**TEST Tear Breakup Dynamics (TBUD) tests**

**TO DIAGNOSE** Test of tear instability.

**VERSION of TEST** There are two versions of the TBUD test:
1: Staring Tear Breakup Dynamics (S-TBUD)
2: Tasks Tear Breakup Dynamics (T-TBUD).

**DESCRIPTION**

1: The S-TBUD is an extension of tear breakup time (TBUT) test.
   - The subject is asked to “stare” straight ahead for as long as possible while the fluorescent tear film is videotaped. The time from start to finish is the maximum blink interval (MBI).
   - Subsequent image analysis allows tear stability to be assessed in a masked manner. The TBUT and the spatial location and growth rate of areas of breakup (AB) can be determined.

2: The T-TBUD monitors ABs while subjects perform various visual tasks, such as playing a computer game or reading.
   - The image analysis methods used are the same as for the S-TBUD.

**STUDY CONDUCT of TEST** A slit-lamp biomicroscopic video set-up is required.

1: S-TBUD:
   - The subject is seated behind the slit-lamp after instillation of 2µl of 2% sodium fluorescein. The experimental eye is voluntarily kept open for as long as possible, until discomfort occurs, similar to a childhood “staring contest.”
   - The other eye is held shut by the subject.
   - During the trial, the tear film is videotaped.
   - Later, an analysis of AB in selected frames of the video is performed using a custom MATLAB program.

#2: T-TBUD:
   - Similar to the S-BUD, except that the subject watches a movie, plays a computer game or reads for 3 minutes while tear breakup and the extent of blinking are quantified.

**RESULTS of STUDY**

1) dry eye subjects show a faster growth rate of ABs than controls (slope of AB/MBI is 4x greater),
2) the slope of AB/MBI is more repeatable than the TBUT,
3) symptoms similar to those of dry eye patients can be generated even in controls after repeated S-TBUD trials without an increase in corneal staining,
4) dry eye subjects showed multiple central ABs in T-TBUD trials. These results imply that tear breakup is rapid and extensive in dry eye subjects, even after the first blink, and that it occurs during normal visual tasks. Increased symptoms secondary to tear breakup, in the absence of corneal staining, suggests that the development of symptoms does not require clinically measurable ocular surface damage.

**Web Video** Not available

**Materials:**
- 2% sodium fluorescein, slit lamp biomicroscope, video set-up, custom computer program

**Standardization**
- Time of day [✓] Temperature [✓] Humidity [✓] Air speed [✓] Illumination [✓]
| **Diagnostic value** | This version: [x]  
The slope of AB/MBI is steeper in dry eye compared to controls. | Begley et al., 2006 |
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<td><strong>Repeatability</strong></td>
<td>Intra-observer agreement. Inter-observer agreement. Not applicable because test is not based on observers.</td>
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| **Sensitivity**      | (true positives) [80% sensitivity]  
Our submitted manuscript indicates 80% sensitivity and specificity for S-TBUD in a small group of subjects. We have not performed this analysis on T-TBUD. | Begley et al., 2006 |
| **Specificity**      | (100 – false positives) [80% specificity]  
see above |                   |
| **Other Stats**      |                                                                                   |                   |
| **Test problems**    | The test requires good videotapes with no shadows. Auxiliary lighting is sometimes needed. |                   |
| **Test solutions**   | In a clinical trial setting, investigators would need to be trained to obtain good quality videos. |                   |
| **FORWARD LOOK**     | Increased programming to move directly from video to results. |                   |
| **Glossary**         | MBI: Maximum Blink Interval  
S-TBUD: Staring Tear Breakup Dynamics  
T-TBUD: Tasks Tear Breakup Dynamics |                   |

**References**


Himebaugh N, Renner D, Begley C. Blink rate, fullness of blink, and tear film break-up with four different visual tasks. *Optom Vis Sci* 2001;78(12s): 121.