Welcome to our latest edition of *Ophthalmology Update*.

At the Cole Eye Institute, we are proud to be taking a leadership role in pioneering the use of advanced diagnostics and technology to improve patient care. In this issue, we take a look at many of our efforts in that area. Highlights include:

- Our surgeons and researchers are developing the next generation of intraoperative optical coherence tomography (OCT) devices and instrumentation to improve surgical decision-making and patient outcomes.

- Armed with a $2 million, five-year grant from the National Institutes of Health, we are developing new ways to measure corneal mechanical properties and put that information into clinical use.

- We are continuing to push the limits on OCT and have found that by refocusing the device, we can actually image the choroid. This important diagnostic advance allows us to differentiate central serous chorioretinopathy from age-related macular degeneration.

- We also are using ultra-widefield imaging (UWFI) to visualize up to a 200-degree retinal field in a single image — nearly 83 percent of the total retinal surface. This gives us a better idea of the scope of retinal disease burden in patients with diabetes, central retinal vein occlusions, branch retinal vein occlusions, and arterial disease and occlusions.

- As an established leader in the use of electronic health records (EHR), we offer an update and resource guide for how to develop a strategy for implementing an image management system and EHR system that is right for your practice.

In addition, we are excited to give you a look inside our new 600-square-foot ophthalmic surgical education lab, made possible with a generous $1 million donation from Timken Foundation. The Louise Timken Microsurgical Education Lab, featuring surgical simulators, is now the centerpiece of our residency program.

Also in this issue, you will find a wealth of information about our CME opportunities, our staff, their notable publications and the launch of our online forum, Consult QD-Ophthalmology, offering insights and perspectives from us and other thought leaders.

If you have additional thoughts or comments on *Ophthalmology Update*, please feel free to contact me at ophthalmologyupdate@ccf.org.

Sincerely,

Daniel F. Martin, MD
CHAIRMAN, COLE EYE INSTITUTE
Intraoperative OCT
Optical coherence tomography (OCT) serves as a noninvasive imaging modality capable of providing high-resolution images of biological structures in living tissues. Using OCT, the retina’s distinctive layers can be seen, enabling in vivo histology to comprehensively map and measure layer thicknesses and identify subsurface pathologies. “For this reason, OCT has become the standard of care in diagnosing and monitoring many eye diseases, such as age-related macular degeneration or macular holes, but it has not yet been widely utilized in the surgical environment due to the lack of an integrated intraoperative OCT platform,” explains Cole Eye Institute vitreoretinal surgeon and assistant professor of ophthalmology Justis P. Ehlers, MD. “One can assess the preoperative and postoperative anatomic configurations, but our ability to assess the immediate alterations of anatomy that occur during surgery is currently lacking.”

Crafting New Instrumentation for Integrated OCT

At Cole Eye Institute, surgeons and researchers are developing the next generation of intraoperative OCT devices and instrumentation to improve ophthalmic surgical outcomes in real time. Led by the combined efforts of Drs. Ehlers, Sunil Srivastava, MD, and Yuankai K. Tao, PhD, a prototype intraoperative microscope-integrated OCT system including dedicated surgical instruments and specially crafted analysis software is in use at Cleveland Clinic in the research setting.

“The major advantage of this instrumentation is the ability to provide images of micron-thick subsurface tissue layers during a surgical procedure,” says Dr. Tao, a Cleveland Clinic ophthalmic researcher who is working on developing a fully microscope-integrated OCT system for intraoperative use. “This provides direct feedback to the surgeon regarding the location and depth of the surgical intervention during surgical maneuvers, information previously unavailable with conventional surgical microscopes.” The hope is that by utilizing this information, the new technology will lead to improved surgical decision-making and patient outcomes.

Through the use of integrated OCT instrumentation, surgeons will have superior ability to differentiate between anatomical structures that appear transparent when viewed through conventional microscopes. During surgical procedures, they will be able to visualize eye tissue layers in real time to provide crucial feedback when assessing an operation’s success or level of completion. Additionally, the high-resolution anatomic information obtained with OCT may open the door to novel surgical procedures that were previously not possible without this technology.

A microscope-integrated intraoperative OCT device would enable the surgeons to directly observe a 3-D high-resolution surgical field and directly assess the field and level of intervention. While commercial portable OCT devices have been available for use in the surgical arena (either immediately before or after a surgical maneuver), they can be cumbersome and cannot provide direct guidance to the surgeon at the point of intervention; instead they require the surgeon to pause, image and then continue the procedure.

In addition to the microscope-integrated system, researchers are developing OCT-friendly surgical instruments. These novel instruments will provide surgeons with improved ability to visualize underlying tissues as well as the instruments...
with OCT imaging. Software algorithms are also being created to facilitate analysis of the dynamic surgical environment and the rapid changes that may occur following surgical manipulation. When combined with the microscope-integrated system, these advances will help to provide an integrative solution to utilizing OCT during ophthalmic surgery.

**PIONEER Study Identifying Potential Applications**

To help identify the optimal applications for intraoperative OCT, the PIONEER study was initiated at the Cole Eye Institute. It is a prospective study examining the use of intraoperative OCT in ophthalmic incisional surgery. To date, more than 500 patients have enrolled in the study, a number significantly larger than that for any previously published intraoperative OCT study. In the PIONEER study, a microscope-mounted portable OCT system is utilized for intraoperative imaging.

“From the retinal standpoint, early data suggest that the technique may be especially helpful for macular conditions such as macular holes and epiretinal membranes,” says Dr. Ehlers, principal investigator for the PIONEER study. It may also facilitate gathering of prognostic information for retinal detachments as well as information on proliferative diabetic retinopathy. Significant architectural alterations appear to occur following surgical interventions. Visualizing these changes may help guide surgeons in surgical maneuvers and in understanding when surgical objectives have been achieved.

Cornea surgeons are utilizing the technology for lamellar keratoplasty, including Descemet’s stripping automated endothelial keratoplasty and deep anterior lamellar keratoplasty. In these cases, OCT allows the surgeon to visualize graft placement, interface fluid and depth of dissection. This information can be utilized to minimize residual interface fluid prior to completing the surgical procedure. Additionally, PIONEER is examining the use of intraoperative OCT technology for cataract surgery in assessing wound construction, intraocular lens placement and capsular dynamics.

The Cole Eye Institute was recently awarded a $3 million innovation platform grant through the state of Ohio’s Third Frontier program supporting the Ophthalmic Imaging Center, including the intraoperative OCT program, and a $1 million NIH/NEI grant to support the intraoperative OCT program. Additionally, Cleveland Clinic is partnering with Duke University in a dual-center grant funded by the NIH to investigate the use of microscope-integrated OCT during ophthalmic surgery.

For more information, contact Dr. Ehlers, Dr. Srivastava or Dr. Tao at ophthalmologyupdate@ccf.org.
Optical coherence tomography (OCT) has revolutionized many aspects of ophthalmology, and the Ophthalmic Imaging Center at Cleveland Clinic’s Cole Eye Institute continues to push the envelope on its uses.

OCT has been used for several years to image the retina and the vitreoretinal interface, but not to evaluate the choroid, as it was widely believed that OCT could not obtain quality choroidal images, says Peter K. Kaiser, MD, Director of the ophthalmic Imaging Center.

“However, it turns out that the reason we weren’t imaging the choroid had to do with how we focused the OCT device. If we focused the device more into the choroid than the retina, essentially pushing the focus further into the eye, we can actually image the choroid with current OCT scanners,” says Dr. Kaiser.

This technique was first described by Richard F. Spaide, MD, of New York, who termed it enhanced depth imaging.

“There are various names for this technique, but what it really allows is evaluating the choroid, and in some cases, you can image the sclera and orbital fat,” Dr. Kaiser says.

This is important because some diseases affect the choroid in different ways, and having better information aids in diagnosis and care, he notes.

One of the earliest applications Dr. Kaiser and his colleagues have found is that the choroid is thickened in patients with central serous chorioretinopathy. In those patients, an enhanced imaging OCT scan is a much easier way to make a diagnosis than fluorescein or indocyanine green angiography.

“When you are able to see the choroid is thickened in both eyes, you know your diagnosis is central serous. We previously had no way to differentiate it from other masquerade syndromes such as age-related macular degeneration (AMD),” he says.

This is particularly true in older patients who have subretinal pigment epithelial fluid, in whom it can be misdiagnosed as exudative AMD.

“I have seen numerous patients who have been receiving anti-VEGF injections at an outside ophthalmologist’s office and they come to me for a second opinion. We do enhanced depth imaging and are able to tell them they have central serous chorioretinopathy and don’t need any injections, and in fact they have a much better visual prognosis,” he says.
Automated Software
In the past, Dr. Kaiser notes, ophthalmologists had to do manual measurements to determine choroidal thickness, which is very tedious. The Ophthalmic Imaging Center has developed automated analysis software that allows physicians to look at choroidal thickness, area and volume across the OCT scan.

Dr. Kaiser and his colleagues have made several other interesting observations about the choroid in their work. For example, patients who are very myopic have a very thin choroid. Patients with age-related choroidal atrophy have features that are not typical of macular degeneration but are still losing vision. “It is a different mechanism than macular degeneration,” he says.

Enhanced depth OCT also is useful in managing uveitis. “With treatment, you can actually see the choroidal thickness go back toward normal in many uveitic disorders,” Dr. Kaiser says.

He and his colleagues are also using enhanced depth imaging to examine retinal degeneration and ocular tumors.

“This is a field in its infancy. In the past, we couldn’t really image the choroid, so we didn’t really pay attention to it. Now that we can image it, we are looking at it in more detail,” he says.

The Ophthalmic Imaging Center is also using different-wavelength OCT systems that have different penetration than the currently available commercial spectral domain OCT devices to obtain an even better view of the choroid.

“As we do more and more scans, we learn more and more about this area,” he concludes.

For more information, contact Dr. Kaiser at ophthalmologyupdate@ccf.org.

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Cornea Modeling
NIH Award Supports Early Diagnosis and Patient-Specific Therapy of the Cornea

Fueled by a recent $2 million, five-year grant from the National Institutes of Health’s National Eye Institute, researchers at Cleveland Clinic’s Cole Eye Institute are developing new ways to measure corneal mechanical properties and put that information into clinical use.

Principal Investigator William J. Dupps Jr., MD, PhD, explains that the goal of this study is to develop patient-specific modeling for simulation-based therapy that can eventually lead to more customized treatments for conditions such as keratoconus.

“Although mechanical properties can potentially be assessed in any type of tissue, we are focusing on the cornea because it has the best clinical potential of any part of the eye, perhaps of the entire body, for harnessing mechanical measurements that can be turned into actionable clinical information,” says Dr. Dupps, who is a cornea and refractive surgery specialist with appointments in the Biomedical Engineering Department and Transplant Center at Cleveland Clinic.

“We are trying to capture three-dimensional information about corneal material strength and incorporate it into a computerized structural representation of the eye. A key part of what we are doing is developing patient-specific models so we can investigate the behavior of a specific patient’s cornea instead of studying an idealized model,” he says.

Corneal strength is not uniform across the cornea’s width or thickness, particularly in eyes with keratoconus or prior corneal surgery. Dr. Dupps hopes that being able to combine corneal shape and material properties in 3-D models will help researchers better understand the underlying mechanisms of keratoconus and postoperative corneal ectasia. More important for patients, however, would be the extension of these findings in ways that allow earlier detection of keratoconus and more effective screening of refractive surgery patients, he says.

“Our hypothesis is that differences in local corneal material properties play a direct role in determining corneal...
shape and, consequently, refractive error. For example, some of the weakening that arises early in the course of keratoconus probably occurs focally and is likely a driver of early shape changes,” says Dr. Dupps.

A recent publication in the journal Investigative Ophthalmology & Visual Science from Dr. Dupps’ lab has tested this hypothesis by simulating the impact of focal material weakness in virtual models of keratoconus.

The importance of early diagnosis is greater than ever because collagen crosslinking now provides a middle-ground treatment option between rigid contact lens use and corneal transplantation.

Collagen crosslinking, a procedure that involves stiffening the cornea, is currently in FDA studies. The Cole Eye Institute recently received Institutional Review Board approval to participate as a clinical site in the ACOS/Avedro KXL crosslinking study.

The current approach to crosslinking is to saturate the cornea with riboflavin drops for about a half hour, followed by the application of ultraviolet light for another half hour. This new study randomly assigns patients with keratoconus or postoperative ectasia to one of three treatment arms in which shorter durations of treatment with higher intensities of light are used.

“The study is currently the only industry-sponsored crosslinking trial in the U.S., and its purpose is to provide access to a very promising treatment while studying the optimal combination of treatment intensity and duration,” Dr. Dupps says.

Beyond Diagnostic Uses

Computational modeling of the cornea to achieve patient-specific, simulation-based therapy is another important aspect of the research program, he says.

“Once we have developed a number of computational models from clinical measurements, and have validated that the models accurately represent the behavior of their living counterparts, then we can begin to ask questions of these virtual eyes that would be impractical or unsafe in actual patients,” he says.

He and his colleagues are working to simulate treatment of normal myopic model eyes to see how predicted outcomes compare with actual outcomes in LASIK. In another arm of the study, the results of clinical crosslinking treatments in keratoconus eyes will be compared.
with the predicted outcomes of simulations based on the same patient and treatment.

“Once we have validated the models, we can begin to use them to modify treatments to better customize treatments to patients’ specific corneal material properties and achieve better, more predictable outcomes,” he says.

Safety
Safety is another concern, as post-LASIK ectasia can be the result of early keratoconus, undetected corneal biomechanical weakness, or a mismatch between the amount of surgery and the cornea’s capacity for maintaining a stable postoperative shape over time.

“We plan to simulate LASIK on a variety of patient models, including patients with varying degrees of keratoconus, to investigate the structural response to many patient-specific structural variables and surgical parameters. By doing hundreds of simulations in these virtual eyes with systematic changes in variables, we can do a sensitivity analysis to determine which risk factors are the most important for avoiding postoperative ectasia,” he says.

He notes that the ultimate intended application of these analyses is the creation of patient-specific treatment designs.

For example, crosslinking currently uses a standard treatment zone that encompasses most of the cornea – 8 to 9 mm. However, in previously published work from his group, Dr. Dupps has found that much greater effect can potentially be achieved with a customized treatment zone that is centered over the point of weakness.

“Instead of just stabilizing the cornea, there is great potential to actually reverse shape changes by altering corneal stiffness in a more rational way,” he says. “We are currently applying the same principle to develop treatments for more common refractive errors such as nearsightedness and astigmatism.”

For more information, contact Dr. Dupps at ophthalmologyupdate@ccf.org.
Case Study: Advanced Diagnostics Lead to Resolution of Microsporidial Keratitis

The use of electron microscopy by corneal surgeons at Cleveland Clinic’s Eye Institute can facilitate diagnosis in difficult cases. In this example, electron microscopy led to the resolution of a prolonged case of microsporidial keratitis after cataract surgery in a 70-year-old immunocompetent male who had been referred for evaluation of chronic unilateral keratitis and iritis.

Punctate keratitis and iritis had been noted within two weeks after uncomplicated cataract surgery at another facility, and progressed to an epithelial defect and presumed herpetic kerato-uveitis contiguous with the temporal cataract wound.

The patient experienced multiple flare-ups over two years that responded well to topical steroids. However, their use led to ocular hypertension.

The patient underwent penetrating keratoplasty and Baerveldt shunt placement at the Cole Eye Institute. Subsequent electron microscopy testing, performed by James McMahon, PhD, in Anatomic Pathology, revealed the presence of microsporidial stromal keratitis that had been missed previously with traditional microscopy.

Cornea surgeon William J. Dupps Jr., MD, PhD, notes that no evidence of recurrence was seen in the graft after postoperative treatment with topical fumagillin and oral albendazole. The patient’s vision corrected to 20/20 with a rigid contact lens. He is a hobby pilot and was able to resume flying after a long hiatus due to his vision problems.

Cataract surgery and local immunosuppression from the topical steroids were the only identifiable risk factors in this unusual case, notes Dr. Dupps. The clinical presentation can overlap with herpetic kerato-uveitis or infectious crystalline keratopathy and delay diagnosis and appropriate management.

“Getting this diagnosis enabled us to appropriately utilize a more suitable antimicrobial to treat the patient’s chronic infection and prevent recurrence in the graft,” he says. “Being able to decrease his steroid use through better control of the infection also was important for giving him relief and allowing us to better manage his postoperative medications.

“While electron microscopy is not a new technology, its use in this case demonstrates the value of a less commonly utilized advanced diagnostic technique,” he concludes.
Expanding the Retinal Imaging Field with Ultra-Widefield Technology

Conventional retinal imaging includes the use of a fundus camera that limits the visual field to approximately 30 to 50 degrees of the retina in a single capture. However, ophthalmologists at Cleveland Clinic’s Cole Eye Institute are using an enhanced retinal imaging technology, ultra-widefield imaging (UWFI), to visualize up to a 200-degree retinal field in a single image, which translates to nearly 83 percent of the total retinal surface.

The UWFI system used at the Cole Eye Institute is the Optos® 200Tx™ system. This technology not only generates fundus images but is also used to provide high-resolution ultra-widefield fluorescein angiograms, particularly important for imaging retinal vascular diseases and inflammatory eye disorders. In addition, ultra-widefield fundus autofluorescence is being used to better characterize diseases impacting the retinal pigment epithelium not only in the macula but also the periphery, such as degenerative retinal diseases.

Assessing Disease Burden

“Ultra-widefield imaging gives us a much better idea of the entire scope of retinal disease burden in diabetes and retinal vascular occlusive disease,” says Justis P. Ehlers, MD, vitreoretinal surgeon and Assistant Professor at Cole Eye Institute. For example, it can detect neovascularization that is present in a diabetic patient that may not be visualized with standard angiography. Because UWFI provides an overview of the entire retinal landscape in more detail rather than just a focused 30-degree field with survey photos, physicians may be able to better characterize the severity of the diseases that they are managing.

Cole Eye Institute ophthalmologists are seeking to understand how UWFI can clarify how to best manage patients based on the degree of ischemic burden. While the treatment repercussions of UWFI are not known for all retinal disorders, researchers are producing early data to learn more about the best uses for UWFI in clinical diagnosis and management.

Titrating Therapy in Ocular Inflammatory Diseases

To improve the diagnosis and measurement of ocular inflammatory activity, Cole Eye Institute ophthalmologists use UWFI, particularly fluorescein angiography. “In our patients with inflammatory diseases,
we are able to detect areas of inflammation or areas of activity that were poorly recognized on traditional angiography,” says Sunil Srivastava, MD, retinal surgeon and uveitis specialist at Cole Eye Institute, referring to a study conducted at Cleveland Clinic. He says, “At the clinic, we use ultra-widefield angiography on the vast majority of, if not all, patients with inflammatory eye disease because we get a much better assessment of what is going on with these patients.”

Most anti-inflammatory medications have varying levels of toxicity. “For this reason I monitor all of my patients with retinal inflammatory diseases who are taking these drugs with UWF angiography,” Dr. Srivastava adds. “It allows me to better titrate the dosing based on the presence of inflammatory activity.”

Cole Eye Institute ophthalmologists have determined that UWFI is especially informative in patients with retinal vasculitis. One disease, Susac’s Syndrome, has been particularly well-characterized with UWFI at the Cole Eye Institute. At the International Susac syndrome Consultation Clinic at Cleveland Clinic, one of the largest clinics in the world for assessing those with the disease, ophthalmologists have learned that UWF angiography is the best way to determine if the disease is active in the eye. Says Dr. Srivastava, “Ultra-widefield imaging makes a huge difference for these patients because it helps us decide when to intervene and treat in order to prevent vision loss.”

**Inherited Retinal Disease**

UWFI with fundus autofluorescence provides a better perspective on inherited retinal diseases. “We do ultra-widefield fundus autofluorescence on all our patients with retinal dystrophies,” explains Elias Traboulsi, MD, Head of the Department of Pediatric Ophthalmology and Director of the Center for Genetic Eye Diseases at Cole Eye Institute. While the list of retinal dystrophies is long, among the most common are Stargardt disease, retinitis pigmentosa, Usher syndrome and choroideremia. “Many of these diseases have very characteristic patterns of abnormality that we can now recognize because we can see nearly the entire retina in just one image,” he adds. No longer is it necessary to spend hours piecing together a collage of retinal images that even when complete do not capture the entire periphery.

Distinguishing between patterns of abnormalities helps ophthalmologists with differential diagnosis, often between a number of very rare inherited diseases. Cole Eye Institute ophthalmologists are hopeful UWFI will also assist in understanding the progression of these rare disorders as well as comparing the effects of treatment. “I think it is also going to be very helpful for us in following patients who will eventually become eligible for gene therapy,” Dr. Traboulsi adds. “As that becomes available, we have to have additional ways of monitoring these patients.”

For more information, contact Dr. Srivastava or Dr. Traboulsi at ophthalmologyupdate@ccf.org.
Ophthalmology practices have grown increasingly reliant on digital diagnostic image capture, and many ophthalmologists recognize a need to store, retrieve, manipulate and display such depictions in an efficient and productive manner. The images may vary from a PDF of an advance beneficiary notice from an insurance provider to a spectral domain OCT report.

The acquisition of these data can have huge financial implications during chart audits by a recovery audit contractor or when an insurance plan refuses payment for a drug without supportive documentation. It also can have a large impact on practice efficiency. A recent study presented at the Association for Research in Vision and Ophthalmology Annual Meeting showed that the implementation of a DICOM-compatible workflow reduced the need to enter or edit patient demographic information by 50 percent and reduced the need to manage misfiled images by 85 percent.

As a result, a growing number of clinicians are turning to either their electronic medical record (EMR) system or an image management system (IMS) that connects to their office’s numerous data-acquisition devices for ready access to these types of documents. Picture archiving and communication systems (PACSs) originated in the 1980s first in radiology and then cardiology. Only in the past decade have PACSs—a generic term for IMSs (the two are often used interchangeably)—expanded into ophthalmology.

Even so, the market penetration of stand-alone PACSs in ophthalmology remains small because many practitioners first tackle the job of implementing electronic health records (EHR) systems as mandated by the federal Department of Health and Human Services. The costs and implementation challenges of installing both types of systems at once are sufficiently daunting that many ophthalmologists are putting off the investment in an IMS until after an EHR system is up and running. At the same time, other practitioners and many industry observers see advantages in implementing both at once. In fact, an American Academy of Ophthalmology (AAO) survey highlighted that one of the largest barriers to EHR implementation was the lack of integration with existing imaging devices. The AAO has provided clinicians recommendations for adopting EHR and image integration systems. (Figure 1).

![Figure 1. Example of a combined clinical display (two different modalities on the same report) allowing for better decision-making.](image-url)
With the advent of any new technology such as IMSs and EHRs, potential buyers must develop a strategy to ensure that the system they acquire is right for their practice. Here’s a brief summary:

- List your diagnostic equipment inventory. Such an inventory allows you to approach EHR vendors with a clear indication of your practice’s clinical needs concerning image management and thereby ensure compatibility. Be sure to note the make, model, year, software version, Ethernet capability and DICOM conformance. These will help immensely in determining whether existing interfaces can be used to pull the images and data or whether customized work will be necessary, resulting in increased costs. In the investigation process, consider investing in newer models to improve connectivity.

- Determine your threshold for image integration. There is a lot of variability in the amount of image integration, from rudimentary to robust. Depending on the type of practice, you may find that the IMSs of the EHR are insufficient. For example, a multispecialty group practice might just want the integration of PDF reports while a retina-only practice may also need the ability to integrate OCT reading software. This exercise is critical in determining whether you will need a separate IMS — products such as Forum® (Carl Zeiss Meditec Inc.) or Axis™ (Sonamed Escalon) — or whether you can get by on what the EHR vendors are providing.

- Test-drive at trade shows. Along with the typical vendor showcases, the AAO has set up special sections at the annual meeting at the IHE Showcase. It also provides user satisfaction surveys at aao.org/aaoe/ehr-central. Plan on setting up a specific meeting time with the vendor rather than using a “drop in” approach.

- Evaluate the user interface. The adage “it’s all in the design” could not be more applicable than it is to image management in EHR systems. The user interface is where practitioners spend most of their time with the images to sort, group, manipulate and display them. If the interface doesn’t meet their standards or facilitate their understanding, then it will most certainly be underutilized.

- Talk with and visit colleagues. Before we implemented our EHR and PACS, we traveled to offices of colleagues to get a firsthand account of how the system was working in real practice. They provided honest feedback as to what was successful, what was not, where they had trouble with implementation and how to best negotiate the contract.

- Have a budget and live by it. EHR implementations can run from $50,000 to $500,000. It’s important to budget honestly for what your practice can afford. Be certain to only factor in the benefits of meaningful use dollars, but the reduced transcription fee and lower image and record storage costs.

A Shopper’s Guide
Cutting-edge Imaging Features

Last year, Cole Eye Institute installed one of the most comprehensive imaging PACS systems, which improves patient experience and physicians’ ability to interpret data rapidly. The features that relate to image management include:

1. **Images everywhere** — The ability to access patient images, regardless of the office location allows for continuity of patient care. In addition, any other physician at Cleveland Clinic can review the images, including those in primary care, endocrinology and neurology. Patients will also be able to review their images from their MyChart® account.

2. **Combined clinical displays** — This represents the greatest breakthrough in image analysis, allowing for the combination of modalities on a single report. This supports improved physician decision-making (Figure 1).

3. **Link between the PACS and Epic (Modality Worklist)** — The link allows for the proper demographic information to be passed to the camera and reduces manual entry and acquisition time for the photographers (Figure 2).

4. **Bidirectional capabilities** — Physicians have access to review software to annotate, zoom in on a particular spot or perform additional analyses. They can do this from the primary workstation and save their images to the central archive for all to see (Figure 3).

5. **Launching of the imaging system from the EHR and image sorting** — This allows for the launch of the stand-alone PACS from the EHR as well as sorting of data by laterality, dates, ordering provider and modality.

**Conclusions**

The image integration with your selected EHR can make or break your user experience. Planning and investigation are the keys to making the migration to the digital age. Cole Eye Institute has implemented one of the most sophisticated systems to date, improving both the physician and patient experience.

For more information, contact Rishi Singh, MD, at ophthalmologyupdate@ccf.org.
An open, online forum from Cleveland Clinic’s Cole Eye Institute. Impact your practice with a daily dose of insights and perspectives from us and other thought leaders.

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– Atul Gawande, MD
professor at Harvard Medical School and bestselling author of
The Checklist Manifesto

Visit clevelandclinic.org/ClevelandClinicWay for details or to order a copy.
Investigations
Clinical Trials

The following studies are either currently enrolling new patients or are pending approval by the Institutional Review Board and should be enrolling shortly:

**RETINAL DISEASES**

A Prospective, Two-Cohort, Single-Masked Study to Evaluate the Effect of ESBA1008 Applied by Microvolume Injection or Infusion in Subjects with Exudative Age-Related Macular Degeneration

**Objective:** Demonstrate a treatment effect of ESBA1008 applied as microvolume injection or infusion on retinal function and morphology in subjects with exudative AMD.

**Contact:** Rishi Singh, MD, 216.445.9497, or Gail Kolin, 216.445.4086

Ozurdex® for Diabetic Macular Edema Treated with Pars Plana Vitrectomy and Membrane Removal (OPERA Study)

**Objective:** Examine the use of Ozurdex in patients who are undergoing pars plana vitrectomy for macular edema due to diabetic macular edema.

**Contact:** Sunil Srivastava, MD, 216.636.2286, or Kim Baynes, 216.444.2566

Safety and Efficacy of Intravitreal Ranibizumab for Diabetic Macular Edema Previously Treated with Intravitreal Bevacizumab: A Randomized Dual-Arm Comparative Dosing Trial (Phase:1/2): REACT Study

**Objective:** Assess the ocular and systemic adverse events of ranibizumab for DME following previous treatment with intravitreal bevacizumab.

**Contact:** Justis Ehlers, MD, 216.636.0183, or Gail Kolin, 216.445.4086

A Phase III, Randomized, Double-Masked, Controlled Trial to Establish the Safety and Efficacy of Intravitreal Administration of Fovista™ (Anti PDGF-B Pegylated Aptamer) Administered in Combination with Lucentis® Compared to Lucentis Monotherapy in Subjects with Subfoveal Neovascular Age-Related Macular Degeneration

**Objective:** Evaluate the safety and efficacy of Fovista intravitreal administration.

**Contact:** Rishi Singh, MD, 216.445.9497, or Kathi Dastoli, RN, 216.445.5248

Prospective Intraoperative and Perioperative Ophthalmic Imaging with Optical Coherence Tomography (PIONEER Study)

**Objective:** Assess the feasibility and utility of intraoperative OCT and perioperative OCT in optimizing the management of surgical ophthalmic diseases.

**Contact:** Justis Ehlers, MD, 216.636.0183, or Jamie Reese, RN, 216.636.0183

**UVEITIS**

A Randomized, Double-Masked, Placebo-Controlled Study of the Safety and Efficacy of Gevokizumab in the Treatment of Active Noninfectious Intermediate, Posterior, or Pan-Uveitis (Eyeguard-A Study)

**Objective:** Demonstrate the superiority of gevokizumab compared to placebo in the treatment of subjects with active noninfectious intermediate, posterior or pan-uveitis. The safety of gevokizumab will also be assessed.

**Contact:** Careen Lowder, MD, 216.444.3642, or Laura Holody, 216.445.3762

A Randomized, Double-Masked, Placebo-Controlled Study of the Safety and Efficacy of Gevokizumab in the Treatment of Subjects with Non-infectious Intermediate, Posterior or Pan-Uveitis Currently Controlled with Systemic Treatment (Eyeguard-C Study)

**Objective:** Demonstrate the superiority of gevokizumab compared to placebo in reducing the risk of recurrent uveitic disease in subjects with noninfectious intermediate, posterior or pan-uveitis currently controlled with systemic treatment. The safety of gevokizumab will also be assessed.

**Contact:** Careen Lowder, MD, 216.444.3642, or Laura Holody, 216.445.3762
Open-Label, Safety and Tolerability Study of Suprachoroidal Triamcinolone Acetonide via Microneedle in Subjects with Noninfectious Uveitis

Objective: Evaluate the safety, tolerability and efficacy of an injection of triamcinolone acetonide (TA) into the SCS of human subjects using a microneedle.

Contact: Sunil Srivastava, MD, 216.636.2286, or Kim Baynes, 216.444.2566

A Phase III, Multinational, Multicenter, Randomized, Masked, Controlled, Safety and Efficacy Study of a Fluocinolone Acetonide Intravitreal (FAI) Insert in Subjects with Chronic Noninfectious Uveitis Affecting the Posterior Segment of the Eye (PSV-FAI-001)

Objective: Evaluate the safety and efficacy of an FAI insert in the management of subjects with chronic noninfectious uveitis affecting the posterior segment of the eye.

Contact: Careen Lowder, MD, 216.444.3642, or Laura Holody, 216.445.2264

THYROID EYE DISEASE

A Multicenter, Double-Masked, Placebo-Controlled, Efficacy and Safety Study of RV-001, an Insulin-Like Growth Factor-1 Receptor (IGF-1R) Antagonist Antibody (fully human), Administered Every 3 Weeks (Q3W) by Intravenous (IV) Infusion in Patients Suffering from Active Thyroid Eye Disease (TED)

Objective: Investigate the efficacy, safety and tolerability of RV-001 (a fully human anti-IGF-1R antibody) administered every three weeks for six months, in comparison to placebo, in the treatment of patients suffering from active TED.

Contact: Julian Perry, MD, 216.444.3635, or Amy Wunderle, RN, 216.636.5294

PEDiatric eye disease

Bilateral Lateral Rectus Recession vs. Unilateral Recess-Resect for Intermittent Exotropia (IXT1)

Objective: Evaluate the effectiveness of bilateral lateral rectus muscle recession versus unilateral lateral rectus recession with medial rectus resection procedures for the treatment of strabismus.

Contact: Elias Traboulsi, MD, 216.444.4363, or Sue Crowe, RN, 216.445.3840

The Natural History of the Progression of Atrophy Secondary to Stargardt Disease: Prospective Observation

Objective: Assess the rate of progression of Stargardt disease by measuring the growth of macular atrophic lesions using fundus autofluorescence.

Contact: Elias Traboulsi, MD, 216.444.4363, or Meghan Marino, 216.445.7671

Genetics

Molecular Genetics of Eye Diseases

Objective: Study the molecular genetics of ophthalmic disorders through the compilation of a collection of DNA, plasma and eye tissue samples from patients and from families with a broad range of eye diseases and malformations.

Contact: Elias Traboulsi, MD, 216.444.4363, or Sonal Uppal, PhD, 216.444.7137

Genetics of Uveitis

Objective: Identify changes in genes that may lead to uveitis.

Contact: Sunil Srivastava, MD, 216.636.2286, or Kim Baynes, 216.444.2566

Cornea/Refractive Surgery

LAsIK Flap Thickness and Visual Outcomes Using the WaveLight FS200 Femtosecond Laser

Objective: To evaluate the visual outcome, accuracy and predictability of LASIK flap thickness using the new WaveLight® FS200 femtosecond laser and compare these results to those obtained using the IntraLase™ FS60 femtosecond laser.

Contact: William J. Dupps Jr., MD, PhD, 216.444.8158, or Laura Holody, 216.445.2264

Long-Term Safety Follow-up for Subjects Previously Implanted with the AcrySof® Cachet™ Phakic Lens in Clinical Studies C-02-23, C-02-40, C-03-21 and C-05-57

Objective: Estimate the annualized endothelial cell loss rate (for up to 10 years following date of implantation) of subjects previously implanted with the L-series AcrySof Cachet Phakic Lens from clinical studies.

Contact: William J. Dupps, Jr., MD, PhD, 216.444.8158, or Laura Holody, 216.445.2264

The following study has completed patient enrollment in the past year at Cole Eye Institute and is in follow-up:

Investigator Initiated Observational Study of Intravitreal Aflibercept Injection for Exudative Age-Related Macular Degeneration Previously Treated with Ranibizumab or Bevacizumab

Contact: William J. Dupps, Jr., MD, PhD, 216.444.8158, or Laura Holody, 216.445.2264
JOURNAL PUBLICATIONS


BMC Ophthalmol.


Cornea


Exp.Eye Res.

Eye (Lond.)


Immunotherapy

Infect. Immun.

Int. J. Inflamm.


J. Comp. Neurol.

J. Neurophysiol.

J. Neurosci.


J. Ophthalmol.


Clinical Scenarios in Surgery: Decision Making and Operative Technique


Essentials of Glaucoma Surgery


Genetic Diseases of the Eye


Introducing the Louise Timken Microsurgical Education Lab

Our institute is specially designed to enable clinicians to develop tomorrow’s advances. For example, we recently received a $1 million donation from the Timken Foundation of Canton, Ohio to create a 600-square-foot ophthalmic surgical education lab. The Louise Timken Microsurgical Education Lab employs the latest advancements in synthetic models and computer simulation technology and is now the centerpiece of our residency program. It is named for the late Louise Timken, who was the first woman in the country to fly and own a jet aircraft.

Teaching Young Ophthalmologists

Residency and fellowship training is considered a high priority at Cleveland Clinic’s Cole Eye Institute and is led by outstanding faculty in a leading-edge facility. Our programs are highly competitive and produce superbly trained clinical and academic ophthalmologists.

Residency Program

Our residency training program’s mission is to prepare future leaders in patient care, teaching and vision research. The program meets all the requirements of the American Board of Ophthalmology and the Accreditation Council for Graduate Medical Education.

Four residents are matched annually in the three-year program. Residents rotate among the institute’s nine departments and at MetroHealth Medical Center, Cleveland Clinic Lakeland and Cleveland Clinic Stephanie Tubbs Jones Health Center. Residents work under the direct supervision of the staff during each rotation through:

- Cornea, external disease, anterior segment
- Glaucoma
- Neuro-ophthalmology/oncology
- Ophthalmic pathology
- Ophthalmic plastic, reconstructive and orbital surgery
- Pediatric ophthalmology and adult strabismus
- Refractive surgery
- Retina, vitreous, low vision
- Uveitis, ocular inflammatory disease and immunology
This curriculum provides a balanced exposure to all subspecialty areas of ophthalmology, ensuring graduates the ability to perform general ophthalmology with skill, knowledge and confidence. Each resident works in a one-on-one relationship with a staff physician to provide the best opportunity to study disease processes and their medical and surgical management. This arrangement also provides excellent supervision and optimal continuity of patient care in the outpatient and hospital settings.

Residents are expected to participate in clinical and basic research activities utilizing the staff’s expertise. They complete independent clinical research projects that involve reviewing the literature, developing a hypothesis, and designing and executing the study. Activities are carefully supervised by an experienced clinical investigator. Residents are expected to submit and present their research at national meetings and to write several papers for publication based on their research activities. Each June, ophthalmology residents, fellows and staff participate in the Annual Research, Residents and Alumni Meeting, a scientific forum for the presentation of research projects.

RESIDENCY GRADUATES
(June 2013)
Elisabeth Aponte, MD
John Au, MD
Igor Estrovich, MD
Sumit Sharma, MD

RESIDENTS, 1ST YEAR
(July 2013)
Maria Choudhary, MD
Joseph Griffith, MD
Nathaniel Sears, MD
Adam Weber, MD

RESIDENTS, 2ND YEAR
(July 2013)
Katie Hallahan, MD
Priyanka Kumar, MD
Tal Rubinstein, MD
Jack Shao, MD

RESIDENTS, 3RD YEAR
(July 2013)
Jedediah McClintic, MD
Stephen McNutt, MD
Karolinnne Rocha, MD, PhD
Georgios Trichonas, MD

FELLOWSHIP PROGRAM
We offer high-quality fellowship training opportunities in a variety of subspecialties to create the next generation of academic leaders in their fields. Training combines an excellent academic environment with close mentorship support.

Fellowships include:
- Two-year vitreoretinal fellowship (two positions annually/four positions total)
- One-year cornea, external disease and refractive surgery fellowship (two positions)
- One-year glaucoma fellowship (one position)
- One-year pediatric ophthalmology fellowship (one position)
- Two-year oculoplastics fellowship (sponsored by ASOPRS) (one position)
- One-year ophthalmic oncology fellowship (one position)

FELLOWSHIP GRADUATES
(June 2013)
Cornea, External Disease and Refractive Surgery
Patrick Chan, MD
Neema Nayeb-Hashemi, MD

Glaucoma
Elisa Bala, MD

Pediatric Ophthalmology
Palak Wall, MD

Vitreoretinal Surgery
Matthew Ohr, MD
Omar Punjabi, MD

CURRENT FELLOWS
(July 1, 2013-June 30, 2014)
Cornea, External Disease and Refractive Surgery
John Au, MD
Viral Juthani, MD

Glaucoma
Mona Kaleem, MD

Oculoplastics
Bryan Costin, MD

Ophthalmic Oncology
Carlos Medina, MD

Pediatric Ophthalmology
Melanie Schmitt, MD

Vitreoretinal Surgery
Robert Courtney, MD
Miriam Englander, MD
Ashleigh Levison, MD
Adiel Smith, MD

For more information about Cole Eye Institute fellowship programs, visit clevelandclinic.org/eyefellowships or contact Jane Sardelle at sardelj@ccf.org.
Distinguished Lecture Series

Feb. 20, 2014
Myeloid Wnt Ligands and a Fetal Light Response Pathway Regulate Vascular Development in the Eye
Richard A. Lang, PhD
Director of the Visual Systems Group
Professor, Department of Pediatrics
Cincinnati Children's Hospital
Medical Center
Cincinnati, Ohio

March 20, 2014
Innate Immunity in the Pathogenesis of Microbial Keratitis
Eric Pearlman, PhD
Professor and Director of Research
Department of Ophthalmology & Visual Sciences
Case Western Reserve University
Cleveland, Ohio

April 17, 2014
Investigating Mechanisms of Retinal Degeneration
Janis Lem, PhD
Director and Associate Professor
Transgenic Core Facility
Tufts Medical Center
Boston, Mass.

May 29, 2014
A New Look at Corticosteroid Actions in the Eye
Francine Behar-Cohen, MD, PhD
Professor of Ophthalmology
Ophthalmology, Hotel-Dieu de Paris
Universite Paris Descartes
Centre de Recherche des Cordeliers
Paris, France

Sept. 18, 2014
Advances in Glaucoma Surgery
Malik Y. Kahook, MD
The Slater Family Endowed Chair in Ophthalmology
Professor of Ophthalmology
Chief, Glaucoma Service Department of Ophthalmology
University of Colorado School of Medicine
Aurora, Colo.

Oct. 16, 2014
Targeting Conventional Outflow: The Next Generation of Glaucoma Drugs
W. Daniel Stamer, PhD
Professor of Ophthalmology
Professor of Biomedical Engineering
Duke University
Durham, N.C.

Nov. 20, 2014
Cataract Surgery: The New Glaucoma Procedure?
Steven L. Mansberger, MD, MPH
Vice Chair, Director of Glaucoma Services
Devers Eye Institute
Portland, Ore.
Cole Eye Institute Grand Rounds

Ophthalmologists are welcome to attend Cole Eye Institute Grand Rounds, held Mondays from 7-8 a.m. from September (beginning the Monday after Labor Day) through mid-June, except during holidays and during major meetings.

Meetings are located in the James P. Storer Conference Room, 1st Floor at Cole Eye Institute.

Residents and fellows present two or three cases at each meeting that represent outstanding teaching examples, followed by discussion. Cases may feature rare or difficult-to-manage conditions, unusual presentations of common disorders and/or leading-edge diagnosis and management. Three to four M&M cases are presented annually.

AMA PRA Category 1 Credits™ are offered through an online evaluation site and a date-specific sign-on code available at each meeting.

No registration is required. For details, please contact Jane Sardelle at sardelj@ccf.org.

Cole Eye Institute CME

Mark your calendars for continuing medical education symposia hosted by the Cole Eye Institute. You’ll gain insights into leading-edge diagnostic, medical and surgical techniques, as well as the promise that research holds for patients with ophthalmic conditions.

Neuro-Ophthalmology Update

Saturday, Feb. 22, 2014

Activity Director:
Gregory S. Kosmorsky, DO

Uveitis Update

Saturday, March 8, 2014

Activity Directors:
Careen Y. Lowder, MD, PhD, and Sunil Srivastava, MD

North Coast Retina Symposium

Friday-Saturday, May 30-31, 2014

Activity Directors:
Daniel F. Martin, MD, and Sunil Srivastava, MD

CME courses will be held at the Cole Eye Institute’s James P. Storer Conference Center. For details, or to confirm dates for any of our 2014 CME courses, please contact Jane Sardelle at sardelj@ccf.org.
Cole Eye Institute Overview

At Cleveland Clinic Cole Eye Institute, our team of the world’s foremost clinicians and researchers is committed to delivering the finest healthcare available today and to improving tomorrow’s care through innovative basic, clinical and translational research.

We believe that research and patient care are interdependent. Therefore, we forge synergistic relationships through analytical and integrative processes, such as surgical outcomes analysis. We are pioneering treatment protocols for complex vision-threatening disorders through our clinical trials and aggressive research programs to shorten the gap between the laboratory discoveries and patient care.

Cleveland Clinic’s ophthalmology program is rated No. 7 in the U.S. News & World Report “Best Hospitals” survey and top-ranked in Ohio.

Clinical Expertise

As one of the country’s leading comprehensive eye institutes, Cole Eye Institute is able to enhance the lives of our patients and to serve our referring physicians by providing early, accurate diagnosis and excellent, efficient, leading-edge care.

In 2012, we had our most productive year ever. Across all Cleveland Clinic ophthalmology locations in Northeast Ohio, we conducted 241,264 physician visits and performed 12,742 surgeries. As more of our retina and other subspecialists see patients in our community locations, we have achieved a geographic expansion that dramatically increases patient access to our services. We are proud that this is part of Cleveland Clinic’s dedication to putting patients first.

We offer primary, secondary and tertiary ophthalmologic services for all ages. Our internationally recognized staff of 45 ophthalmologists and researchers is composed almost entirely of subspecialists, and eight optometrists round out our comprehensive services.

Patient-Centered Facilities

Cleveland Clinic Cole Eye Institute offers leading-edge care at our main campus and in the community. The goal is to deliver maximum patient comfort and optimum service and quality. Our main campus building allows us to provide the full spectrum of clinical services at one location. Exam lanes, a diagnostic services suite and operating rooms are all housed in one building, with features such as:

- Windows with special filters to minimize light on dilated or newly treated eyes
- A comfortable waiting room with a special play area for children
- Valet parking and an easy postoperative pickup area
- Conveniently located food services

Fostering Innovation

In addition, our Education Pavilion with the James P. Storer Conference Center (designed with televideo technology) features video rooms, resident carrels and ample conference space. Our entire staff is committed to working with residents and fellows to maximize their growth and education as they prepare to be the leaders of tomorrow.
Unique Capabilities of the Cole Eye Institute

Electronic Medical Records
Cole Eye Institute was among the first academic centers to customize an electronic medical record for ophthalmic use. A two-year project allowed Cole Eye Institute staff across the system to share this type of record by the end of 2012. The electronic medical record integrates ophthalmic imaging and provides full access to patient histories as well as streamlines data collection.

The Center for Genetic Eye Diseases
The Center for Genetic Eye Diseases provides multidisciplinary clinical diagnostic and therapeutic services for patients with inherited eye conditions such as corneal and retinal dystrophies and microphthalmia. Patients with inherited disorders that involve the eye, such as neurofibromatosis, albinism, neurodegenerative disorders and Marfan syndrome, are referred to the center by physicians from around the country.

A regularly held specialty clinic is dedicated to patients with retinal dystrophies and their families.

National Eye Donor Program
The Foundation Fighting Blindness Center, a central collection agency for eyes donated by individuals across the United States for blindness research, shares tissue samples with researchers worldwide. Formally known as the Retinal Degeneration Pathophysiology Facility, the collection center accepts eye donations from people of all ages with normal vision or any degree of vision loss resulting from a retinal degenerative disease.

Cole Eye Institute staff members prepare a detailed medical report about each donated eye to help researchers track the effects of eye disease in different types of people and environments.
2012 Cole Eye Institute Outcomes Snapshots

182,663
Total Visits

8,054
Total Surgeries

10,020
Total Surgical Procedures (surgeries in operating rooms and all outpatient procedures)

1,807
Total Laser Procedures
Cole Eye Institute New Staff Spotlight

**Annapurna Singh, MD**

Ophthalmologist Annapurna Singh, MD, joined Cleveland Clinic in 2013. She previously served on the staffs of University Hospitals of Cleveland; Optimax Laser Centre, Leeds, United Kingdom; and Scheie Eye Institute, Philadelphia, Pa.

Her specialty interests include medical, laser and surgical treatment of glaucoma and cataract surgery.

Dr. Singh completed residencies at the University of Florida, Gainesville, Fla; and Erie County Medical Center, Buffalo, N.Y. She completed her glaucoma fellowship at Scheie Eye Institute, Philadelphia.

Dr. Singh graduated from All India Institute of Medical Sciences, New Delhi, India.

Dr. Singh practices at Cleveland Clinic main campus and Hillcrest Hospital. She can be reached at 216.445.5277 or singha2@ccf.org.

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**Palak Wall, MD**

Ophthalmologist Palak Wall, MD, joined Cleveland Clinic as staff in 2013 after completing her residency at The Ohio State University Medical Center in Columbus, Ohio. She also completed a fellowship in pediatric ophthalmology at Cleveland Clinic.

Her specialty interests include pediatric ophthalmology and strabismus, retinopathy of prematurity, and pediatric oculoplastic disorders.

Dr. Wall graduated from The Ohio State University College of Medicine and Public Health.

Dr. Wall practices at Cleveland Clinic main campus and can be reached at 216.444.4821 or walt@ccf.org.
### Cole Eye Institute Leadership

**CHAIRMAN, COLE EYE INSTITUTE**  
Daniel F. Martin, MD .......................... 216.444.0430

**INSTITUTE VICE CHAIRMAN**  
**INSTITUTE QUALITY REVIEW OFFICER**  
Andrew P. Schachat, MD ..................... 216.444.7963

**INSTITUTE VICE CHAIRMAN**  
FOR EDUCATION  
Elias I. Traboulsi, MD ....................... 216.444.2030

**CENTER DIRECTOR, CLEVELAND CLINIC FLORIDA OPHTHALMOLOGY**  
Albert Caruana Jr., MD ....................... 954.659.5000

### Comprehensive Ophthalmology

Aimee Chappelow, MD .......................... 440.988.4040  
John Costin, MD ................................. 440.988.4040  
Richard E. Gans, MD, FACS .................. 216.444.0848  
Philip N. Goldberg, MD ....................... 216.831.0120  
Michael Gressel, MD ......................... 440.988.4040  
Mohinder Gupta, MD ........................... 419.289.6466  
Shari Martyn, MD ............................... 216.831.0120

Peter McGannon, MD ......................... 216.529.5320  
Michael E. Millstein, MD .................... 216.831.0120  
Wynne Morley, MD ............................. 440.366.9444  
Sheldon M. Oberfeld, MD .................... 440.461.4733  
Stella Paparizos, MD .......................... 216.444.2020  
Allen S. Roth, MD .............................. 216.831.0120  
David B. Sholiton, MD ....................... 216.831.0120  
Scott A. Wagenberg, MD ..................... 440.461.4733

### Cornea and External Disease

William J. Dupps Jr., MD, PhD .............. 216.444.2020  
Jeffrey M. Goshe, MD .......................... 216.444.0845  
Roger H.S. Langston, MD ..................... 216.444.5898  
Peter McGannon, MD .......................... 440.529.5320  
David M. Meisler, MD ......................... 216.444.8102  
Wynne Morley, MD ............................. 440.366.9444  
Sheldon M. Oberfeld, MD .................... 440.461.4733  
Allen S. Roth, MD .............................. 216.831.0120  
Scott A. Wagenberg, MD ..................... 440.461.4733  
Steven E. Wilson, MD ......................... 216.444.5887
Glaucoma
Jonathan A. Eisengart, MD................................. 216.445.9429
Edward J. Rockwood, MD................................ 216.444.1995
Annapurna Singh, MD................................. 216.444.2020
Shalini Sood-Mendiratta, MD......................... 216.445.5277

Keratorefractive Surgery
William J. Dupps Jr., MD, PhD......................... 216.444.2020
Ronald R. Krueger, MD, MSE............................ 216.444.8158
Michael E. Millstein, MD............................... 216.831.0120
Allen S. Roth, MD.......................................... 216.831.0120
Steven E. Wilson, MD..................................... 216.444.5887

Neuro-Ophthalmology
Gregory S. Kosmorsky, DO .............................. 216.444.2855
Lisa D. Lystad, MD......................................... 216.445.2530

Oculoplastics and Orbital Surgery
Mark Levine, MD........................................... 440.988.4040
Julian D. Perry, MD......................................... 216.444.3635

Ophthalmic Anesthesia
Marc A. Feldman, MD.................................... 216.444.9088
M. Inton-Santos, MD............................... 216.445.1016
J. Victor Ryckman, MD................................. 216.444.6330
Sara Spagnuolo, MD....................................... 216.444.6324

Ophthalmic Oncology
Arun D. Singh, MD......................................... 216.445.9479

Ophthalmic Research
Bela Anand-Apte, MBBS, PhD.......................... 216.445.9739
Vera Bonilha, PhD........................................ 216.445.7960
John W. Crabb, PhD.................................. 216.445.0425
William J. Dupps Jr., MD, PhD....................... 216.444.2020
Stephanie Hagstrom, PhD............................. 216.445.4133

Retina
Amy Babiuch, MD........................................... 440.366.9444
Ryan Deasy, MD.......................................... 440.695.4010
Justis P. Ehlers, MD.................................. 216.636.0183
Peter K. Kaiser, MD.................................. 216.444.6702
Daniel F. Martin, MD................................. 216.444.0430
Andrew P. Schachat, MD.............................. 216.444.7963
Jonathan E. Sears, MD............................... 216.444.8157
Rishi P. Singh, MD.................................. 216.445.9497
Sunil K. Srivastava, MD.............................. 216.636.2286
Richard Wyszynski, MD............................. 440.988.4040
Alex Yuan, MD, PhD.................................. 216.444.2020

Uveitis
Careen Y. Lowder, MD, PhD.......................... 216.444.3642
Sunil K. Srivastava, MD.............................. 216.636.2286

Cleveland Clinic Florida
Albert Caruana Jr., MD............................... 954.659.5000
Dean Mitchell, MD.................................. 877.463.2010
Geetha Vedula, MD................................. 877.463.2010

Patient Referral Information
To refer a patient to the Cole Eye Institute, please call our referring physician hotline at 855.REFER.123 (855.733.3712).
24/7 Referrals

Referring Physician Hotline
855.REFER.123 (855.733.3712)
clevelandclinic.org/refer123

Live help connecting with our specialists, scheduling and confirming appointments, and resolving service-related issues.

Hospital Transfers
800.553.5056

About Cleveland Clinic

Cleveland Clinic is an integrated healthcare delivery system with local, national and international reach. At Cleveland Clinic, more than 3,000 physicians and researchers represent 120 medical specialties and subspecialties. We are a nonprofit academic medical center with a main campus, eight community hospitals, more than 75 northern Ohio outpatient locations (including 16 full-service family health centers), Cleveland Clinic Florida, Cleveland Clinic Lou Ruvo Center for Brain Health in Las Vegas, Cleveland Clinic Canada, Sheikh Khalifa Medical City and Cleveland Clinic Abu Dhabi.

In 2013, Cleveland Clinic was ranked one of America’s top four hospitals in U.S. News & World Report’s annual “Best Hospitals” survey. The survey ranks Cleveland Clinic among the nation’s top 10 hospitals in 14 specialty areas, and the top in heart care for the 19th consecutive year.

Download Today!

Physician Referral App

Contacting us is easier than ever before.
With our new free Physician Referral App, you will be able to view all our specialists, transfer a patient and get in touch immediately with one click of your iPhone®, iPad®, or Android™ phone or tablet. Download today at the App Store or Google Play.

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