The Collaborative Longitudinal Evaluation of Keratoconus (CLEK) Study is a multicenter observational study supported by the National Eye Institute, a division of the National Institutes of Health. The purpose of the CLEK Study is to prospectively characterize changes in vision, corneal curvature, corneal status (i.e., corneal scarring), and quality of life in keratoconus patients and to determine the factors associated with these changes across time.

Keratoconus is a progressive, asymmetric, non-inflammatory disease of the cornea characterized by steepening and distortion, apical thinning, and central scarring of the cornea. These corneal changes lead to a mild to marked decrease in vision secondary to high irregular astigmatism and, frequently, central corneal scarring. There are several characteristic biomicroscopic corneal signs which become more common as the disease progresses. These include: an inferiorly displaced, thinned protrusion of the cornea, corneal thinning over the apex of the cone, Vogt’s striae in the posterior stroma, scars in Bowman’s layer, and Fleischer’s ring (of iron in the corneal epithelium at the base of the cone, either full or partial). Although the etiology of keratoconus is unknown, keratoconus has been associated with atopic disease, eye rubbing, inheritance, and contact lens wear.

Management varies with disease severity. Non-surgical alternatives are the primary method of patient management in keratoconus. Although these visual problems in keratoconus can be managed with spectacles or hydrogel lenses early on, rigid gas permeable contact lenses are the treatment of choice for the irregular astigmatism associated with the disease. Occasionally, soft contact lenses are used with rigid lenses in a piggyback lens design.

Patients are generally referred for penetrating keratoplasty (corneal transplant) when they can no longer tolerate contact lenses or when contact lenses provide inadequate vision. Poor vision with contact lenses is often accompanied by apical corneal scarring, but vision can be compromised even with optimal contact lens correction and no corneal scarring. With concerted effort, the vast majority of patients initially referred for corneal transplants can be successfully refitted without surgery, yielding improved visual acuity and longer contact lens wearing time.

Previous, large-scale studies of keratoconus have focused on describing the disease’s incidence and prevalence, on attempting to establish disease causes, or on trends in the clinical management of keratoconus. Few have characterized the course of the disease and its associated factors in large samples of keratoconus patients. With the exception of our previous CLEK Survey, all previous studies have relied on retrospective evaluation of keratoconus patients’ medical records. None of the previous studies has characterized the relation among
cornal curvature, biomicroscopic findings, and vision in keratoconus. Although visual function (other than visual acuity) has been described in small samples of keratoconus patients, none of the large-scale studies has characterized vision and visual function beyond retrospective Snellen visual acuity measurements as recorded by an examining clinician. No surveys of quality of life in keratoconus have been performed. No data exist comparing keratoconus patients’ visual symptoms with their clinically measured visual performance. None of the attempts to stage and/or classify keratoconus has been performed in a standardized fashion.

The CLEK Study is a multicenter, prospective, observational study designed to describe the course of keratoconus and to describe the associations among its visual and physiological manifestations. Over the course of 13 months, 1,209 patients were enrolled at 16 clinics. Patients will be examined annually for at least three years. Baseline and annual visits examinations include visual acuity (high and low contrast), patient-reported quality of life, manifest refraction, keratometry, photo-documentation of the cornea, photodocumentation of the patient’s habitual rigid contact lenses, and photodocumentation of the flattest rigid contact lens from the CLEK Study trial lens set to show apical clearance (the First Definite Apical Clearance Lens, or FDACL). The CLEK Study’s goal is to identify risk factors that determine disease severity and progression in keratoconus.

Specific aims of the CLEK Study include a general description of the course of the disease and its progression as measured by visual acuity, corneal scarring, and corneal curvature. The CLEK Study will describe the distribution and rate of change in best corrected, high and low contrast visual acuity, corneal curvature, the proportion of patients developing incident corneal scarring, and the proportion of patients requiring penetrating keratoplasty.

A total of 1,209 patients were enrolled in the CLEK Study (Figure 1). By self-report, 829 (68.5%) of the patients were white, 240 (19.9%) of the patients were black, 99 (8.2%) of the patients were Hispanic, and 44 (3.4%) of the patients were a mix of other ethnic categories. Men comprised 35.9% of the sample. The age distribution of the patients is shown in Figure 2 (mean age = 39.29 years ± 10.90 years (sd). One hundred eighteen of the patients (9.8%) entered the CLEK Study with one eye having undergone a corneal transplant in one eye prior to the Baseline Visit (54 in the right eye and 64 in the left eye).
The majority of the patients were corrected with contact lenses in both eyes (892 of 1,209 or 74%); of these, 571 of 892 (64%) also used glasses in some capacity. A small proportion of patients (3.6%) did not utilize any visual correction for either eye at baseline. Sixty-five percent (790 of 1,209 patients) wore rigid contact lenses in both eyes, and 8% (94 of 1,209 patients) wore rigid contact lenses in one eye only.

We surveyed for a history of Down syndrome, Marfan syndrome, focal dermal hypoplasia, Ehlers-Danlos syndrome, infantile tapetoretinal degeneration, oculodentodigital syndrome, osteogenesis imperfecta, and Rieger's anomaly, not a single patient reported having any of these diseases. Six hundred thirty-nine patients (52.9%) reported having hay fever or allergies, 180 patients (14.9%) reported having asthma, and 101 patients (8.4%) reported having atopic dermatitis. Cardiovascular disease was present in 74 patients (6.1%), diabetes mellitus was present in 23 patients (1.9%), and two patients reported having cystic fibrosis.

Of the 896 patients for whom contact lens comfort was assessed at baseline, 652 (72.8%) reported their contact lenses as comfortable in both eyes. Ninety-six patients (10.7%) reported both contact lenses as irritating, and 147 patients (16.4%) reported one lens as uncomfortable and the other as irritating.

One hundred sixty-three patients (13.5%) reported a family history of keratoconus in either a parent, sibling, child, aunt, or uncle.

Ninety percent of the patients had entrance vision of 20/40 or better, and 95.5% of the patients had best corrected vision of 20/40 or better. Forty-five percent of patients had similar entrance visual acuity in both eyes. Sixty-three percent of patients had entrance visual acuity of 20/40 or better in both eyes. Approximately one-half of the patients had equal visual acuity in both eyes. Compared to the entrance visual acuity, a higher proportion of patients achieved at least 20/20 best corrected visual acuity in both eyes. A small proportion of patients had best corrected visual acuity worse than 20/60 in either eye.

These initial baseline results are useful in characterizing the patients enrolled in the CLEK Study. As the study continues and we begin analyses of subsequent years' data, changes in these parameters will be useful in achieving the CLEK Study's specific aims.

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A Word from the Chair...

Over the course of the year, the CLEK Chairman's Office receives a number of inquiries as well as general comments from interested individuals mentioning a wide variety of topics related to keratoconus. We are very pleased to have the honor of sharing a poem with our readers that was sent to us. The poem is a personal reflection on behalf of the author and appears as it was presented. The poem first appeared in the newsletter of Moorfield's Eye Hospital, Keratoconus Support Group, 1993.

We hope that you enjoy this reflection as much as we did. Reprinted with permission from the author.

On having Keratoconus - a prayer

Dear God, I do not mind that by some freak of heredity
You have blessed me with this rare eye disease.
In the course of which my corneas
Depressed of collagen
Grew progressively more cone shaped
And my vision blurred.

But I wish you would instruct the other people in your world
To treat me more kindly, intelligently and compassionately
So that I may tolerate its inconveniences more easily.
Serve you more gloriously and more effectively
And worry those who love less.

Please tell them not to say to me
Rudely and impatiently
O stop complaining and wear glasses
For in their infinite ignorance
They do not know that I cannot see with glasses
Only with hard contact lenses
And Eventually someone dying
Must donate their corneas
So that I may see.

The cruel outside world does not understand
How hard it is to constantly invert and remove the lenses
And how they slip and slide upon our eyelids
And visly lost—not covered by insurance.

But expensive to replace, although our need is not cosmetic
But crucial to our daily function.
The latest research gives us hope
If not for us at least for our progeny
It may be possible to isolate the gene artificially and alter
Or supply the collagen artificially before the disease develops.

Please, O you godlike scientists
Spare some time for us
We live longer than the average
Are intelligent
And
Worth
Helping.
Corneal Topography Reading Center Started

A new study resource center has been added to the CLEK Study arsenal, the CLEK Corneal Topography Reading Center (CTRC for short). This new center will be housed at the University of Illinois at Chicago, under the direction of Tim McMahon, OD. The CTRC will collect data from the 15 study centers around the country, establish a longitudinal data base, and in concert with the Coordinating Center, analyze these data.

The CTRC will be staffed by a research assistant, Stephanie Walker Cooper, on a part-time basis and supervised by a part-time study coordinator, Laura Kistler Brown, who is on temporary loan from another study, Robert Anderson, PhD from the School of Public Health at the University of Illinois at Chicago will serve as the biostatistician for the Center. Thomas W. Raasch, OD, PhD at The Ohio State University College of Optometry will be a consultant to the Center.

An advisory group to the Executive Committee of the CLEK Study was formed two years ago to develop the rationale and methods for evaluating corneal topography measures for the CLEK Study. The CTRC is a direct result of the efforts of this group. The Topography Analysis Group (TAG), headed by Loretta Szczypta, OD, MS from University Hospitals of Cleveland/Case Western Reserve University, will continue to advise and direct the CTRC in its effort to contribute to the overall CLEK Study analysis goals. The other members of TAG are Nina Friedman, OD, MS, at University of California, Berkeley; School of Optometry, Larry Davis, OD from University of Missouri-St. Louis College of Optometry, Robert Anderson, PhD, Thomas Raasch, OD, PhD and Timothy McMahon, OD.

Corneal Topography: What is it and why do we need to measure it?

Keratoconus affects the cornea. The thinning and scarring that are hallmark clinical features of this disorder affect vision primarily through associated deformities in the curvature of the cornea. In essence then, keratoconus interferes with vision by warping the shape of the cornea. When the shape of the cornea is warped, vision is only partially corrected by glasses. Contact lenses are frequently prescribed because they can mask the deformities. This is accomplished by using a rigid contact lens over the distorted cornea. The rigid surface of the lens remains smooth and regular, while tears fill in the

Studies, such as CLEK, provide the scientific community with a wealth of knowledge and an abundance of jargon. The final testing procedure during your examination (the one where several rigid contact lenses are placed on your eyes and photographed) has received the moniker “FDACL.” FDACL translates to First Definite Apical Clearance Lens. The FDACL protocol was developed specifically for the CLEK Study as a measure of disease severity and progression in keratoconus. Traditionally, the corneal “curvature” has been measured using the keratometer. The keratometer was designed to measure spherical surfaces with smooth contours; keratoconus corneas tend to be irregular in shape. Recently, videokeratography (topography) instruments have been used to provide information regarding corneal curvature and shape. Although this technology has been extremely useful in better understanding the corneal surface and has aided in diagnosing early keratoconus, the instrument’s computer software was primarily developed to evaluate regularly shaped corneas.

FDACL was designed to determine the height of the cone (steepest part of the cornea) in keratoconus. The FDACL protocol determines the flattest lens in the CLEK Study trial lens set that exhibits an apical clearance or steep fit. The CLEK Study Group published a study showing FDACL to be a repeatable and valid method of determining disease severity in keratoconus. We are currently preparing a manuscript for publication to report the most popular methods of fitting rigid contact lenses in keratoconus. The fitting curvature on the back surface of CLEK Study patients’ own rigid contact lenses will be compared to the FDACL back surface curvature to determine current trends in prescribing rigid contact lenses in keratoconus. In other words, we will determine how flat or how steep keratoconus patients’ contact lenses are fitted.
space between the lens and the cornea. Under these conditions, the front of the contact lens acts like a smooth cornea, and vision is typically quite good. Unfortunately, corneal distortion is not the only source of vision problems in keratoconus, so contact lenses do not completely hide the effects of the disease. Disorganization of structural elements within the cornea and scarring also contribute to causing vision problems that contact lenses wear will not alleviate.

This picture represents the average CLEK right cornea at the baseline visit. The contours represent the optical power, and how it varies across the surface of the cornea.

Because distortion of the cornea is a very important part of keratoconus, it is very valuable to measure and track this distortion to gauge disease progression and to determine if there are associations with other features of living with the disorder such as quality of life, vision, likelihood of, or need for corneal transplant surgery, etc. We describe the measurement of the shape of the cornea as corneal topography. We can assess corneal topography by a variety of means, and we use three of these in the CLEK Study. The first is a measurement known as keratometry. Each CLEK patient has had this simple measurement taken several times. The “business end” of this instrument has a single white ring with plus and minus signs located on the outside of the ring. Keratometry gives us a very precise but limited picture of the curvature of the central cornea. Videokeratography employs a series of white concentric rings projected onto the cornea. These instruments produce the fancy color maps of corneal curvature. The color coding per-

mits the doctor and our analysis team, to analyze upward of 6000 data points spread all over the cornea. Corneal topography is a rapid and viable means to assess the effects of keratoconus on corneal curvature over a much broader area of the cornea than keratometry. Our First Definite Apical Clearance Lens (FDACL) measurement (the one where we put on a bunch of different lenses and then take pictures of two lenses on each eye) is a measure of corneal “height” which is related to curvature in our setting.

With these three sets of data accumulated over the course of the study we hope to characterize the breadth and extent of corneal topography changes that occur with keratoconus and discover if there are predictable relations with other study measures. It is too early to know exactly what we are going to find. We’ll keep you posted!

What have we learned from photography?

First, we’ve learned that the photographic and reading systems are reliable. This is important to the scientific integrity of the study. We’ve also learned that it is helpful for maintaining quality control for the study.

We have seen things that have not been seen before including in some eyes the observation that the Fleischer’s ring (deposition of brown hemosiderin material thought to be located at the base of the “cone”) actually extends beyond this area. This may help us better understand the progression of keratoconus.

Cornell photograph illustrating scarring. In the baseline CLEK data, only 31% of right eyes had scarring (similar to left eyes). Most of the scarring is less than is illustrated here.
Q. Is there a "right time" for corneal transplant?

In general, keratoconus patients undergo corneal transplants as an elective procedure. It is very rare to have the keratoconus "get so bad" that surgeons must perform the procedure. People generally elect to have the surgery either when they can no longer tolerate contact lenses and/or when the contact lenses do not provide adequate vision for their everyday activities.

Q. How do I find a skilled corneal surgeon?

The best way is to ask a trusted eye care practitioner. If you have been seeing an optometrist, for example, for your contact lens fitting, he or she probably has experience with corneal surgeons in the area and can recommend someone. Alternatively, if it is someone you’ve located through the Yellow Pages, local medical society, or the Internet, be sure that your surgeon is Board Certified in Ophthalmology, was educated in a corneal fellowship following his or her ophthalmology residency, and performs more than just a few corneal transplants each year. These are all evidence of expertise.

Q. Would you explain what a piggyback lens and a Softperm lens are?

A piggyback lens system is one in which the patient wears a soft contact lens with a rigid gas permeable lens over it. Each lens is cared for separately, although with compatible solutions, and the lenses are inserted separately. A Softperm, or so-called hybrid lens, is actually a rigid gas permeable lens center bonded to a soft lens "skirt." The lens is inserted and cared for as a single lens.

Q. What is the association between severe ocular trauma and keratoconus?

We are not sure if there is a connection and, if there is, what the nature of it would be. We have had some hint from the CLEK Study data that there may be an association, but it is not a straightforward one. We also do not know if keratoconus that appears to result from trauma might have actually been present in a subtle form before the trauma.

Q. I was planning on having "RK" surgery. My eye doctor diagnosed keratoconus and would not perform the procedure. What is the reasoning for this?

Radial keratotomy (RK) is a procedure where radial incisions are made that go part of the way through the cornea to flatten the central cornea and correct nearsightedness. It has not been so popular since the development of laser procedures for the correction of nearsightedness. One of the problems with RK is its unpredictability. The irregular curvature and protrusion of keratoconus only make RK more unpredictable, and the thinned keratoconic cornea would make the "most of the way through" the cornea incisions in RK very difficult to accomplish safely.

Q. I am 21 years old and have just been diagnosed with keratoconus. Is this the typical age for onset of this disease?

This is a common age for the diagnosis of keratoconus. However, in some cases it could be diagnosed years prior to this age or even as late as the 30s. Actually the "onset" may be long before the person notices that something is wrong (blurred vision) or before the doctor detects it with special instrumentation.

Q. I have been wearing hard contact lenses for over 22 years (before the days of gas permeable lenses). I was diagnosed with keratoconus a few months ago. Did my hard contact lenses contribute to this disease?

We do not believe that hard or rigid contact lenses cause keratoconus. However, there is literature with suggestive possibility. If keratoconus has a genetic cause, then you were destined to have it regardless of contact lens wear. There is recent biochemical evidence that contact lenses could complicate keratoconus, but at this time, we strongly believe the benefits of the best vision obtained with state-of-the-art rigid gas permeable contact lenses far outweigh any potential risks.
Q. Does excessive eye strain from tasks such as computer-related work have any effect on my keratoconus?

Although eye strain from tasks like computer work may be irritating, it is not likely that it causes the keratoconus to worsen. However, ask your doctor if other eye problems may be part of the problem, such as focusing difficulties or problems with coordination of the eyes. Sometimes special reading glasses and, in some cases, vision training can be helpful.

Q. Have I been diagnosed with keratoconus in one of my eyes. Will I be predisposed to contracting this disease in my unaffected eye as well?

Our data suggests that less than 10% of cases of keratoconus are unilateral. We believe most people end up with keratoconus in both eyes. It is common for one eye to be somewhat better than the other.

Q. I have keratoconus with a scar on one cornea. How can my vision be corrected?

Sclaring is a part of the natural course of keratoconus. The scarring generally occurs later or in more advanced stages of the disease. We believe scarring contributes to a decrease in vision and is not a simple issue to correct. Wearing rigid contact lenses will likely improve your vision compared to glasses at this point. If the vision is not “good enough”, that would represent one of the indications for a corneal transplant operation, to replace the affected cornea with a healthy cornea.

Q. I have keratoconus in both of my eyes. I have undergone corneal grafting surgery in my right eye. I am wearing normal glasses now. My left eye is not severely affected. What can I expect in the future?

Great question. The simple answer is we don’t know. There doesn’t appear to be a predictive relationship where having one transplant means the other eye will need one. On the other hand, keratoconus is a “progressive” disorder, meaning things tend to worsen with time. The rate of progression is highly variable and goes nowhere is some folks and in some eyes. We hope that the CLEK Study will give us further “statistics” to better answer this question. Stay tuned.

Q. What is cornea transplant surgery? Is it the same as corneal grafting surgery?

Corneal transplant surgery is the same thing as corneal grafting surgery. The formal name for the operation is “penetrating keratoplasty”. This operation consists of removing the central 2/3 or so of the cornea and replacing it with donor cornea cut to the same shape. The tissue is sewn into place with very tiny sutures. The sutures hold the tissue in place until it can heal. This process takes months. The surgery is very common and is quite successful. In fact the best success with corneal transplant seems to come in eyes with keratoconus. Even though the operation is highly successful, we wait until glasses or contact lenses no longer are sufficiently helpful because the risks associated with the surgery are great than those found with glasses or contact lenses. We manage the risks vs. the benefits throughout the course of the disorder, adding risk only when it makes sense in terms of the benefits gained.

Q. My wife has been recently diagnosed with keratoconus. We are expecting our first child. Will my children inherit this disease?

The cause of keratoconus is not known. The issue of this disease being a hereditary disease pops up from time to time – this is one of those points in history where the issue of a hereditary origin for keratoconus is a popular one. A few lack. Somewhere between one-in-eight and one-in-ten families have other family members somewhere in their family tree with keratoconus. All the rest don’t. Therefore the likelihood that your children will have the disease is very small. On the other hand, when we look at family members of subjects with keratoconus using corneal topography measurements (color coded maps of the corneal surface) a little over half those family members will have unusual corneal topography suggestive of keratoconus, but no other signs or symptoms of the disease. Therefore, the jury is still out as to whether keratoconus is a inherited disease or not. Clearly, the chance of one of your kids developing the symptoms of the disease is less than one-in-seven.

Q. I have been diagnosed with keratoconus for the past 5 years. I started wearing gas permeable hard contact lenses, and I experience scratching with much pain and discomfort. Should I stop wearing my lenses?

Q. Does excessive eye strain from tasks such as computer-related work have any effect on my keratoconus? Although eye strain from tasks like computer work may be irritating, it is not likely that it causes the keratoconus to worsen. However, ask your doctor if other eye problems may be part of the problem, such as focusing difficulties or problems with coordination of the eyes. Sometimes special reading glasses and, in some cases, vision training can be helpful.

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Q. I have been diagnosed with keratoconus for the past 5 years. I started wearing gas permeable hard contact lenses, and I experience scratching with much pain and discomfort. Should I stop wearing my lenses?
If you experience excessive discomfort, pain or blurred vision while wearing your rigid contact lenses, you should consult your eye care practitioner. Discomfort may indicate the need for contact lens refitting or modification to your current lenses. It may also be indicative of a compromised cornea and the need for treatment with eye drops or temporary discontinuation of contact lens wear.

Q. Is keratoconus more common in males or females? Does hormone therapy play a role in this disease?

Approximately 60 percent of the 1,200 keratoconus patients enrolled in the CLEK Study are male. It has been reported in the literature that hormone supplements may cause minor steepening of the cornea's curvature, but these changes are probably not clinically significant in affecting the natural course of keratoconus. More important clinically, hormone therapy may increase symptoms of dry eye leading to decreased lens tolerance and reduced wearing time.

Q. Does wearing contact daily for 14-16 hours per day affect the physical integrity of my eyes?

Your contact lens practitioner will prescribe a maximum safe wearing schedule for your rigid contact lenses. This recommendation will be based upon the health of the corneas as observed with the slit lamp biomicroscope.

Q. Is there anything that can be done to alter the progression of keratoconus?

In the past many eye care practitioners felt that rigid contact lenses should be fitted flat relative to the curvature of the cornea to retard or decrease the progression of keratoconus. Concerns were raised that fitting the lenses too flat could result in insult to the corneal tissue and resulting scar formation. The current thought is that rigid contact lenses should be fitted only to optimize vision and comfort, not to alter the course of the condition, and the lenses should only lightly touch the cone.

Q. I will be relocating and am interested in locating a CLEK Participating Clinic in my new area. Can you help?

We can help! There are 15 CLEK Participating Clinics nationwide in addition to the CLEK Chairman’s office. We value your continued commitment to this very important project. Study office staff members are available to service you and may be contacted at the following locations:

The Ohio State University
College of Optometry
Chairman’s Office
Study Coordinator: Jodi Malone, RN
(614) 292-6603

University of Alabama at Birmingham
School of Optometry
Study Coordinator: Maria Voce
(205) 934-6734

University of California, Berkeley
School of Optometry
Study Coordinator: Pamela Quailley, MA
(510) 642-5456

University Hospitals of Cleveland and Case Western Reserve University
Department of Ophthalmology
Study Coordinator: Stephanie Schach, MA
(216) 844-7408

Gundersen Lutheran
Study Coordinators: Jill Nelson, COT or Janet Hess, COT, NCLC
(608) 782-7300

University of Illinois-Chicago
Department of Ophthalmology
Study Coordinator: Jamie Putz, COMT, NCLC
(312) 996-5410

Indiana University
School of Optometry
Study Coordinator: Lee Wagoner, MHA
or
Study Coordinator/Technician: Donna K. Carter, BGS, A5
(317) 265-4893

UCLA School of Medicine
Jules Stein Eye Institute
Study Coordinator: Lillian Andaya, NCLC, COA
(310) 206-6351

University of Missouri-St. Louis
School of Optometry
Study Coordinator: Amber Reeves, MA
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Northwestern Eye Institute
Study Coordinator: Cheryl Haefele, COT
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SUNY State College of Optometry
Principal Investigator: David Libassi, OD
(212) 790-5057

University of Utah
Department of Ophthalmology
Study Coordinator/Technician:
Marie Cason
(801) 581-3357

CLEK Participating Clinics

The CLEK Website is located at:
http://www.optometry.ohio-state.edu/CLEK/default.htm
It's Library Time! If you have not used your library card recently, it's time to get it out, dust it off and head for your favorite location and secure your choice of CLEK publications:


Electronic Network for Keratoconus Patients and Eye Care Practitioners

Mark J. Mannis, Director of the Cornea and External Disease Service and Professor of Ophthalmology at the University of California, Davis, and Karla Zadnik, Assistant Professor and CLEK Study Chairman at The Ohio State University College of Optometry, co-moderate a network for keratoconus patients called "keratoconus-link".

The network continues to grow, with 302 new members hopping on board since February 1997. The network now boasts 528 members! Join us for lively discussions about keratoconus in general, contact lenses wear, corneal transplant experiences, and a variety of other issues.

To reserve your new subscription, simply send an e-mail message to:
listproc@ucdavis.edu

In the body of your message, type:
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Postings for discussion should be sent to:
keratoconus-link@ucdavis.edu

For more information (other than to subscribe), Drs. Mannis and Zadnik can be contacted at:
mjmannis@ucdavis.edu or zadnik.k@osu.edu