New Method Classifies FECD Severity: Tomographic Evaluation of Corneas for Subclinical Edema

A study by Sanjay V. Patel, M.D., Ophthalmology chair, and fellow researchers at Mayo Clinic’s campus in Rochester, Minnesota, supports a new method of classifying Fuchs’ endothelial corneal dystrophy (FECD) severity that is independent of central corneal thickness and employs Scheimpflug tomography for preoperative assessment of corneas for the presence of subclinical edema.

The severity of FECD is currently assessed based on the distribution of guttae and the presence of edema using a method documented by Jay H. Krachmer, M.D., and others in *The Archives of Ophthalmology* in 1978. Modified versions of this morphological and subjective method of assessment have also been described.

“Although current grading scales incorporate the presence of edema as indicative of worse disease severity, the scales are confusing,” says Dr. Patel. “Krachmer grading suggests that corneal edema can only be present with extensive guttae, whereas modified versions suggest that clinically apparent edema can be present with lower grades of guttae and that these eyes should be described as the lower grade, with edema noted separately. In reality, the onset of edema is gradual and early edema is not easily detected by using slit-lamp examination. Corneal edema warrants a classification that reflects this subtlety.”

The study by Dr. Patel and others was published in *Ophthalmology* in 2019.

In the cross-sectional study (with follow-up of outcomes) of 93 eyes from 57 patients with a range of severity of FECD and 74 eyes from 40 patients with normal corneas, the Mayo researchers clinically assessed corneas for FECD and corneal edema via slit-lamp biomicroscopy. They categorized the eyes as:
- Having clinically definite edema (obvious visible edema)
- Being suspicious for subclinical edema (possible corneal thickening without obvious edema on slit-lamp examination)
- Not having edema (no clinical suspicion of edema)

Tomographic pachymetry and anterior elevation maps derived from Scheimpflug images were evaluated for specific features believed to be consistent with corneal edema. FECD clinical disease course and outcomes were reviewed from the time of Scheimpflug image acquisition to the last available follow-up. Specific information collected included:
- Clinical management recommendation at the consultation when Scheimpflug imaging was performed
- Clinical outcomes if endothelial keratoplasty was performed
- Clinical progression of FECD if endothelial keratoplasty was not performed

Clinical progression was defined as a subsequent decision to proceed to endothelial keratoplasty based on an increase in central corneal thickness or the presence of visible edema associated with subjective impairment of vision by the patient.

Changes in central corneal thickness throughout the clinical course were measured by using ultrasonic pachymetry, and subsequent Scheimpflug imaging and measurements were reviewed if available.

“We initially proposed a fourth feature of corneal edema on tomography, defined as focal elevation of the anterior corneal surface...”
corresponding to the same location as focal posterior depression,” says Dr. Patel. “We found only three eyes that had focal anterior elevation, and all three had clinically definite edema by slit-lamp examination. Because our interests lie in detecting subclinical edema, we elected not to include this fourth feature in our analysis.”

3 main outcome measures
“In this study, careful evaluation of tomographic pachymetry and posterior corneal elevation maps successfully identified corneas with subclinical edema because subtle corneal thickening manifested as loss of the normal parallel isopachs, displacement of the thinnest point of the cornea and posterior corneal surface depression,” says Dr. Patel. “Clinical outcomes included the changes in central corneal thickness and vision after endothelial keratoplasty.”

The three specific tomographic features were all present in all FECD corneas with clinically definite edema, in 81 percent or more of FECD corneas suspicious for subclinical edema, and in 5 percent or less of normal corneas. The tomographic features of edema were present in 42 percent or less of FECD corneas deemed not to have edema clinically, suggesting that tomographic analysis might be more sensitive than clinical suspicion.

Of corneas suspicious for subclinical edema that subsequently underwent endothelial keratoplasty, all had at least two of the tomographic features present before endothelial keratoplasty. Improvements in vision, central corneal thickness and tomographic features after endothelial keratoplasty confirmed the presence of subclinical edema preoperatively.

“We recommend classifying FECD corneas as having clinically definite edema, subclinical edema or no edema, independent of central corneal thickness,” says Dr. Patel. “Tomography should be performed only when clinically definite edema is not visible and when assessing patients with visual complaints or prior to surgery in the setting of FECD.”

For more information


Optimal Timing for Intervention in Congenital Nasolacrimal Duct Obstruction

Congenital nasolacrimal duct obstruction (CNLDO), which occurs in 1 in 9 newborns, is characterized by persistent tearing and intermittent mucopurulent discharge from one or both eyes. Standard early treatment includes hydrostatic nasolacrimal massage and topical antibiotics. While the obstruction spontaneously resolves in most infants, it does not resolve in up to 25 percent of infants affected.

Results from a retrospective study of 1,998 infants with CNLDO suggest that surgical intervention may be appropriate during a new time frame — between ages 9 and 15 months — that capitalizes on the condition’s changing rate of resolution and the declining success rate of the initial probing.

“Although the overall rate of spontaneous resolution in CNLDO and efficacy of probing have been documented in the literature, the optimal timing of intervention remains controversial,” says Brian G. Mohney, M.D., with Ophthalmology at Mayo Clinic’s campus in Rochester, Minnesota, who led the research team. “In current practice, probing is generally recommended to occur after the patient reaches age 1 year. We wished to confirm whether that timing is optimal.”

Using data from the Rochester Epidemiology Project, the team retrospectively reviewed the medical records of 1,998 consecutive infants (younger than 5 years) diagnosed with CNLDO from Jan. 1, 1995, through Dec. 31, 2004, while residing in Olmsted County, Minnesota. The data recorded included sex, laterality, natural history and treatment:

• The cohort was 48 percent female and 89 percent white.
• Among the 1,998 infants who received a diagnosis during the 10-year period, CNLDO in 1,669 (83.5 percent) spontaneously resolved, 289 (14.5 percent) required surgical treatment, and 40 (2.0 percent) were lost to follow-up.
• The 1,669 infants whose obstructions spontaneously resolved were diagnosed at a median age of 1 month compared with 6.0 months for the 289 infants who required treatment.
• The median age at resolution was 2.4 months for the 1,669 infants whose obstructions...
Risk of Primary Open-Angle Glaucoma Increases After Vitreoretinal Surgery

“Close monitoring of intraocular pressure in the early postoperative period after vitreoretinal surgery is common clinical practice. Whether there is a need for long-term monitoring for glaucoma after vitreoretinal surgery, however, is less clear,” says Arthur J. Sit, M.D., with Ophthalmology at Mayo Clinic’s campus in Rochester, Minnesota. “Confirming the risk of late-onset, primary open-angle glaucoma (POAG) after scleral buckling and vitrectomy, as well as baseline risk factors, can help facilitate earlier detection and treatment of POAG.”

Dr. Sit and fellow researchers conducted a retrospective, population-based cohort study to determine the long-term risk of primary open-angle glaucoma (POAG) after vitreoretinal surgery, published in American Journal of Ophthalmology in 2018. The research team used data from the Rochester Epidemiology Project (REP) to identify all residents of Olmsted County, Minnesota, who underwent scleral buckling, vitrectomy or both between 2004 and 2015. A total of 344 eyes fulfilled the inclusion and exclusion criteria:

- 160 male and 184 female eyes with a mean age of 64.7 ± 11.1 years at the time of surgery (the fellow 277 nonoperative eyes were included in the comparison cohort)
- 58, 57 and 229 study eyes in the scleral buckling, scleral buckling with vitrectomy and vitrectomy-only cohorts, respectively

“Advantages of this study include its population-based nature and large sample size, which enabled calculation of incidence rates for POAG in various cohorts and comparison to

Findings support new time frame for intervention

“Our goal was to identify the rate of spontaneous resolution of the condition over time and by sex, as well as the optimal timing of intervention,” says Dr. Mohney. Study results include:

- The rate of spontaneous resolution was highest in the first few months of life, declining until age 9 months, when the resolution rate flattened. The rate of resolution was 35 percent faster at younger than 1 month versus 3 months; 43 percent faster at 3 months versus 6 months; 39 percent faster at 6 months versus 9 months; and 1 percent slower at 9 months versus 12 months.
- Boys’ obstructions resolved 0.5 months faster than girls’, and unilateral obstructions resolved 0.2 months faster than bilateral obstructions.
- Of the 289 infants who were treated surgically, 272 (94.1 percent) eventually underwent a probing. The obstruction resolved in 242 (89 percent) of those probed without additional treatment.
- After adjusting for the effects of age at diagnosis, sex and laterality, infants probed at 15 months or older had decreased odds of resolution after probing relative to infants probed at ages 12 to 14 months.
- When infants younger than 11 months were compared with infants of 12 to 14 months of age who were probed, there was no difference in their success rates. The success rate of probing was 89.5 percent (n = 68 of 76) in infants younger than 9 months; 94.5 percent (n = 52 of 55) in infants 9 to 11 months of age; 97.8 percent (n = 45 of 46) in infants 12 to 14 months of age; and 81.1 percent (n = 77 of 95) in infants 15 months or older.

“Given that the rate of spontaneous resolution appears to plateau after age 9 months and a successful probing outcome declines beyond age 15 months, surgical intervention between these time intervals appears to be a reasonable treatment strategy for infants with CNLDO,” Dr. Mohney says. “This time frame establishes both an earlier and narrower range of ages for intervention compared with the current general practice of probing after age 1 year.

“An additional argument for earlier probing may be that by delaying procedures, older children could develop more-complicated obstructions and ultimately require additional surgical procedures and increased exposure to general anesthesia.”

Study results were published in JAMA Ophthalmology in 2018.

For more information


an unexposed cohort, as well as expected rates for the general population,” says Dr. Sit. “We were able to focus on open-angle glaucoma as our primary endpoint due to our long follow-up — the mean follow-up was 62.1 ± 38.4 months — and the availability of linked records through the REP. Furthermore, glaucoma suspects could be more fully evaluated, since diagnosis was based on findings recorded over all of the follow-up visits. Selection bias was likely very low, since it included all patients in the Olmsted County population undergoing vitreoretinal surgery.”

Findings include:

• The 10-year probability of POAG was 17.5 percent and 10.0 percent in the scleral buckling with vitrectomy and the vitrectomy-only cohorts, respectively, compared with 1.0 percent in the nonoperative cohort.
• None of the eyes in the scleral buckling cohort developed glaucoma.
• The mean and median time intervals for development of POAG after surgery were 40.2 months and 46.1 months, respectively.
• The rates of POAG in operative eyes undergoing scleral buckling with vitrectomy and vitrectomy-only were significantly greater than the 1.0 percent rate of POAG for the Olmsted County general population.

“We found that there was a tenfold to seventeenfold increased risk of POAG in eyes after vitrectomy or scleral buckling with vitreoretinal surgery when compared with fellow nonoperative eyes,” says Dr. Sit.

Other risk factors for glaucoma
Researchers also compared the observed rate of glaucoma in the nonoperative cohort of eyes with the expected rates of POAG in the age- and sex-matched general population and found no difference. Further, the only other variable associated with an increased risk of POAG was higher baseline intraocular pressure. These results suggest that pre-existing risk factors for glaucoma may not be significant contributors to the increased risk of glaucoma after vitreoretinal surgery and that the development of POAG is due to risks related to the surgery itself.

Previous researchers have suggested that increased oxygen-free radical damage to the trabecular meshwork in vitrectomized eyes may lead to increased intraocular pressure and glaucoma. However, among the patients who developed glaucoma, 27 percent had normal-tension glaucoma. Further, among patients with suspected POAG, 61 percent had normal pressures but had optic disk or visual field findings that were suspicious for glaucoma. This outcome suggests that multiple mechanisms may be involved in the pathogenesis of POAG after vitrectomy, and not just elevated intraocular pressure. “Whether or not it is appropriate to classify the glaucoma as POAG is therefore debatable,” says Dr. Sit. “It may be more accurate to describe the disease as vitrectomy-associated glaucoma, but further research is required to clarify the mechanism of damage.

“In summary, the study results provide strong evidence for an increased risk of glaucoma after vitrectomy or vitrectomy with scleral buckling, but not scleral buckling alone. This finding is of particular concern, since the rates of vitrectomy are increasing and there is a trend toward vitrectomy replacing scleral buckling for management of retinal detachment,” says Dr. Sit. “Our study suggests a need for more-frequent monitoring for glaucoma after vitrectomy and the discussion of glaucoma risk with patients prior to vitreoretinal surgery.”

For more information