove useful to paint a more accurate international picture which, in turn, may assist in developing both global and country-specific efforts to further progress in research and in improving clinical practices toward dry eye and tear film evaluation.

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Research Interest

My research interest is focused on the importance of visual perception relating to sports. If we consider the dynamic characteristics of most sporting modalities that generally involve constant environmental changes, sudden and fast movements of players and ball, speed, etc. we have to accept that action sports require visual performance evaluation that is different from normal vision testing, since routine testing only samples static vision. Assessment of specific sports-related visual abilities includes peripheral vision, visual reaction time or dynamic visual acuity. In reference to the evaluation of dynamic visual acuity, defined as the ability to resolve a target under conditions of relative motion between the observer and the test stimulus, we have been working in the development of a new instrument (a computer-assisted test named DinVA 3.0.) to establish objective, precise and reliable measurements of a visual skill, considered, not only from the sporting field but also from driving security or aircraft operating as one of the more predictive of real world task performance, especially in dynamic conditions. The efficacy of our instrument has been already stated in my doctoral thesis. From that point I am mainly interested in applying the DinVA 3.0 to study the characteristics of dynamic visual acuity, its influence in performance in different application contexts as the ones mentioned above (fast ball sports or driving), and the possibility to be enhanced through training.