Objective: To examine the role, validity, and interpretation of Watzke-Allen slit beam testing in patients with idiopathic senile macular holes.

Methods: Thirty-seven consecutive patients with 40 full-thickness macular holes, confirmed on optical coherence tomography, were prospectively recruited. The Watzke-Allen slit beam test was used centrally and on the rim of the macular hole in both vertical and horizontal orientations.

Results: In 24 eyes, the beam was reported as thinned in both vertical and horizontal orientations when placed directly over the center of the macular hole. In 9 eyes, the Watzke-Allen slit was reported as broken in both vertical and horizontal orientations. In 6 eyes, the beam was reported as broken in one orientation and thinned in the other. In 1 eye, the beam was reported as kinked but not thinned or broken. When the beam was placed on the edge of the macular hole, all patients reported a displacement or bowing of the beam away from the center of the hole.

Conclusions: These findings confirm tangential traction of photoreceptors from a central foveal dehiscence as the causative mechanism in the development of the majority of macular holes. Careful interpretation of the Watzke-Allen sign may offer a technique for preoperatively determining visual prognosis.

PATIENTS AND METHODS

Thirty-seven consecutive patients with 40 FTMHs were prospectively recruited from a teaching hospital retinal clinic between March 1998 and March 1999. A complete ocular examination was performed, including best-corrected visual acuity measurement, using a standard examination lane with an illuminated Snellen visual acuity chart read at 6 m. A diagnosis of FTMHs was initially made on clinical features as observed by biomicroscopy of the macula and vitreomacular relationships using a Goldmann macula contact lens.

All patients were examined by OCT by one examiner (V.T.) to confirm the presence of a full-thickness retinal break. Before OCT examination, pupil dilation was performed using 1% tropicamide. A B-scan OCT of the macular region was obtained using a commercially available OCT machine (Zeiss-Humphrey, San Leandro, Calif) as described by Hee et al.12,22 Optical coherence tomography uses low-coherence interferometry to obtain information on tissue depth and reflectivity by analyzing a probe beam reflected from retinal structures and light returning from a variable reference optical delay pathway. All B-scan retinal images were composed of 100 consecutive A-scans acquired through the center of the macula in both vertical and horizontal orientations. (Figure 1). Any patient who did not appear to have an FTMH on OCT examination was excluded from the study. The first 20 patients admitted to this study had the presence of an FTMH confirmed using the 50-µm laser aiming beam test.12 in addition to OCT examination. A Watzke-Allen slit beam test was performed on all patients using a macula contact lens. A slit beam of 100-µm diameter was centered over the macula in both vertical and horizontal orientations. The slit beam was also placed on the nasal and temporal rim of the macular hole in the vertical orientation and on the superior and inferior rim in the horizontal orientation. The patient was shown a diagram of different slit beam appearances (Figure 2) and asked to choose the image that best correlated with the appearance of the slit beam in each of the different test positions. If the patient was uncertain in his or her response, the test was repeated until a reproducible and definite response was obtained.

Staging of macular holes was performed using the criteria developed by Gass6 and information obtained from both ophtalmoscopical and OCT examination. In Gass’ classification, stage 1 is an impending macular hole with an attached posterior hyaloid face, stage 2 is an early FTMH less than 400 µm with an attached posterior hyaloid face with or without an overlying prefoveal opacity, stage 3 is an FTMH greater than 400 µm with an attached posterior hyaloid face with or without an overlying prefoveal opacity, and stage 4 is an FTMH with complete detachment of the posterior hyaloid face. All stage 1 macular holes were excluded from this study because an FTMH was not confirmed on OCT, and the absence of an FTMH prevented detection of any abnormality on the Watzke-Allen slit beam test.

Data were analyzed using SPSS (Statistical Package for Social Sciences, 1995; SPSS Inc, Chicago, Ill). Continuous variables were analyzed using Wilcoxon rank sum test, and χ² tests were used for categorical variables.

BASELINE INFORMATION

Forty FTMHs were examined in 37 patients (3 cases were bilateral). The mean age of the 27 women and 10 men was 70.1 years (range, 60-83 years). Twelve eyes were classified as stage 2 holes, 18 eyes as stage 3 holes, and 10 eyes as stage 4 holes. Mean duration of symptoms was 9.4 months (range, 4 weeks to 3 years). Visual acuity measurements ranged from 6/9 to counting fingers. The right eye was affected in 21 cases and the left in 19 cases.

WATZKE-ALLEN TESTING

The subjective appearance of the Watzke-Allen slit beam test for each test position is shown in Figure 3.

In 24 eyes, the slit beam was reported as unbroken and thinned centrally in both vertical and horizontal orientations. In this group the beam was reported as continuous but bowed away from the center of the macula when placed on the nasal or temporal or superior or inferior hole rim in the vertical and horizontal orientations, respectively.

In 9 eyes, the slit beam was reported as broken centrally in both vertical and horizontal orientations. In most cases this group also reported the slit beam as bowed away from the center of the macula when placed on the hole rim. In addition, 3 patients reported that the slit beam appeared to be thinned or have a small piece missing when placed on the hole rim.

In 5 eyes, the slit beam was reported as thinned centrally in the vertical orientation but broken horizontally. In 1 eye, the slit beam was reported as thinned centrally in the horizontal orientation but broken vertically. This group also reported the slit beam as bowed away from the center of the macula when placed on the hole rim.

In 1 patient with a very small grade 2 hole, it was not possible to accurately perform the full Watzke-
Allen test protocol, because the hole rim was too small. This patient reported a displacement of the vertically orientated beam when placed centrally over the hole. The slit beam was reported as straight and continuous when placed in all other test positions.

The mean duration of symptoms was 11.7 months in those who reported a broken slit beam in both vertical and horizontal orientations and 10.1 months in those who reported the beam as thinned in both orientations. Analysis revealed no statistically significant difference between the groups (W4,20=49.5, P=.50).

Of 24 eyes in which the slit beam was reported as thinned centrally in both vertical and horizontal orientations, 8 eyes were classified as having stage 2 holes, 9 eyes as stage 3 holes, and 7 eyes as stage 4 holes. Of 9 eyes in which the slit beam was reported as broken in both vertical and horizontal orientations, 1 eye was classified as having a stage 2 hole, 5 eyes as stage 3 holes, and 3 eyes as stage 4 holes. Analysis revealed no statistically significant difference in hole classification between those reporting the slit beam as thinned centrally and those reporting it as broken (n=333, \( \chi^2 = 1.73, P = .42 \)).

The visual acuities of all patients are shown in Figure 4. Median visual acuity was 6/60 (range, 6/9 to counting fingers) in those reporting a broken beam in both vertical and horizontal orientations and 6/36 (range, 6/9 to counting fingers) in those reporting a thinned beam.

**PREFOVEAL OPACITIES**

Twenty-one eyes had prefoveal opacities. Eighteen were identified by Goldmann contact lens examination and confirmed on OCT examination. Three opacities were identified on OCT examination but could not be seen on Goldmann contact lens examination. Of 9 eyes in which a broken slit beam was reported in both vertical and horizontal orientations, 4 eyes (44%) were identified as having a prefoveal opacity either clinically or on OCT. Of 24 eyes in which a thinned slit beam was reported in both vertical and horizontal orientations, 13 eyes (54%) were identified as having a prefoveal opacity. Analysis revealed no statistically significant difference between the 2 groups (n=33; \( \chi^2 = 0.005, P = .93 \)).
A positive Watzke-Allen sign is often used clinically to differentiate FTMHs from mimicking conditions. Several studies, including the Vitrectomy for Macular Hole Study Group, have used the presence of a reported break in the slit beam as an entry criteria for inclusion. We have shown that if the Watzke-Allen test is performed carefully, using a macular contact lens, the majority of patients with FTMHs do not report a break in the slit beam when placed directly over the center of the macular hole. Several other investigators have reported similar findings. Martinez et al. reported a thinning of the slit beam in 4 of 16 FTMHs confirmed with the 50-μm laser aiming beam test, and Asrani et al. reported a thinning of the slit beam in 8 of 22 FTMHs confirmed on a scanning retinal thickness analyzer. Tsujikawa et al. reported an additional 3 cases of thinning of the slit beam in FTMHs confirmed by scanning laser ophthalmoscopy.

In Watzke and Allen’s original description of the slit beam test, they report a range of patient responses in association with FTMHs, including a central break and peripheral bowing of the slit beam, which they attributed to displacement of photoreceptors. In our study, patients most often report a central thinning rather than a break of the slit beam. It may be that the option of reporting a thinning, in conjunction with use of a diagram to aid in response, encouraged patients to report this appearance. Use of the macular contact lens in performing the test allows for accurate placement of the slit beam and may also contribute to increased recognition of different slit beam appearances.

It is interesting to speculate why patients with a definite FTMH confirmed in our series by OCT should not report a definite break in the slit beam. If Gass’ theory of central dehiscence at the umbo and centrifugal traction of photoreceptors is correct, then there is, of course, no loss of foveal tissue in the creation of an FTMH. An individual photoreceptor has no sense of position and has a fixed visual direction. Therefore, when stimulated by incident light, the photoreceptor transmits a signal that is interpreted as originating from its original position, thus accounting for the complaint of metamorphopsia seen in conditions such as central serous retinopathy, subfoveal neovascular membranes, and, of course, FTMHs themselves. Therefore, in patients with functioning foveal tissue on the rim of an FTMH, a slit beam would not be reported as broken. A subjective thinning of the beam is likely, since the photoreceptors are more spread out on the rim of the hole than in their original, central foveal position.

Bowing of the slit beam when placed on the edge of an FTMH requires further explanation. For example, if the vertical beam is placed on the temporal rim of an FTMH in the right eye, it will stimulate photoreceptors that were originally situated more nasally. The beam will therefore be interpreted as having a small central bend or kink. Since the retinal image is inverted, the central kink in the beam of light will be perceived as pointing in a more temporal direction, ie, away from the center of the hole. A similar explanation can be provided for the observed positions of the slit beam when placed on the nasal, superior, and inferior hole rim.

This explanation for the reported observations with the Watzke-Allen slit beam test supports Gass’ theory of tangential traction with no loss of foveal tissue in the development of FTMHs. The observations also suggest that patients who report only a thinning of the slit beam have functioning foveal tissue on the rim of an FTMH and potentially a favorable prognosis following successful anatomical closure of the FTMH. However, in our series, the central slit beam was reported as broken rather than thinned in 9 eyes with FTMHs. One possible explanation for this finding is that patients with a central break in the slit beam have macular holes of longer duration in which the photoreceptors on the elevated rim of the FTMH have undergone secondary degeneration and are no longer functioning. This theory is not supported by the fact that in our series there was no statistically significant difference in mean duration of symptoms in patients reporting a central break in the slit beam (11.7 months) compared with those reporting a central thinning (10.1 months).

A second explanation for the finding of a central break in the slit beam is that in these eyes the FTMH was created by a different mechanism, resulting in loss of photoreceptors, compared with those holes in which only a thinning of the beam is reported. Such a mechanism involving loss of foveal tissue in the overlying prefoveal opacity was originally described by Gass and has also been suggested by other investigators studying the histopathologic characteristics of prefoveal opacities removed at the time of macular hole surgery. If some FTMHs are created via the loss of foveal tissue, then it may be this group that, despite anatomical closure of the hole, does not achieve significant improvement in visual acuity following macular hole surgery. This explanation is only partly supported by our series, since prefoveal opacities were seen in 4 of 9 of those reporting a broken Watzke-Allen slit beam in both vertical and horizontal orientations and in 13 of 24 of those reporting a thinned Watzke-Allen slit beam.

Patients who report a central break in the slit beam despite careful examination may not be expected to achieve as marked an improvement in visual acuity following surgery as those who report only a central thinning. The identification of this group with a readily available, inexpensive, and noninvasive test such as the Watzke-Allen slit beam test may therefore allow an opportunity to target surgery for cases with a better visual potential and may also prevent unnecessary intervention or alter the surgical technique in those who are unlikely to achieve a satisfactory result. We are currently following up this group of patients to determine if the appearance of a broken as opposed to a thinned slit beam on the preoperative Watzke-Allen test is associated with a poorer improvement in visual acuity following surgery.

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REFERENCES


From the Archives of the ARCHIVES

A look at the past . . .

Dr. C.H. Williams, of Boston, said that it seems rational where a cut is made, to close it. In one case of his father’s the suture was left in 40 days, and there was no irritation. His father used to make the Le Brun corneal section. If you have a conjunctival flap, a number of sutures, three or four, can be inserted and can secure a prompt closing of the wound. There is prompt healing of the conjunctiva, and thus the cornea is better nourished and assisted in healing. However, the use of corneal sutures is not a routine method assisted in healing. However, the use of corneal sutures is not a routine method of treatment with himself. Where there is prolapse of the iris or vitreous, or


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