The Journal of the Association of Schools and Colleges of Optometry

OPTOMETRIC EDUCATION

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Teaching Communication Skills: An Australian Optometry Program's New Course

Idiopathic Macular Hole: A Teaching Case Report

Case-Based Student Performance: Socratic Method vs. Passive Presentation

Scholarly Productivity Related to Academic Rank in Optometric Faculty

Subconjunctival Hemorrhage and Diabetes: A Lesson Learned: A Teaching Case Report

Also Inside:

Association of Schools and Colleges of Optometry

The Association of Schools and Colleges of Optometry (ASCO) represents the professional programs of optometric education in the United States. ASCO is a nonprofit, tax-exempt professional educational association with national headquarters in Rockville, MD.

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INDUSTRY NEWS

The following companies support ASCO's national programs and activities benefiting the schools and colleges of optometry in the United States and Puerto Rico.*

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** As of Oct. 1, 2014*

New Scholarship Honors Lens Inventor

Essilor has established the Bernard Maitenaz Scholarship for third-year optometry students. One winner will be selected annually for the $10,000 award, which is administered by Optometry Cares – The AOA Foundation.

The scholarship honors Bernard Maitenaz, inventor of the Varilux lens and one of the foremost authorities in optical science and engineering. He worked at Essilor for 43 years and served as chief operating officer, chief executive officer and chairman of the company. For more information and application requirements, visit www.aoafoundation.org.

Scholarship Winners Reception to be Held

VSP Global will host a reception to present its scholarship awards to the class of 2015 winners from U.S. and Canadian schools and colleges of optometry. The reception will be held Nov. 13 (during the 2014 American Academy of Optometry annual meeting) at 4 p.m. in Room 102 of the Denver Convention Center. Deans and professors of the winning students are encouraged to attend.

In partnership with the American Optometric Foundation, VSP provides the scholarships, totaling $160,000, along with a travel grant to attend the American Academy of Optometry annual meeting, to 40 students who are near the top of their class academically and clinically and plan to pursue a private-practice career.

Professional Services Director Joins Team

Irwin Kronenberg is Marco's new Director of Institutional Sales and Professional Services. Kronenberg has 35 years of experience in the industry, including most recently as Vice-President of Sales and Marketing for Reliance/Haag-Streit. With Marco, he works with the schools and colleges of optometry to ensure that the company continues to provide exceptional support.

Irwin Kronenberg

More information about Marco and its products can be found at www.marco.com, and Irwin can be reached at ikronenberg@marco.com.

New Retina Camera is Fully Automated

Topcon has unveiled its new, fully automatic TRC-NW400 Non-Mydriatic Retinal Camera. Using the TRC-NW400, operators do not need to spend time aligning, centering, focusing or capturing color retinal images because the unit automatically performs these steps once the camera is positioned in front of the eye. It also automatically travels from one eye to the other when both eyes are being imaged.

The instrument can be operated from any angle because it incorporates a rotating touch panel monitor. The TRC-NW400 can also take photographs of the anterior segment. Fully DICOM-compliant, it can be connected to a digital capture system or used as a stand-alone instrument. Visit www.topconmedical.com.

High-Cylinder Lens Now Readily Available

Johnson & Johnson Vision Care Inc.'s Acuvue Oasys Brand Contact Lenses for Astigmatism are now the first and only silicone hydrogel toric contact lenses with -2.75 cylinder that are readily available, with no need to special order.

Visit www.acuvue.com/products-acuvue-oasys-for-astigmatism for more information.

Collaboration for Better Eye Health

Transitions Optical recently released highlights from a roundtable discussion it hosted on the topic of improving the eye health of culturally diverse populations. Participants included representatives from the optical and general health industries, as well as representatives from cultural, community and health-based organizations. According to Transitions, the strong link between eye health and overall health/quality of life necessitates that eyecare professionals (ECPs) – and the optical industry as a whole – collaborate with the general healthcare sector and other experts to promote eye health education and provide optimal eye care.

The discussion included strategies ECPs can employ to increase collaboration with general healthcare professionals, including promoting ongoing referrals by initiating relationships with local primary care physicians and other health specialists; encouraging the sharing of eye health and medical records via fax, mail or electronic medical records, providing ongoing education and resources to general health professionals about eye health issues; initiating joint educational programs/promotions, particularly during awareness months such as American Heart Month in February; and participating in local community outreach efforts or health screenings alongside other health professionals.

The panel also discussed strategies for connecting with families and cultural organizations. A consensus paper based on the roundtable discussion will be available at MyMulticulturalToolkit.com.

Also: Transitions released a poster and online education course, "Riding the Age Wave," to help ECPs educate patients on how normal aging affects vision and to advise them on options for treatment that will restore, maintain and enhance vision (Brainshark.com/Transitions/AgeWave).

Student and Alumni Programs at Expo

According to officials with International Vision Expo West, a record number of optometry students participated in programs designed for their benefit at this year's meeting. Among the events available to them was the newly launched Young Professionals Club. Also, for the first time, receptions were hosted for alumni of three of the schools and colleges of optometry.

International Vision Expo says it is proud to offer a program that encompasses all phases of an optometrist's career and notes that, because each school and college of optometry is unique, benefits and programs can be tailored to meet specific needs. For more information, contact Professionals Relations Manager Kristen Reynolds at KReynolds@thevisioncouncil.org.

Contact Lens Educational Event

Bausch + Lomb held a two-day workshop for eyecare professionals Sept. 15-16 in Las Vegas, where they could learn about MoistureSeal technology, the innovation behind the company's innovative silicone hydrogel Ultra contact lenses, hear from colleagues who have successfully incorporated the lenses into their practices, and experience the new technology for themselves.

Bausch + Lomb received FDA marketing clearance for the frequent replacement and monthly modality contact lenses in September 2013. Visit www.bausch.com for more information.

Allergan Academic Partnership

Allergan is dedicated to supporting optometrists throughout all phases of their careers, and the Allergan Academic Partnership is the foundation of that support. We strongly believe that a commitment to optometric teaching institutions is a commitment to the future of optometry. The Allergan Academic Partnership program offers a full spectrum of resources, including:

The Allergan Academic Partnership Support Team

- Academic Development Manager—Liaison between Allergan and your institution's leadership teams
- Teaching Institution Sales Team—Representatives who provide product education to ensure faculty, residents, and students have a thorough understanding of the Allergan product portfolio
- Eye Care Business Advisor Team—Specialists who offer a suite of sophisticated, customer-focused practice management programs and services

Student Support

- Travel grants to attend *Optometry's Meeting*®
- Practice management education through Private Practice Clubs
- Expert guest lecturers on Allergan products and common ocular diseases
- 3D patient counseling app to educate patients in clinics on 7 common eye conditions
- American Academy of Optometry (AAO), American Optometric Student Association (AOSA), and National Optometric Student Association (NOSA) support

Resident Support

- Travel fellowships to attend AAO
- Interview skills training program to help prepare for future career opportunities
- Resident-practitioner networking event to assist in identifying potential employment opportunities
- Advisory board held at the Allergan corporate office to help us find the best ways to support students and residents
- Sponsorship of important events such as orientation, Resident's Day, and graduation

Faculty Support

- Product education and samples for patients who need them
- Allergan product presentations featuring nationally recognized experts in the field of optometry
- Allergan advisory board composed of faculty and administrators who provide direction on how to best support optometric teaching institutions
- ASCO Benefactor-Level Supporter
- Faculty conferences, grand rounds, and faculty retreats

Institutional Support

- Unrestricted grants to support continuing education of optometrists
- Sponsorship of award banquets, White Coat Ceremonies, graduations, and alumni events
- Practice management resources provided by the Allergan Business Consulting Services Team
- Philanthropic support provided through The Allergan Foundation
- Inspirational programs featuring *InfantSEE* and Tom Sullivan

For more information, contact: Mark Risher, Senior Manager, Optometric Academic Development (Risher_Mark@allergan.com)

EDITORIAL

Can We Judge High Quality Scholarship?

Aurora Denial, OD, FAAO

Scholarly activity has become an essential component in the careers of most optometric faculty and can be vital in career advancement, but evaluating scholarship can be a formidable task. Faculty and promotion review boards are faced with the difficult challenge of demonstrating or judging the quality and impact of scholarship. Faculty often employ qualitative measures, such as external review by an expert or colleague peer-review, to help establish the quality of scholarship with promotion review boards. Scholarly activity can be broadly defined to include the discovery, integration, application and teaching of knowledge.[1] The knowledge becomes scholarship when it is assessed by peers and made public.[2] The process of dissemination most often involves the publication of scholarship and the peer-review system.

The peer-review process is one standard for establishing the quality of scholarship. Scholarship is reviewed, critiqued and judged by experts in the field before acceptance for publication. Overall the process works well to ensure high quality publications. However, the peer-review process is not foolproof and all reviewers may not share equitably in the time, talent or motivation needed to accomplish an unblemished process.

There are a number of metrics dedicated to evaluating scholarship. Research into these metrics can be overwhelming and confusing. Each method has a specific purpose with limitations impacting usefulness and accuracy. Any method based on citation counts has inherent weaknesses. These weaknesses include content of the database (e.g., quantity and type of journals indexed, inclusion of conferences) and self-citations and context of citations (e.g., citations in editorials, letters to the editor). Impact factor, h-index and altmetrics are commonly used methods of judging journals and scholarship and are discussed here to provide readers with some insight and baseline knowledge.

Impact factor, as reported by the Web of Science, is a "measure of the frequency with which the 'average article' in a journal has been cited in a particular year or period ... Thus, the impact factor of a journal is calculated by dividing the number of current year citations to the source items published in that journal during the previous two years."[3] Impact factor cannot be used as a measure for an individual manuscript. It is often inferred that publishing in a high impact journal is an indication of a high quality paper. This is flawed thinking because it is based on an assumption that high impact journals only accept high quality manuscripts. Because impact factor reflects an average, a small number of highly cited papers can skew the data and contribute to a high impact factor. Journal policy can also influence impact factor. Journals that favor review articles, which are more frequently cited than research articles, can have artificially high impact factors.[3] Additionally, there is controversy about whether impact factors can be independently reproduced.[4] In addition to impact factor, other metrics, such as acceptance rate, immediacy index, cited half-life, aggregate impact factor, source normalized impact per paper and Eigenfactor, are applied to journals.

What metrics are available for judging individual scholarship? The h-index, sometimes called the Hirsch index or number, was created by Jorge Hirsch and has been in use since 2005. H-index is used to measure the quantity and quality of an individual's work.[5] The index is based on an individual's most cited papers and the numbers of citations the papers have produced.[5] Although this method takes into account both quality and quantity of an individual's work, it is not without criticism. The database used to identify and tally total publications and citations can impact and vary

the final h-index.[6] Therefore, for example, the h-index calculated from Scopus vs. Web of Knowledge may be different. The h-index can be used within a discipline but not across disciplines.[7] My research revealed that h-index values are prevalent in the sciences, and baselines for comparisons can be found in the literature. However, h-indexes are not as prevalent in the healthcare fields, and baselines may be difficult to find. Because the h-index involves number of publications, its usefulness can be limited in the earlier years of a career or a short career.

The growing use of technology and changing times has influenced the development of a new set of tools for evaluation, known as altmetrics, which can be used to judge journals or individual scholarship. Altmetrics can include the number of times an article was viewed, downloaded, bookmarked or cited. The use of altmetrics for determining quality of publications is still new and controversial. Altmetrics may only demonstrate engagement rather than true quality or impact. For instance, a controversial paper may have many tweets but demonstrate low quality or little impact in science or medicine.

Faculty members and promotion review boards face a difficult task when assessing promotion information. It is apparent to me that accurate, reliable and fair judgement of scholarship, especially when that scholarship is outside an individual's area of expertise, is a challenging task. Judging scholarship by using several metrics may prove to be the most beneficial method. Even though the assessment of scholarship remains challenging, the goal of faculty should be a consistent pattern of high quality scholarship.

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Don't Miss It

Check your Inbox on or around December 19 for the announcement that the Winter 2014 issue of ASCO's online newsletter *Eye on Education* is available.

In addition to the news from the schools and colleges and industry that you've come to expect, the issue will include the story behind ASCO's new logo and updates on the Association's various initiatives.

In the meantime, you can visit the ASCO website at www.opted.org for a wealth of tools and information, including the latest press releases, Faculty Directory, Optometry Resident Directory, 2013-2014 Annual Faculty Data Report and past issues of ASCO publications.

Working Toward a More Engaging Gross Anatomy Course for Optometry Students

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Anatomy is commonly taught using didactic lectures, emphasizing clinically relevant facts and guiding students through the body by cadaveric dissection with the help of atlases and clinical cadaveric images.[1-3] Students are expected to independently study from recommended atlases and textbooks. This general didactic approach has been substantially improved with wider availability and more reliance on models, imaging, simulation and online tools[2,4-6] to enhance the learning experience. In addition, team-, problem- and case-based learning strategies (TBL, PBL and CBL)[1,4,7-12] are being adopted at many institutions to make learning more interactive. Although the importance of multimodal teaching has been widely recognized and assessed, the didactic tools of anatomy education are in need of overhauling and updating, especially in regard to keeping up with the pace of technology and the tech savviness of today's average student. A challenge is the widespread belief among optometry students that their future profession "begins and ends in the orbit." The failure on the part of many students of health sciences other than medicine to recognize the importance and necessity of the "big picture" makes the task of teaching anatomy especially challenging.

Here, we describe how several new teaching tactics were introduced into a Gross Anatomy of the Head and Neck course for students of optometry. The additions were meant to encourage self-directed learning and included modified elements of TBL/PBL, online anatomy resources and video-podcasts (i.e., vodcasts) of the upcoming dissections. The goal was to highlight the relevance of knowledge of gross anatomy of the head and neck to the students' future profession and make the learning experience intuitive by supplying frequent clinical correlates. We report how students perceived the implementation of each new element, highlight issues that arose and make suggestions for improvements as we deem appropriate.

Course Design

The course taught in 2011 was structured as a standard didactic anatomy course consisting of lectures, clinical presentations by student groups and dissections. At the end of each lab, an in-lab quiz (n=5) was given. See **Table 1** for the value of each of these assignments.

Table 1
Original and Revised Course Components

Component	Percent of Final Course Grade	
	Original	Revised
Midterm written examination	20	20
Midterm practical examination	20	20
Final written examination	20	20
Final practical examination	20	20
Introductory take-home quiz	4	4
Attendance	2	2
In-lab quizzes	8	N/A
Team dissection tagging	N/A	8
Clinical presentations	6	N/A
Peer evaluation (n=2)	N/A	4
Jung Typology Test	N/A	2
Total	100	100

Prior to the beginning of the 2012 course, a class-appointed representative of the preceding year's class was interviewed to gain insight into how the different elements of the course resonated with the class. The primary goal was to use the information gained from student feedback to create a revised course that meets the curriculum's requirement and is also didactically organized to be intuitive, clinically focused and fun. The most frequent critique was the request for more guidance prior to performing the dissections (in addition to the requirement to read the dissector).

2012 revised course design: new features

In response to the feedback, several new elements that were considered helpful were added. Others, perceived as not helpful, were omitted. The course grading rubric was revised to reflect the increased emphasis on team learning (especially team dissection tagging and peer evaluations).

Team selection

Working as a team doing dissections promotes both psychosocial development and attitudes towards professionalism and teamwork.[1,9,11,13] Teams were not selected alphabetically as was previously done. Instead, students were asked to complete a short Jung/Myers-Briggs-style typology test online (http://www.humanmetrics.com/cgi-win/jtypes2.asp) and supply their four-letter result to the new course director. The individual results were used to assemble heterogeneous teams based on typology and to prevent students from choosing their teams based on pre-existing cliques. Details about the main temperaments are found online (http://www.myersbriggs.org/my-mbti-personality-type/my-mbti-results/how-frequent-is-my-type.asp).

Vodcasts

In response to the most frequent request for more guidance before lab, the course director created vodcasts for the students to view ahead of lab. A vodcast is a narrated video presentation. The vodcasts described the order of dissection (based on Grant's Dissector 14th Ed.) for the day, showing suggestions and useful images and pointing to additional resources. The 10- 15-minute vodcasts were created using the recording feature in PowerPoint 2010 and were uploaded to Blackboard for the students to access. Previewing the vodcast was recommended to the students, and it was stressed that it did not replace the requirement to pre-read the dissector.

Prosection

To provide additional "hands-on" help to the students, the course director performed each dissection by himself prior to the dissection day. This prosection was fitted with four tags per lab, each representing a key structure of the respective lab. This provided an authentic template for the dissection the students were going to perform.

Team tagging dissections for grades

To give concrete goals for dissection, each team was assigned four items per lab (different items per team as far as possible). This created a sort of permanent practice practical exam, and — as the correct tagging of the structures contributed to the overall grade (see below) — enhanced motivation and engagement during lab time. In addition, teams that found especially good structures, e.g., well-dissected and of representative anatomy, noted this on a white board in the anatomy lab for all other teams to review.

Special topics day

To show and underscore how gross anatomy of the head and neck is related to optometry, a "special topics day" was initiated after the midterm examinations. This day had two parts. During the first two hours, the students were asked to solve clinical anatomy case studies working in their assigned teams. Following this session, faculty from the School of Optometry gave guest lectures, highlighting how the disciplines of optometry and gross anatomy are inter-related.

Peer evaluation

As done frequently in TBL, the students were asked to fill out peer evaluations at midterm and at the end of the course. There are many different ways peer evaluations can be used.[14-16] For example, they may or may not count as part of the grade. It was decided to use graded peer evaluations, the assumption being that the students are (mature) adults, know the causal link between work and reward, and appreciate that everybody will be held responsible to a small degree for their actions, or lack thereof. In total, the peer evaluations made up 4% of the final grade. Design of the questionnaire was as described by Michaelsen et al.[14,17]

Bonus points on final practical and written exam

On the final written and practical exams, a total of six bonus questions were included (three practical and three written). The rationale was two-fold: 1) there was no curving or rounding of grades, 2) to compensate (or overcompensate) for any points lost in peer evaluations.

Interactive media and other resources

To make lectures more interactive, to enhance the learning experience and to account for attendance, an audience response system (ARS) was used. Studies have shown that along with real-time feedback, ARS usage correlates positively with student performance on summative examinations.[18] By asking specific on-topic questions throughout the lectures, the students were able to self-assess their anatomy knowledge.

Students were granted access to the anatomy lab for study 24/7. Apart from their dissections, there were also a number of anatomical models available for study. Today's students are generally very computer and tech savvy. An increasing amount of interactive online resources are available for anatomy training. As stated by McNulty and colleagues, "The future of anatomy teaching must rely more on visual aids outside of the dissection room as students who accessed web-based, computer-aided instruction resources scored significantly higher on examinations than students who never accessed the online content."[6] With this in mind, several select online and interactive resources were pointed out to the students. These included the award-winning Aclands DVD Atlas of Human Anatomy,[19] access to 3D Human Anatomy Software (Primal Pictures Interactive Anatomy, Anatomy.tv) and links to other academic institutions' anatomy homepages that contain learning modules and dissection videos (University of Michigan, University of Wisconsin School of Public Health).

Unfortunately it was not possible to separate the lecture day from the day of the corresponding dissection. To compensate for this, several changes and additions to the course content were made. The introductory, open-book take-home quiz on the introductory chapter of the required anatomy text was kept with the intention to help introduce out-of-class expectations and serve as a potential motivator because it counted toward the course grade. Lecture time was reduced from two hours to approximately one hour, and lab time was extended from two to three hours per session. There was a voluntary open-lab session on Wednesday for two hours where instructors were present and students could come to lab to study and receive guidance if needed. Also, on the weekend before the midterm examinations, instructors were available in the anatomy lab for several hours each day.

Outcome and Student-Derived General Course Critique

The average grade in the class was 84.5%. One student withdrew, and one student failed the course. None of the students objected to the team selection strategy by typology test.

Students indicated the vodcast was a very helpful tool that facilitated the following dissection in lab. However, despite the vodcast, dissector pre-reading assignment and other available resources, students often came to lab underprepared.

The prosection was frequently used by the student groups as a guide and reference, and tagging the dissections for points resonated well with the students in general. Students indicated the special topics session was beneficial because it allowed them to work together at solving clinical cases.

The least favored element of the course was the peer evaluations and the fact that they counted for a portion of the final course grade (albeit small). It was perceived that peer evaluations "are not really fair." The students exhibited a strong dislike of being required to rate their peers' accountability (e.g., preparedness, sharing knowledge, timeliness). The majority of students attempted to give all of their peers full scores in all rubrics, making it necessary to distribute a "clarification on peer evaluations," which possibly exacerbated the general resentment of this form of evaluation.

As there was no curving or rounding of grades, and also due to the great discontent about graded peer evaluations, bonus questions were included at the final examinations as described previously.

The optional, instructor-facilitated lab time on Wednesdays was poorly attended. Predictably, attendance increased closer to examinations, and on the weekend before the midterm examinations the majority of students went to lab at some time. It should be noted that it was not possible logistically for instructors to be in the anatomy lab on the weekend before the final exam, which caused some discontent among the students. Online resources were not used frequently, or at least students did not report using them.

Team selection using the typology test seemed beneficial, as no signs of disharmony were observed among the teams. Despite the indication that vodcasts were helpful in preparing for dissection lab, the fact that many students would still come to lab underprepared highlighted the unwillingness of some individuals to actually utilize these and the other available resources without the direct pressure of an examination on the content, e.g., a pre-lab exam. Due to this lack of voluntary pre-class preparation, in the future, it is planned to introduce a "readiness assurance test" (Michaelsen, 2004) based on the dissection and the pre-reading material.

Having numbered tags on the prosection together with an identifier key gave students quick access and confirmation of vital structures without instructor help and encouraged self-directed study. Although grading tags necessitated extra time for the instructors in lab, the time was in general negligible, and it was very beneficial for the students to have basically all structures they were responsible for tagged across their respective dissections. Also, having specific structures as goals kept dissectors communicating with each other and increased team cohesion.

Students indicated the special topics session was beneficial because it allowed them to work together at solving clinical cases. In the future, to maximize student team cohesion and productive interaction, we plan to use more of a TBL approach for the entire course. Inviting faculty from the School of Optometry as guest lecturers also resonated very well with the students. Although the main goal of creating a clearer tie between optometry and gross anatomy was achieved, one concern was the additional specific information and the depth at which it would be required for the final examination. To put the students' minds at ease, only specific questions about the most quintessential message from each of the guest lecturers' presentations were asked.

If a graded peer evaluation system is to be used, it has to be unmistakably clear in the instructions how points can be allotted. In the future, correct completion of these evaluations will count towards the grade, but the evaluation will not influence their peers' grades.

Predictably, the students appreciated the inclusion of bonus questions, a feature that will be continued in the future.

Conclusion

Teaching anatomy to health professions students who do not perceive the need for the course creates special challenges. Highly specialized areas such as head and neck anatomy can be particularly challenging, no matter how creatively they are packaged. The implementation of technology such as vodcasts or approaches such as preparing a prosection for review and using graded team dissection tags can be valuable instructional methods that are well-accepted by students. Emphasis needs to be on specific preparation for the dissection and there should be constant reminders of how this relates to the students' future profession. A TBL-based approach may also be an efficient way to ascertain student preparedness (readiness assurance) and facilitate interactive learning (with structured team application activities).

In this course, we have tried to unite several different learning methods, supported by a light scaffold of CBL/PBL/TBL strategies. We learned that, in line with

the saying "you can lead a horse to water but you can't make it drink," even if a variety of learning tools are available to students they still may not study before lab. This conundrum may be alleviated with a full-on TBL approach, which includes short, individual and team-readiness assurance tests before lab.

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ANNOUNCEMENT

A Message from the World Council of Optometry (WCO)

The WCO is holding its first World Congress of Optometry in Colombia next year.

This event, which will take place in Medellin, Colombia, Aug. 14-16, 2015, in conjunction with the Federacion Colombiana de Optometras (FEDOPTO), will feature speakers and delegates from all over the world. Join your colleagues for the latest in continuing optometric education combined with exciting social events that highlight the culture of Colombia.

We look forward to seeing you in Medellin — a thriving city of culture, tango and beautiful scenery!

Rural Healthcare Pilot Clinic: Low Vision Clinical Video Telehealth

Carolyn Ihrig, OD

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Uncorrectable vision loss due to conditions such as macular degeneration and diabetic retinopathy restricts travel (especially by automobile) and is one of the barriers to receiving low vision rehabilitation faced by partially sighted individuals who live in rural areas. In 2011, the U.S. Department of Veterans Affairs (VA) Blind Rehabilitation Services (BRS) began pursuing innovative care delivery strategies to help veterans with visual impairment, especially those residing in rural or highly rural areas. The intent was to improve access to care and increase patient satisfaction. It is likely that family members and/or friends of the visually impaired are more willing to drive a few miles to a local VA healthcare facility instead of several miles to a specialty clinic.

As part of the strategy, funding was sent to VA facilities for the purchase of telehealth equipment. Telemedicine continues to advance and has been critical to improving health across rural regions. VA Telehealth Services clinics are set up around the country for cardiology, neurology, psychiatry, etc. Ophthalmology/optometry clinics within several VA hospitals utilize store and forward (S&F) technology for telehealth encounters, sending digital retinal images for medical opinions or diagnoses.

This Educator's Podium describes the ongoing pilot low vision clinical video telehealth clinic at our facility, the Buffalo VA in western New York.

The effective delivery of low vision rehabilitation services utilizing telehealth is not without challenges and requires significant planning. A significant challenge in this case was to implement the telehealth services without compromising the Buffalo VA's Vision Impairment Services for Outpatient Rehabilitation (VISOR) comprehensive vision rehabilitative care, which includes individualized adjustment programs. A main challenge for low vision telehealth in general is that specific optometric testing, such as visual acuity measurement, lensometry, refraction, ocular health assessment, and confrontation visual fields, cannot be performed through clinical video telehealth (CVT). Therefore, a team approach was developed, which involved the low vision optometrist at the Buffalo VA VISOR clinic and the local primary care optometrists/ophthalmologists at three rural VA facilities up to 105 miles away. Accessing and utilizing specific clinical information from local eyecare providers (VA and non-VA) allows low vision rehabilitation to be completed by a low vision optometrist via CVT.

Setting Up the Pilot Clinic

The Cisco TelePresence PrecisionHD USB camera, which delivers high-definition business-quality video, is set up at the Buffalo VA VISOR clinic. This technology enables a face-to-face experience with remote participants over the network as if they are in the same room (telepresence). Cisco Jabber licensed video software (previously called Movi) is deployed on the VA network and allows extended video communication. The value VA derives from telehealth is not in implementing telehealth technologies alone, but in how it uses the technologies to target care/case management to facilitate access to care and improve the health of veterans.

To establish our pilot program, telehealth clinical coordinators at the provider site (Buffalo VA) and at the three rural clinical sites (up to 105 miles away) worked with the VISOR team. The coordinators: 1) facilitated the ordering, setup and training with the telehealth equipment with our BRS team; 2) established and implemented service agreements between the various facilities; 3) hired telehealth clinical technicians (TCTs); and 4) trained the TCTs on the proper use of the telehealth equipment. Designated days and times were set up for clinical video telehealth appointments on the provider side and the patient side to enable proper scheduling and documentation.

Our low vision/blind rehabilitation VISOR team traveled and met the telehealth clinical coordinators and technicians at the rural sites to observe the telehealth clinical room and list the low vision equipment available for demonstration and training with patients.

Patient location

The patient's ocular health and refractive status need to be determined by either the local or VA optometrist/ophthalmologist. This comprehensive eyecare examination appointment is necessary before a telehealth low vision evaluation can be scheduled because it cannot be performed through CVT. Specifically, to maintain continuity of care with patients and their VA eye doctor and telehealth low vision optometrist, the following are necessary:

- unaided distance and near visual acuities
- current spectacle correction with distance and near acuities
- refraction with best-corrected visual acuities at distance and near
- visual field testing (confrontation or electronic)
- other relevant tests results
- current diagnosis and treatment options.

The VISOR low vision optometrist reviews the electronic health record of each patient who has been evaluated by the local VA optometrist/ophthalmologist. For veterans who are followed by a local non-VA eyecare provider, a letter is sent to request clinical information. The local eye doctor completes the form and returns the document by mail or fax to the clinic. The reported clinical information from services that can only be done face-to-face is reviewed by the low vision optometrist. Provided the information is current and sufficient, a request for a telehealth consult is submitted to the patient's local VA.

Next, the patient is called by a TCT and scheduled for a one-hour low vision telehealth evaluation with the Buffalo VISOR low vision optometrist followed by a one-hour telehealth assessment with a BRS therapist. For both appointments, the local VA TCT is with the patient in his or her designated local office with appropriate CVT equipment. Each local site varies with regard to the low vision adaptive devices that are accessible for the low vision optometrist or BRS therapist for directing the TCT to properly assist the patient.

TCTs do not require specialized training on the proper utilization of low vision devices prior to the telehealth evaluation. They have been trained on the proper use of telehealth equipment only. The ultimate success of this CVT program depends on the equipment working properly, enabling the provider, patient and TCT to see each other "video face-to-face." Observation through CVT allows the low vision optometrist and BRS therapist to properly educate and train each patient with the help of the TCT.

Provider location

A low vision optometrist provides a low vision CVT rehabilitation evaluation, which is similar to a face-to face evaluation in that it is a thorough assessment of a patient's functional vision so that he or she can receive the appropriate help in coping with the obstacles to independent living that can lead to depression. **Figure 1** illustrates the provider's use of the equipment, viewing the monitor showing the two people on the "patient side." This creates a "video face-to-face" clinical setting. **Figure 2** illustrates how the two people on the patient side can see and speak to the provider through their camera and monitor. In this example, the visual and auditory information helps the patient understand the proper use of the device. Having a family member or a TCT with the patient is helpful as needed if the patient has difficulty seeing, hearing or understanding the provider. The provider can verify visually and verbally also.

The BRS assessment consists of low vision therapy and home adaptive skills training to help patients cope with the obstacles they face. Proper training and education begins during, but is not limited to, the first visit (CVT or face-to-face). A face-to-face low vision rehabilitation follow-up appointment is scheduled by the BRS at the patient's home to assess other areas of adaptive living skills as needed, which includes a home safety checklist, orientation and mobility training, computer access training, etc. The current vision-related activities assessed (core areas) are meal management, home management, financial management, family

Figure 1
The provider side of the low vision telehealth clinical setting.

care management, communications, personal care, leisure time activities, job site adaptations, orientation and mobility, low vision devices, CCTV use, computer access training, and other. Whether low vision services are initially CVT or face-to-face, results are unique to each patient.

Discussion

CVT currently allows low vision rehabilitation with a low vision optometrist and a blind rehabilitation specialist at the Buffalo VA in a timely manner, without the need for the patient to travel several miles. CVT and the team approach involving highly qualified professionals who are dedicated to optimum vision rehabilitation enable each patient to maximize his or her independent abilities by beginning low vision rehabilitation as early as possible. In the private sector, further information is needed to assess whether insurance carriers will compensate providers for telehealth vision rehabilitation services in satellite private offices.

The challenges faced during the low vision telehealth evaluation include patients not remembering to bring their glasses on the day of their appointment. During a face-to-face low vision evaluation, trial lenses can be used to demonstrate the effective use of their documented prescription, but trial lenses are not readily available on the patient side of CVT. While the initial low vision evaluation in this pilot clinic is conducted using CVT, interventions — prescriptions, provision of low-vision devices and BRS home visits — are similar.

Other challenges include patient hearing loss. Some patients have difficulty understanding the provider through the speakers. Having a family member or TCT present during the evaluation is helpful, as he or she can repeat instructions at a closer distance to the patient. Another disadvantage is the inability to demonstrate and train all devices available during the CVT session because each facility carries a limited variety. Communication via CVT assesses initial needs and enables an early discussion of options available. Scheduling face-to-face follow-up home visits within days of the initial telehealth assessment provides ongoing training as needed. Subsequent home training (VA or non-VA) could be expanded if the patient's home personal computer technology has the appropriate capabilities, i.e., the therapist (provider side) must be able to view the patient with a family member (patient side) using his or her personal monitor. Further information is needed to assess whether insurance carriers and/or Medicare will pay providers for telehealth vision rehabilitation services utilizing the patient's own technology.

The low vision CVT clinic at the Buffalo VA began scheduling patients in November 2012 with one low vision CVT clinic per week. That number has been increased to three to five per week. Patients have provided positive feedback, noting they appreciate the CVT program because it allows them to receive services they would not otherwise be able to receive. This positive feedback is encouraging in light of our plan to expand our CVT program to eight additional rural VA community outpatient centers within the southern tier of western New York. This expansion also includes home-based primary care and is currently in progress. In the future, a retrospective review of medical records of participants will assess the validity of this unique pilot low vision clinical video telehealth clinic.

Figure 2
The patient side of the low vision telehealth clinical setting.

Book Review

Scholarship Reconsidered: Priorities of the Professoriate

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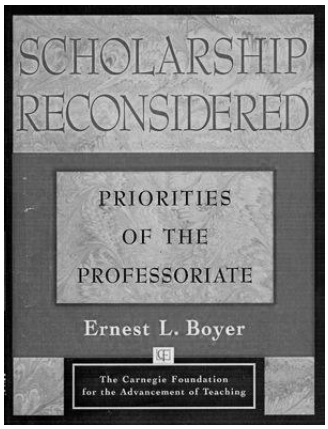

As a new faculty member in a new optometry program I quickly became eager to develop and refine my understanding of optometric and vision science as well as academic and professorial dogma. I recognized that one does not become an academic optometrist by simply being an optometrist employed by an academic institution. A new set of skills, a novel array of experiences and a unique vocabulary must also be developed. I turned to *Optometric Education* to expedite this process and perhaps discover the scholarly canon upon which experienced faculty have founded careers. I discovered several articles referencing Ernest L. Boyer's book "Scholarship Reconsidered: Priorities of the Professoriate."[1] Although it is not a new publication (first published in 1990), introducing — or reintroducing — its topics and principles can be beneficial as new personal and academic cultures are being defined.

In his preface, Boyer states that it is an important obligation of colleges and universities "to break out of the tired old teaching versus research debate and define, in more creative ways, what it means to be a scholar. It is time to recognize the full range of faculty talent and the great diversity of functions higher education must perform." For some, this may be too big of a jump to take. In his first chapter, "Scholarship over Time," Dr. Boyer illustrates that education has always been an industry comfortable with shifts of this magnitude. He explains that our current education system blossomed from colonial colleges established before the American Revolution whose goals were "building character and preparing new generations for civic and religious leadership." Our system today is filled with universities, colleges, junior colleges, liberal arts colleges and technical schools, all designed to provide knowledge, experience and guidance through a myriad of potential career paths. With each change, education has not abandoned any of its ideals but has added more. This has translated into more being required of faculty. These requirements demand dynamic individuals with innumerable skill sets and large capacities for comprehension.

It seems only appropriate that such a dynamic body be defined and evaluated by accomplishments in several areas of scholarship instead of just one. Boyer has outlined these areas as: 1) the scholarship of discovery, 2) the scholarship of integration, 3) the scholarship of application, and 4) the scholarship of teaching. If these categories sound familiar it is likely that you have read them on ASCO's website within the publication guidelines of *Optometric Education*.

The scholarship of discovery is the noble pursuit of new knowledge. Although Boyer in his book is attempting to redefine scholarship, he does not lessen the emphasis placed on research. He quotes medical writer Lewis Thomas when he observes, "It was basic science of a very high order, storing up a great mass of interesting knowledge for its own sake, creating, so to speak, a bank of information, ready for drawing on when the time for intelligent use arrived." Discovery is an essential part of the learning process.

Not only is discovery required of faculty, but also of our students. Early in the optometric curricula we present students a large amount of information, the fruits of discovery, with the hope that it will be called upon later for "intelligent use." It is easy to see with this illustration, that knowing is simply not enough. The knowledge gained must be effectively utilized.

Yet no one can predict what change will result in academic or clinical environments from the discovery of new knowledge. For that reason, Boyer states, "We strongly affirm the importance of research - what we have called the scholarship of discovery. Without the vigorous pursuit of free and open inquiry this country simply will not have the intellectual capacity it needs to resolve the huge, almost intractable social, economic and ecological problems, both national and global. Nor will the academy itself remain vital if it fails to enlarge its own store of human knowledge. But to define the work of the professoriate narrowly — chiefly in terms of the research model — is to deny many powerful realities."

The scholarship of integration in the words of Boyer is "Interpretation, fitting one's own research — or the research of others — into large intellectual patterns." By finding and defining

these connections, more windows open to unique research in the area of overlapping specialties. "Multidisciplinary" has become a trendy term in academia, including in health care. If there is one good thing that comes from systemic pathologies, such as diabetes, it is that they have the ability to create collaboration between healthcare providers. This allows professionals with differing specialties an opportunity for common ground and to treat the patient as a whole. The scholarship of integration is becoming more and more important as we are constantly reminded that no organ is an island.

The scholarship of application is the process of using knowledge to engage an institution or a problem. Not all knowledge is appropriately applicable, and sometimes it requires application to reveal this. Boyer mentions that new intellectual understandings can arise out of the very act of application, whether in medical diagnosis, serving clients in psychotherapy, shaping public policy, creating an architectural design, or working with the public schools. In activities such as these, theory and practice vitally interact and one renews the other. Boyer also asks a very profound rhetorical question: "Can problems themselves define an agenda for scholarly investigation?" This statement highlights the fact that knowledge does not always first need to be discovered then applied, but that one can be the inspiration for the other.

The scholarship of teaching indicates that teaching both "educates and entices" future scholars. This skill has its place among the other three as, according to Boyer, "the work of the professor becomes consequential only as it is understood by others." The communication and relay of information is a mere facet of teaching, which also requires engagement, understanding and knowledge. Advancements in the technique of teaching have the potential to help thousands of students and potential scholars.

Teaching is a unique skill required of faculty, and because of this Boyer recommends that even as early as graduate school, students who are likely to go on to academic careers be introduced and instructed on classroom techniques and course administration. He also recommends that in order for this redefinition of scholarship to have long-staying power the scholarship of teaching needs to be "vigorously assessed." Whether by peers, self or students, critique of teaching ought to be performed. He does not mention one specific method for doing this, but notes that course items such as class goals and procedures, course outlines, descriptions of teaching materials and copies of evaluation tasks should all be assessed. His hope in this scholarly pursuit is one shared by Kenneth E. Eble, a University of Utah academic whom he quotes: "Do less counting of our own and our colleagues' publications and more thinking about what we do day-to-day which will never be published. Do less longing to arrive at the higher goals of academe and more about making wherever you are a livable and interesting and compassionate community."

Dr. Boyer recognized that a serious commitment from those in charge of structuring contracts (and therefore expectations) would be required for this definition of scholarship to be accepted and properly utilized. He advocates that there be "career paths that provide flexibility and change" as "faculty renewal is essential." He also proposes that faculty expectations and related evaluation not only be broadened but that they be individualized and continuous as well. And "if faculty are to build on their strengths and contribute constructively to the institutions where they work, evaluation criteria must be tailored to personal talents, as well as campus needs."

In all, "Scholarship Reconsidered" does not shine a light on where academia is, but where it should move. I'm motivated that this book has been recognized by authors in the journal of *Optometric Education* and that the field is already seeing its impact. I look forward to my career as an academic optometrist and am thankful that inspiring texts such as "Scholarship Reconsidered" exist to help illuminate and direct my scholarly efforts.

Reference

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EDUCATOR'S PODIUM
Submission Guidelines

Educator's Podium is an opinion-based, nonpeer-reviewed forum for optometric educators to share, think and question within any area related to the educational process or improving patient care. Send submissions (500-1,500 words) and a 150-word synopsis for Facebook to journal Editor Dr. Aurora Denial at deniala@neco.edu.

Teaching Communication Skills: An Australian Optometry Program's New Course

Rob Brandenburg, Doctor of Counselling
Konrad Pesudovs, BscOptom, PhD

Abstract

After a review of the literature, the authors describe the experience of developing and teaching a new communication skills course at Flinders University in South Australia. A follow-up survey indicated that optometry students fully embraced the course and reported that their communication skills had been enhanced in 20 specific domains. The specific skills/tasks for which the most improvement was reported included the ability to accurately reflect feelings and content back to the other person, allowing time for silence, being more self-aware when communicating, and relating effectively with a person who is emotionally distressed.

Key Words: *communication skills, optometry, education, teaching, curriculum*

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Introduction

Effective communication skills are considered a critical element of the optometrist-patient relationship and an essential element of successful optometry practice. In its "Code of Conduct for optometrists," for example, the Optometry Board of Australia (OBA) emphasizes the importance of developing relationships with patients that are built on openness, trust and good communication.[1] The OBA describes a range of specific communication skills required for patient care, including listening, compassion, responding to questions respectfully and treating each patient as an individual.

The purpose of this article is to identify and explore a range of possible strategies and approaches for the development and effective teaching of a dedicated communication skills course within an optometric education program. First, we review the relevant literature. Second, we describe the key elements of a communication skills course introduced at Flinders University. Third, we report the findings of a student survey regarding the effectiveness of the new course in terms of reported changes in student confidence levels for 20 specific communication skills or tasks. We also summarize student feedback in the areas of curriculum structure, teaching methodologies, assessment tasks, learning outcomes and faculty expertise/effectiveness.

Literature Review

Within the optometric education literature, there has been some limited discussion regarding the need to teach optometry students effective communication skills to ensure that they become effective practitioners. Kaplan[2] presented the view that any communication skills course taught within an optometric program needs to emphasize effective interprofessional communication. Kaplan described an elective course at the University of Houston that focused on helping students to develop their interview skills. For the first six weeks of the semester, students attended formal lectures and participated in role-playing before undertaking a written examination to determine whether they could progress to the clinical phase. Students

were also required to learn a range of relevant psychological terms and concepts in order to help them understand patient behavior. Kaplan believed that "there is a carryover to a private practice setting" of the communication skills that students developed throughout the course but presented no data to support this claim.

Levine[3] advocated the need for teaching affective skills (that focus on feelings and emotions) in optometric education programs. He was of the view that the "art" of optometric care is not inborn and can be acquired as part of the clinical experience. The author described an elective communication skills course within the optometry program at Pacific University that emphasized the importance of specific counseling skills such as reflection, confrontation, summation, clarification, closed and open questioning, and directive and indirective leading. Students developed their "attending skills" in a range of role-play situations. This involved: " … facing the patient squarely, maintaining good eye contact, leaning slightly toward the patient, maintaining an open posture, and remaining relatively relaxed. Psychological attending skills include listening to both the verbal and nonverbal messages of the patient, while at the same time being attentive to one's own verbal and nonverbal behavior."

Australian academics Thompson et al[4] commented that it is a common misconception that communication skills are immutable and entirely dependent on personality, and firmly believed that these skills can be taught to optometrists. Using questionnaires and interviews, they surveyed 65 new patients who required contact lenses for the first time and concluded: "Aspects of the patients' satisfaction were significantly influenced by specific interpersonal communication skills of the clinician optometrist [including] empathy, information exchange, willingness to explain, clarity of instructions and optometrist comfort in the interaction. ... The results of this study are consistent with those from other health care settings which show that doctor-patient relation is important in determining patient outcomes and success with treatment."

Wallis[5] reflected on the range of skills required by professional optometrists and concluded that communication and affective skills are highly important. He lamented that communication skills, while so essential for safe and effective practice, were not usually taught in optometric programs. He expressed the view that an optometrist without effective communication skills "becomes a technician, or worse, a machine."[5]

British optometric academics Howard and Ehrlich[6] identified seven specific communication skills they believed were important, including the physical setting, helping the patient to feel at ease, the use of appropriate questioning techniques, active listening, summarizing information, avoiding jargon, and breaking information into small chunks. They also promoted the need for optometrists to be able to effectively communicate with patients from different cultural backgrounds and with a range of patient age groups. Howard and Ehrlich suggested optometrists video-record and review their consultations as part of an ongoing commitment to professional development. Presumably they would see a similar role for the video-recording and reviewing of simulated/standardized patient (SP) interactions as part of student learning at university.

In a 2008 article in *Optometric Education* on interacting with patients, Gross et al emphasized the importance of effective communication skills to ensure that interpersonal exchanges are "empathetic, easily understood, culturally competent and compassionate."[7] They advocated the need for well-designed curricula and suitable pedagogies in optometric education. Their pilot survey of 88 third-year and 44 fourth-year students at the Illinois College of Optometry indicated that despite an array of patient encounters during their clinical experiences, respondents reported very modest gains in confidence regarding their communication and interpersonal skills. Gross et al poignantly expressed that optometry students are typically expected to develop their communication skills through passive learning models, such as clinical observations, and not via more focused and proactive teaching methodologies.

Spafford has conducted several small-scale surveys in Canada that highlight the importance of communication skills in optometric schools. In reporting the findings of one preliminary examination on delivering bad news, she advocates the need for more explicit teaching of communication skills in university teaching clinics, especially regarding the appropriate use of counseling skills and the displaying of empathy while maintaining a professional distance.[8]

There have been several journal articles in recent years regarding teaching communication skills in the related field of ophthalmology. They provide some insight into what might be included in an optometry education program. Similar to optometry, there is scant empirical evidence regarding the long-term professional impact of teaching communication skills within a university ophthalmology program.

In a survey[8] of 147 U.S. ophthalmologists,[9] communication and interpersonal skills were identified from a list of 17 ophthalmology-related skill sets as being the most important. It was generally considered that these skills should be taught prior to commencing a professional career in ophthalmology.

A pilot study by Vegni and Moja[10] involving 11 ophthalmologists in Northern Italy who participated in a 16-hour communication course found that communication competence was enhanced. The authors concluded that following the course, participants became more attentive to patients' psychological needs, both in terms of general quality of consultation (patient centeredness) and in terms of using specific interpersonal skills. The authors acknowledged that, due to the small sample size, the results were preliminary. They also advocated the need for further research (with a larger sample) to evaluate the ongoing impact that education and training has on communication skills in clinical practice.

An online survey of 225 Canadian ophthalmologists[11] found the vast majority believed that it is important to communicate effectively when delivering "bad news" to patients. The authors concluded that communication skills training would be beneficial for

future ophthalmologists and should be included in the university curriculum. While there was no consensus on the precise nature of how communication skills should be taught, the most popular methodologies recommended by the survey respondents were interactive small group discussions, video presentations of proper communication techniques and the practicing (role-playing) of scenarios.

Hahn, in an article for *Ophthalmology* on providing glaucoma medication, concluded that "patient-centered communication techniques can engage the patient in shared decision-making."[12] He emphasized the importance of addressing the psychological needs of patients by actively listening to ensure patients feel that they have been heard and understood. Hahn et al[13] subsequently conducted a study of 23 ophthalmologists and 100 regularly scheduled patients with glaucoma. The physicians received a three-hour educational program on patient-centered communication skills that included role-plays and videotaped vignettes of simulated patient encounters. The authors concluded from the study that community physicians had significantly improved their communication skills as a result of undertaking the program.

There has been increasing discussion over the past three decades regarding the need to develop effective communication skills in medical students so that they may become more effective and humane medical practitioners. For example, in 1999, Aspegren[14] conducted an extensive literature search of 180 articles concerning the teaching and learning of communication skills in medicine and recommended that all students should have communication skills training and that the focus should be on experiential learning.

In 1999, the Association of American Medical Colleges[15] conducted a survey of 144 medical schools in the United States regarding the teaching of communication skills. Of these, 85% reported using a combination of discussion, observation and practice in teaching these skills. The primary teaching methods consisted of small group discussions and seminars (91%), lectures and presentations (82%), student interviews with SPs (79%) and student interviews with real patients (72%). The provision of both formal and informal feedback to students was identified as a key aspect of the assessment process. More objective methods of assessment, such as the use of SPs, were less common.

More recently (2012), Hausberg et al[16] studied the effectiveness of a communication skills course that was introduced at the beginning of their medical program. Based on self-rated questionnaires and independent evaluation of videotapes, students reported a significant increase in their communication skills compared with those in the comparison group. The authors identified self-reflection activities and the ongoing practice of core communication skills as being critical in helping students to consolidate their learning and further develop their communication competencies throughout the curriculum.

In summary, the literature indicates a wide range of opinion, often not specific in nature, regarding strategies and approaches for the effective teaching of a communication skills course in optometric education. To gain further insight and ensure that the curriculum we planned to introduce at Flinders University reflected the needs of the broader optometry profession, we consulted with a range of experienced optometrists and the Optometrists Association Australia.

The Flinders University Experience of Teaching Communication Skills

Overview

In March 2012, Flinders University introduced an innovative course, Communication for the Consulting Room, into the third year of the Bachelor of Medical Sciences (Vision Science)/ Master of Optometry double degree program. This double degree is one of the entry qualifications for practicing optometry in Australia. Approximately 36 students, typically with the highest GPA scores from their secondary school education, enter via the undergraduate program each year. The curriculum was developed with the objective of preparing students for their first clinical experiences in their fourth year as well as assisting them to develop the necessary communication and interpersonal skills required to forge successful careers in optometry.

A new course coordinator, with a Doctor of Counselling qualification and extensive higher education experience teaching communication skills, was appointed. Two additional sessional tutors with master or doctorate level qualifications in counseling and/or psychology were also appointed. In addition to drawing on his own expertise in curriculum development, the course coordinator undertook a review of the literature and consulted with two senior members of the Optometrists Association Australia and with five practicing optometrists who had an average of 30 years professional experience.

Approval was received from the Flinders University Social and Behavioural Ethics Committee in March 2013 to conduct a confidential survey of students who completed the course when it was taught again from March to June (semester one) 2013. The questionnaires were confidentially administered in class at the commencement of the second semester in July 2013. They were designed to identify what, if any, learning outcomes and/or specific communication skills students felt that they had developed as a result of participating in the course. Feedback on teaching effectiveness was also requested to enable ongoing continuous improvement of the course. The findings of this survey are included below.

Curriculum structure

Based on the literature review, consultation and knowledge of the area, the broad curriculum structure (and timetable) for the 13-week course was developed. **(Table 1)**

Teaching methodologies

A range of teaching methodologies was utilized in order to enhance student learning. Considerable emphasis was placed on skills-based learning that engaged the students in practical activities and real-world scenarios. More specifically, this involved students submitting a reflective journal online prior to each workshop and then discussing aspects of the reflective questions in small groups. Considerable emphasis was placed on discussing case stud-

Table 1
Curriculum/Timetable

Week	Workshop Title
1	Introduction to communication
2	Self-awareness & emotional intelligence Introduction to Myers-Briggs Type Indicator (MBTI)
3	MBTI (continued) Reflective practice
4	Respect, empathy, listening, non-verbal communication The whole person
5	Assumptions and stereotypes Creating the right environment
6	Working in groups (1)
7	Conflict and misunderstandings Working in groups (2)
8	People experiencing strong emotions and distress
9	Patients in different stages of the lifespan Patients fulfilling particular life roles Patients experiencing long-term conditions (mental & physical)
10	Culturally competent communication Communicating with indigenous peoples
11	Ethical communication Interprofessional communication Avoiding professional burnout
12	Group presentations
13	Review of topic Role-plays and scenarios
14	Oral examination (mini interview)

ies (in small groups) at the start of the semester. Role-playing became more prominent as the students developed their self-awareness and knowledge of the extensive range of specific communication skills/tasks that they needed to develop. In 2013, actors/SPs were introduced to enhance the role-plays as a "real" learning experience for the students. Similarly in 2013, role-plays with SPs were introduced as one element of the oral exam.

The majority of workshop teaching was provided within three small tutorial groups consisting of approximately 11 students and one tutor/educator. No separate formal lecture was provided, although there was typically a brief information and discussion component for the entire class (usually no more than 30 minutes in duration) at the beginning of all the three-hour workshops. The class often reconvened briefly with the topic coordinator at the end of the workshop to clarify, summarize and gain student/tutor feedback as to whether the workshop's learning outcomes had been achieved as planned.

Assessment methods

Four assessments were developed for the course. First, students were required to undertake background reading each week, including the relevant chapters from the designated textbook *Communication: Core interpersonal skills for health professionals*,[17] and then submit their responses in the form of various online self-reflection activities (which were only for the tutors to read). These reflections were also used as the basis for student discussion at weekly tutorials (of 11 students) that were conducted within the three-hour weekly workshop format. Second, attendance at all 13 workshops was compulsory and students were evaluated on their participation. Third, all students were required to work on a group project and conduct a formal presentation (in groups of three or four) on one of a range of specific communication and health-related topics. The fourth assessment was an oral examination (mini interview). It involved assessing the ability to practically apply, in a range of situations and contexts, the communication skills learned in the course. Students had to satisfactorily complete all four assessment tasks in order to pass the course. **Appendix A** is a summary of the information that was provided to the students regarding the assessment tasks.

To help monitor student progress and provide constructive comments, each student was supported by two one-on-one interview/coaching sessions. The sessions were provided by the educator/tutor to help identify specific communication skills and behaviors that students wished to enhance as part of their ongoing learning and development. Refer to **Appendix B** for the Assessment of Workshop Participation Form that students completed and brought to the session as the basis for a two-way discussion and for tutor feedback. Students were also required to provide a Personal Learning Statement that summarized key areas of learning that they had explored in their reflective journaling.

Sample teaching resources

Appendix C contains sample reflection questions that students were required to respond to and submit online prior to each workshop. They were also used as the basis for weekly tutorial discussions (except for week 12 when the group presentations were scheduled). Student requirements for the group project and presentation are included in **Appendix A**.

The Myers-Briggs Type Indicator

Participants were able to gain insight into their personality type and preferred communication style by experiencing the Myers-Briggs (Personality) Type Indicator (MBTI). The MBTI is an approach to personality type that is used internationally in a range of communication, leadership and team development programs. It was introduced into the curriculum to assist students in becoming more self-aware of the way they interact with others and the manner or style in which they are likely to communicate with patients.[17] As a result, students were able to gain valuable insight into their personality type and how this affected their communication style. The MBTI preferences of these students were used during the following semester to assist in the organization of problem-based learning (PBL) groups within other courses to ensure a balance of personality types in each group.

Additional follow-up workshops

As part of a strategy to build on the foundational communication skills developed in the course, six more specialized workshops were conducted with the same students (as part of the clinical skills course) in the following semester. Each three hours in duration, these were typically more optometry-specific and involved extensive role-playing with SPs in areas such as taking a case history, delivering bad news (for example, presbyopia and age-related diseases), obtaining informed consent for cataract surgery, contact lens compliance and genetic counseling. Refer to **Appendix D** for sample role-play scenarios used in an "informing the patient" workshop.

In addition, prior to the students undertaking their compulsory work placements in an optometric practice (in the fourth year of the program), a four-day pre-placement intensive workshop was introduced in 2013 for the student cohort that had completed the inaugural communication skills course in 2012. This program included more than eight hours of role-playing (with SPs) a range of challenging scenarios such as dealing with emotional patients, overcoming complaints regarding the optometrist being "too young," addressing inappropriate patient behavior and communicating effectively with patients who are "in a hurry." Other interactive sessions and discussions were also facilitated within the workshop on similar scenarios under the theme of "managing difficult conversations."

Table 2
Changes in Confidence to Perform Specific Communication Skills/Tasks

Question:

Please rate your confidence to perform each of the following communication skills or tasks by marking the scales provided with an X to indicate your confidence levels:

(a) before commencing this course

(b) after completing this course

Scale: 0 = "Totally lacking in confidence" and 10 = "Very confident"

Please attribute a reason(s) for any difference in your ratings.

Rank	Score	Skill or Task
1	+108	Reflect back content (i.e., paraphrase) to the other person
2	+108	Reflect back feelings to the other person
3	+101	Allowing for silence when communicating with others
4	+91	An understanding of how my own self-awareness influences communication with others
5	+85	Communication with someone who is distressed
6	+80	An awareness of how my own values influence my communication with others
7	+76	Summarize what the other person has said
8	+76	Appropriately use questions (including open & closed questions)
9	+70	Not stereotyping or making assumptions about the other person
10	+69	Empathize with the other person
11	+63	Managing conflict with another person
12	+63	Communicating with people from a different stage of the lifespan (e.g., children, adolescents, elderly)
13	+62	Actively listen to the other person
14	+61	Making an initial introduction & building initial rapport with others
15	+61	Physically attending & the appropriate use of body language
16	+57	Communicating in a culturally safe and aware manner
17	+55	Working and communicating effectively within a team
18	+51	Challenge or confront another person (in an appropriate way)
19	+50	Use self-disclosure appropriately when talking to others
20	+17	Matching the other person's language and communication style

Student Survey Findings

Although participation in the survey was not compulsory, 32 of the 33 students who studied the course completed the first questionnaire and all 33 completed the second.

Questionnaire 1 asked students to rate their confidence to perform 20 specific communication skills or tasks: (a) before commencing the course and (b) at the completion of the course. A scale from zero to 10 was used whereby zero indicated students felt they were "totally lacking in confidence" and 10 indicated they were "very confident." The "before" and "after" scores were aggregated and the difference between the two was calculated for each of the 20 skills/tasks. The 20 skills/tasks were then ranked according to the level of reported change that responders felt had occurred from commencement to completion of the course. **Table 2** summarizes the results.

Overall, students reported a considerable increase in confidence regarding their general communication skills levels. The specific skills/tasks for which they reported most improvement included the ability to accurately reflect back both feelings and content to the other person, allowing time for silence, being more self-aware when communicating, and relating effectively with a person who is emotionally distressed.

Questionnaire 2 was more pedagogy focused and sought feedback regarding curriculum structure, teaching methodologies, assessment methods, learning outcomes, students' experience with the MBTI and faculty expertise/effectiveness. Some questions required responders to rate using a five-category scale (ranging from poor to excellent), while others involved writing open-ended (optional) responses. The results of this questionnaire are included in the following sections.

Curriculum structure

Optional written feedback provided some insight into the respondents' perceptions of the curriculum and the way it was structured. Typically, the course was perceived as highly stimulating, thought-provoking and beneficial in

terms of communication skills development and heightened self-awareness. **Table 3** contains illustrative student quotations on the course and its structure.

Teaching methodologies

Using a five-category rating scale, students were surveyed regarding the effectiveness, in terms of assisting them in their learning, of the five primary methodologies utilized in the course. The results are summarized in **Table 4**.

The scenario/case study-related activities and the small group discussions were most highly evaluated by the students in regard to enhancing their learning. Role-plays and then reflective journaling were ranked next. The team project was seen as the least valuable methodology, perhaps partly due to students having experienced similar learning approaches in other courses and in their earlier years at university and secondary school.

Optional written responses that were received also emphasized the importance of the small tutorial group discussions in enhancing student engagement and learning. **Table 3** contains illustrative quotations regarding the main methodologies utilized in teaching the course.

Assessment methods

The survey included a question on student perceptions of the effectiveness/suitability of the assessment methods for the course. The responses, on a five-category rating scale, indicated that overall the assessment tasks were considered to be reasonable and quite beneficial. The results are summarized in **Table 5**.

Several students wrote additional optional comments indicating that they had been a little uncertain regarding what was required for some of the assessment tasks **(refer to Table 3)**. The oral exam in particular was seen by these students as a challenging experience and some concern was expressed regarding the degree of difficulty of some of the questions and/or role-plays. There was also some written feedback regarding the practical benefits of the group project/presentation (and the accompanying teaching on group dynamics) and how this, and the course

Table 3
Student Written Feedback
Illustrative Quotations

Questions:

1) What aspects of this course <u>most helped</u> you to enhance your communication skills?

2) What aspects of this course <u>least helped</u> you to enhance your communication skills?

3) Please comment freely on your overall opinion of the course. Do you have any suggestions for improvement?

1. Course structure/ general comments	... well set up. I have incredibly enjoyed the topic and I am surprised about how much I have learned and am applying in real life. It is a good topic to have for [an] optometry career. ... excellent in every way in helping students to learn about many different life skills and communication strategies and apply them in real life situations.
1. Role-plays	...helped reinforce what we learned and discussed in class [and were] most beneficial in improving [my] communication skills. I really loved the [role-plays with] the standardized patients.
3. Reflective journaling	... because it brought out my values, beliefs and emotions that I rarely think about. ... very valuable as they helped identify weaknesses that need further development.
4. Small group discussions (including case studies)	... were quite informal as it gave everyone a chance to have their say and share their thought [which] created an environment that was safe and without pressure.
5. Faculty expertise	The teaching team provided great skills and knowledge to help us in our course. The knowledge of the tutors was essential for my learning.
6. Myers-Briggs Type Indicator	... assisted [me] in understanding the way that I react and the way I interact with people ... very effective for self-awareness. Myers-Briggs was very interesting but I think too much emphasis on it.
7. Assessment methods	I think the assessment criteria [were] appropriate. The group project helped me to become more self-aware [and to gain an] understanding of how my personality can affect other group members.

Table 4
Effectiveness of Teaching Methodologies in Assisting Learning

Question:

How effective were each of the following in assisting you to learn?

Student Evaluation (N=33)

Methodology / Activity	Excellent and Good	Average and Adequate	Poor
1. Scenarios & case studies	33	0	0
2. Small group discussions	31	2	0
3. Role-plays	31	2	0
4. Reflective journaling	30	3	0
5. Team project & presentation	27	6	0

Table 5
Student Evaluation of Assessment Methods

Question:

How effective do you consider each of the four assessment tasks for this course?

Student Evaluation (N=33)

Assessment Task	% of Marks	Excellent and Good	Average and Adequate	Poor
1. Pre-workshop online reflective journals	15%	27	2	0
2. Workshop participation	10%	31	3	0
3. Group project & oral presentation	25%	28	5	0
4. Mini interview/oral exam	50%	22	1	0

more generally, had impacted positively on their ability to work in teams both at university and in the workplace.

Learning outcomes

Using a five-category rating scale, students were asked to rate their perceived level of learning against each of the five course objectives. **Table 6** summarizes the results.

Overall, the feedback was very positive in terms of students rating their perception of whether the learning outcomes had been met, with 99% of all student responses evaluating this as either "excellent" or "good." Of note is that only two "average" responses were received and no student reported his or her learning outcomes as "adequate" or "poor."

The Myers-Briggs Type Indicator

Student responses on a five-point scale regarding their experience with the MBTI were: Excellent (22) Good (3) Average (8) Adequate (0) Poor (0).

Table 3 contains several illustrative comments received regarding the MBTI. While generally very positive, several students expressed some ambivalence regarding the time and focus given to the MBTI in order to raise student self-awareness, particularly in regard to communication strengths and areas that might require further development.

Faculty expertise and effectiveness

Students' feedback was obtained on how they perceived the skills, knowledge and effectiveness of the teaching team in delivering this course. The aggregated student responses indicated an outstanding level of evaluation: Excellent (27) Good (6) Average (0) Adequate (0) Poor (0).

Table 3 contains illustrative quotations regarding the effectiveness of the teaching faculty.

Conclusion

There is limited evidence regarding the effectiveness of teaching communication skills within university optometric education programs. Our survey of students who had completed a dedicated optometry course on communication skills in 2013 indicated that the students fully embraced the course and believed overall that their skills had been enhanced in a broad range of specific domains. Some even described the impact of this experience as "life-changing."

While our study represents a rudimentary assessment of outcomes, we believe the course "Communication for the Consulting Room" has helped students to develop effective and appropriate communication skills, which will underpin successful and rewarding careers in optometry. However, further evidence-based research is clearly required, especially with regard to the inherent supposition that students retain the reported initial improvement in their communication skills as they progress further in their chosen profession.

Table 6
Student Evaluation of Learning Outcomes

Question:
Please provide feedback on your learning for each of the following course objectives
Student Evaluation (N=33)

Learning Outcome	Excellent and Good	Average and Adequate	Poor
1. Demonstrate and apply the key principles of effective interpersonal and interprofessional communication in health care	33	0	0
2. Demonstrate the ability to reflect on personal communication skills and identify areas for further development	32	1	1
3. Demonstrate a greater understanding of your own values and the impact of your values and judgments on communication	33	0	0
4. Demonstrate and apply the ability to work collaboratively and make effective oral team presentations	32	1	0
5. Demonstrate and apply the ability to communicate in a culturally safe and ethical manner	33	0	0

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Appendix A: Assessment Requirements

1. Pre-workshop activities/reflective journal (15%)

Before the start of each workshop, students are required to complete the online activity for that week. You will be asked to write a brief reflective paper (approximately 250-500 words) that you should submit online and print to bring with you to the workshop.

2. Workshop participation and two personal learning statements (10%)

Each week, a three-hour workshop will be conducted. Workshop attendance is compulsory. The pre-workshop readings will be assumed knowledge, and your participation will be assessed.

All students are required to attend two individual feedback sessions during the semester. There is a mid-semester (formative) session and an end of semester (summative) session where individual feedback on your participation in the program will be provided by your tutor.

You are required to come to both feedback sessions with a Personal Learning Statement (250-500 words) that summarizes your strengths and limitations, as highlighted in your reflective journaling. Both Personal Learning Statements must be submitted electronically 24 hours prior to the feedback session.

3. Group project and oral presentation (25%)

During the semester, in groups of three or four, you will spend time working on a group project, which will culminate in a group oral presentation in Week 12. Each group will be assigned a different topic on which to present.

The project will focus on a group of individuals who have specific communication issues or needs when accessing optometry/healthcare services. The presentation should be 20 minutes long (plus 5-10 minutes for questions).

4. Oral examination/mini interview (50%)

At the end of the semester, an oral examination will be conducted in the form of a mini interview. The interview will assess your knowledge, ability to apply what you have learned and ability to reflect on your own skills and learning.

Appendix B: Form for Assessment of Workshop Participation

Personal Learning Statement submitted indicating effective and insightful reflective practice (Tutor to circle **YES** or **NO**)

	Often	Sometimes	Rarely / Never	Area Needs Attention
Demonstrates self-awareness, an understanding of personal values and an ability for personal reflection (reflective journal)				
Attends, arrives on time and actively participates in workshop discussions and activities				
Demonstrates key principles of effective communication including developing trust, respect and rapport				
Demonstrates a range of communication skills including active listening, empathy, appropriate use of body language and suitable questioning				
Demonstrates the ability to communicate in a culturally safe and ethical manner				
Demonstrates the ability to work effectively and collaboratively in groups				
Demonstrates the ability to be aware of the needs of others and to modify behavior in response to constructive feedback				

Comments by student:

Other observations by tutor:

Appendix C: Sample Reflective Journal Questions

Self-awareness (Week 2)

- What is self-awareness and why is it important for health professionals to be self-aware?

Emotional intelligence (Week 3)

- Reflect on your relative strengths and weaknesses in the context of Goleman's notion of emotional intelligence "competencies."

The whole person (Week 4)

- a) Identify and reflect on some of your core values. b) What specific kinds of patients might you have difficulty with because of a potential clash of values?

Working in groups (Week 7)

- Reflect on the group process during the initial "forming" meeting that you had in class with your project group, including the contribution that you and others made and the "roles" that group members undertook.

Appendix D: Sample Role-Play Scenarios (from "Informing the Patient" Workshop)

1) Steve is a 52-year-old accountant who has been wearing reading glasses for several years. He presents today noting that he thinks he needs stronger reading glasses again. His distance vision is 6/7.5 (20/25) OD and 6/9-1 (20/32) OS. He is in good health, not taking any medication and has no significant family history. From your examination you find that he now has 0.25D of myopia in each eye that was not present 2 years ago, and he needs a slight increase in his reading prescription. However, you also note that he has early nuclear cataracts in both eyes and a significant cortical spoke cataract encroaching on the visual axis of the left eye. You are required to formulate a plan to advise Steve of your findings and consider referral for consultation with a cataract specialist. How will you now inform Steve?

2) Gerald is a 27-year-old cook. He presents for a routine eye examination as he wants a new frame. His last eye examination was elsewhere several years ago. VA is 6/6 (20/20) OU with his present -1.00D Rx. He is on medication for bipolar disorder and is otherwise healthy. He is vague about family history but knows of an uncle who "went blind from something." On examination all external and internal findings are normal and there is no change in his spectacle Rx. However, he has IOPs of 34 and 35 mmHg. Given the IOPs and alarming family history, you conclude he is a glaucoma suspect and want to refer him to a glaucoma specialist. How do you inform Gerald?

Idiopathic Macular Hole: A Teaching Case Report

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Abstract

A macular hole (MH) is an anatomical opening or dehiscence in the fovea. Idiopathic MHs are considered to be a fairly common retinal condition and are most frequently found in healthy women with a normal refractive error in their seventh or eighth decade of life. This teaching case report reviews the important role of the clinician in accurate diagnosis, timely referral for treatment, and continued monitoring of the patient's post-surgical ocular health. It also addresses diagnostic testing, such as optical coherence tomography (OCT), and how it can be implemented for the diagnosis and long-term management of MHs.

Key Words: *idiopathic macular hole, optical coherence tomography, pars plana vitrectomy, posterior vitreous detachment, perifoveal posterior vitreous detachment*

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Background

The following case report involves a 61-year-old Caucasian female who was diagnosed with a full-thickness idiopathic macular hole (MH) in the left eye that was surgically managed. The patient subsequently developed an impending MH in the right eye that resolved without intervention. A MH is a condition in which an anatomical opening or dehiscence develops in the fovea.[1] A full-thickness MH is defined as an anatomical defect in the fovea with interruption of all neural retinal layers from the internal limiting membrane (ILM) to the retinal pigment epithelium (RPE).[2] Though trauma, previous ocular surgery, and other findings may be associated with MHs, the vast majority of MHs are considered idiopathic.[3,4] Idiopathic MHs are most frequently found in healthy women with a normal refractive error in their seventh or eighth decade of life.[4-6]

The most common presenting symptoms related to any type of MH are metamorphopsia and blurring of the central vision.[7,8] The vision loss for a patient diagnosed with a MH can range from mild to as severe as 20/400.[9] Historically, the pathophysiology of MHs was not well understood due to the lack of detailed imaging capability.[10,11] However, recent advances in retinal and macular imaging have provided additional insight into the pathogenesis and treatment of idiopathic MHs.[12] In particular, optical coherence tomography (OCT) has been useful in diagnosing and characterizing MHs.[8]

This teaching case stresses the important role of the optometrist in accurate diagnosis, timely referral for treatment, and continued monitoring of the patient's post-surgical ocular health. It highlights diagnostic testing, such as OCT, and how it can be implemented for the diagnosis and long-term management of macular conditions. Additionally, it addresses the need for thorough patient education on management options, including surgical intervention, and the importance of patient compliance with post-surgical instructions. This case can be used as a teaching guide for third- and fourth-year optometry students, as well as optometry residents. There is the potential for this pathology to present in

both an urgent care and a primary care setting. The case could serve as a teaching tool for the review of macular anatomy, particularly in conjunction with utilization of OCT. It can also be used to demonstrate how knowledge learned in the didactic setting can be applied to the diagnosis and accurate classification of a MH in a clinical setting. Finally, fourth-year students and residents can use this teaching case to review proper management and patient education for an eye disease that may need to be addressed with a degree of urgency.

Student Discussion Guide

Case description

A 61-year-old female presented to the primary eyecare clinic with a complaint of decreased vision. The visual complaints were at distance and near, with and without correction for both eyes. She stated the change in her vision seemed different than the blur she had experienced in the past. This patient had been seen in the primary eye clinic on three previous visits, each time with blur and eyestrain complaints. At the most recent visit a year and a half prior, her vision was best-corrected to 20/20 OD and OS at distance and near with an updated low hyperopic and presbyopic spectacle correction. The patient's medical history was significant only for hyperthyroidism, for which she had undergone radioactive iodine therapy approximately one year prior. She denied taking any medications. The patient's allergy history included hypersensitivity to both sulfa and penicillin. Her family ocular history revealed that her father had glaucoma and her mother had keratoconus. The patient's father also had heart disease and hypercholesterolemia.

Visual acuities were measured with habitual correction OD as 20/25 at distance, 20/20 at near, and OS as 20/80 at distance and 20/100 at near. There was no improvement with pinhole OS, and, at this time, the patient noted that all the letters appeared to be jumping OS. Pupils were equal, round and reactive to light with no afferent pupillary defect OD, OS. Extraocular motilities were full and smooth OU. Amsler grid was performed with normal results OD; the patient could only recognize part of the central dot and the lines appeared collapsed centrally and superiorly around the central dot OS. Red cap desaturation was graded as 10/10 OD and OS. The patient's current glasses were approximately two years old, and the refraction at this visit showed a minimal change OD to increase the vision to 20/20 at distance and no change OS with no improvement of vision. Her keratometry readings were stable from previous readings with measurements of 43.50/43.00 @ 090 OD and 43.75/43.75 @ 090 OS.

Anterior segment evaluation revealed normal findings OU. However, the patient's angles were evaluated as a Van Herick grade 1 temporal and grade 2 nasal OD, and grade 1 temporal and grade 2 nasal OS. Goldmann tonometry results were 16 mmHg OD and 15 mmHg OS. Gonioscopy was performed with ciliary body visible in all four quadrants OD and OS along with trace pigment 360 degrees OD and OS.

Dilated fundus examination revealed healthy, well-perfused optic nerves with cup-to-disc ratios of 0.25/0.25 OD and 0.25/0.25 OS. There was no posterior vitreous detachment (PVD) in either eye. The macula OD was flat and clear with a positive foveal reflex. The macula OS was abnormal with the appearance of a small, discrete, red-colored circular defect centered in the fovea. **(Figure 1)** An OCT was performed OD and OS at this time. **(Figure 2)** The blood ves-

Figure 1
Fundus photos of the right (a) and left (b) eye at initial presentation.

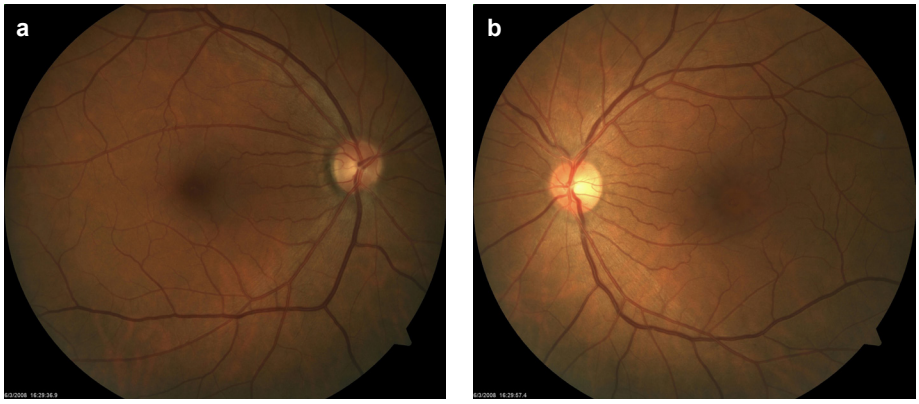
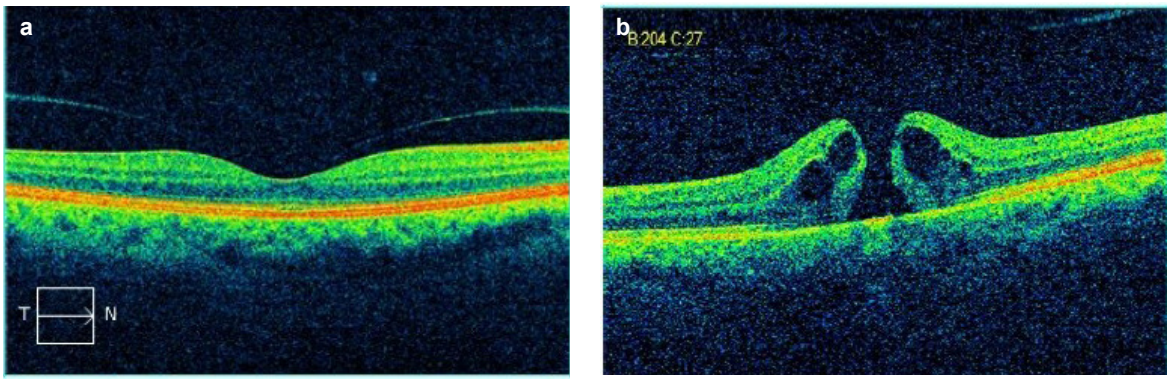


Figure 2
Macular OCT images for the right (a) and left (b) eye at initial presentation.



sels and background were normal OU with the retina being flat and clear 360° to the ora OD and OS.

Educator's Guide

The educator's guide contains additional patient exam evaluations, a review of the literature and discussion points to help facilitate the thoughtful discussion of the case. There is also an overview of the disease process and important factors aimed at the primary eyecare provider.

Learning Objectives

At the conclusion of this case discussion, participants should be able to:

1. Be familiar with the signs and symptoms of macular holes.
2. Be knowledgeable regarding the differential diagnosis of macular holes.
3. Understand the typical patient demographics of the disease profile.
4. Understand the morphological process that leads to macular hole formation.
5. Provide patient education regarding management options and appropriate patient expectations for chosen treatment.
6. Appropriately co-manage with retinal ophthalmology for surgical management and follow-up.
7. Be able to educate the patient on potential secondary manifestations of surgical treatment and on risk of macular hole in the other eye.

Key Concepts

1. Recognition of clinical findings with macular holes and the appropriate tests to perform.
2. The use of technology in aiding with diagnosis and prognosis of macular holes.
3. The importance of patient education regarding the condition, treatment options, post-surgical considerations, and possible sequelae.
4. Recognition of post-treatment management of patients with this condition.

Discussion Questions

1. Knowledge, concepts, facts and information required for critical review of the case
   a. Which examination tests can help to refine and confirm the diagnosis?
      i. Entrance tests
      ii. Ocular health exam
      iii. Supplemental tests
   b. Does this patient fit the typical demographic for her suspected diagnosis?
   c. Based on the OCT results, how would you grade the stage of her condition?
      i. Can some stages of this condition be monitored?
      ii. How do you know when treatment is indicated?
2. Differential diagnosis
   a. What is your differential diagnosis:
      i. After the case history alone?
      ii. After entrance tests and refraction?
      iii. After ocular health examination?
   b. Aside from an OCT, what tests could you perform to narrow down your differential list?
3. Patient management
   a. What treatment, if any, would you recommend to this patient?
   b. Based upon the stage of her condition, how quickly should the patient undergo treatment?
   c. At what point after symptoms present is treatment no longer recommended, as a successful outcome is unlikely?
   d. How would you manage this patient after successful treatment?
4. Communication with the patient regarding diagnosis, prognosis, treatment options, and potential sequelae of treatment
   a. How would you educate this patient regarding her diagnosis and prognosis?
   b. What is the risk of the fellow eye developing the same condition?
   c. What aspects of treatment may be difficult for the patient?
   d. What potential post-treatment sequelae should you educate the patient about?

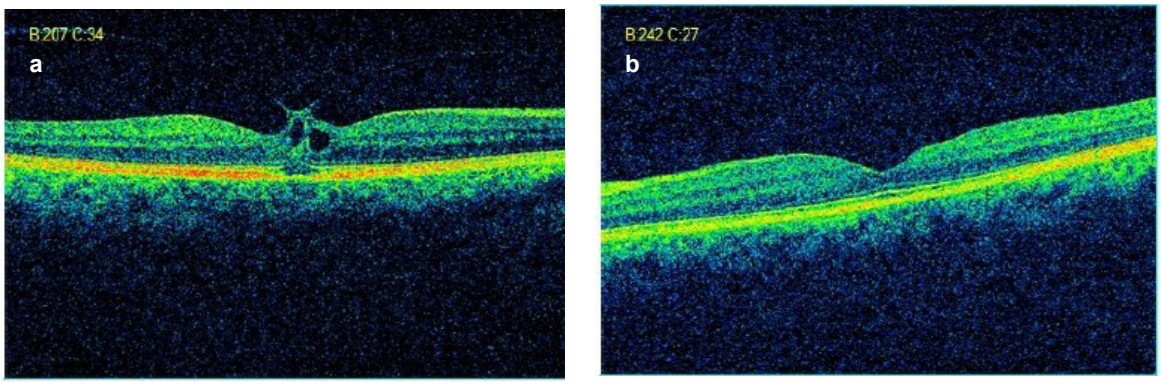
Additional Evaluation and Follow-Up

The retinal specialist concurred with the diagnosis of stage 3 MH in the left eye and recommended surgical intervention in the form of pars plana vitrectomy with a membrane peel and a gas bubble with post-surgical face-down positioning (FDP). The surgery was successfully performed OS one month after initial presentation. The patient reported compliance with face-down positioning for two weeks post-surgery. Her post-surgical vision OS was 20/30. Over the course of the next six months, the patient developed a cataract OS and underwent cataract surgery.

Approximately two weeks after cataract surgery OS, the patient returned to the eye clinic complaining that she could not see as well after the cataract surgery as she felt she should. Her entering visual acuities were 20/70 OD and 20/30 OS at distance. All entrance testing was normal OD and OS. A refraction was performed that enabled the patient to see 20/40 OD and 20/30 OS. The patient's anterior segment exam was unchanged from the original visit with the exception of a grade 4 Van Herick angle, 2+ cells in the anterior chamber and a posterior chamber intraocular lens, all OS. She reported taking prednisolone acetate 1% ophthalmic suspension three times per day OS as instructed after cataract surgery. A fundus evaluation OD revealed a foveolar yellow spot and the absence of a PVD. An OCT was performed OD showing a cystic-like space of the inner retina and the presence of a stage 1A MH was confirmed. **(Figure 3)** The patient was told that surgery was not yet indicated and that she should follow up every month for serial OCTs to monitor the OD for change. The patient returned one month later and the OCT revealed that the posterior hyaloid OD had detached from the macula, the stage 1A

Figure 3

Macular OCT images of the right (a) and left (b) eye after surgical repair of a macular hole in the left eye and with a new macular hole in the right eye.



MH had resolved, and her vision improved to 20/20.

Literature Review

Epidemiology

Idiopathic MHs are considered to be a fairly common age-related retinal condition.[8] Though the epidemiologic data is limited, a recent study in the United States reported that idiopathic MHs affect 7.8 people per 100,000 population per year.[3] Studies have consistently found that idiopathic MHs affect women more often than men, and the increased risk for women has long been recognized.[3,13] Higher age and a history of cataract surgery are also significantly associated with an increased prevalence of MHs.[9,14] MHs are most often unilateral; however, the incidence of fellow eye involvement for any stage of MHs has been reported to vary from 11.7% to 19%.[3,9,15-17]

Pathophysiology and classification

The pathogenesis of idiopathic MHs is not completely understood. Historically, various theories regarding the etiology have been debated.[10,11] MHs were originally thought to form secondary to trauma, but clinical and histopathologic studies in the 1960s observed the forces of the vitreous on the macula, leading to the theory that vitreomacular traction played a role in idiopathic MH formation.[10,11] The exact nature of the tractional force was unknown, but Gass proposed a theory of tangential vitreous traction that was initially widely accepted.[6,18] More recently, the adherence of the posterior hyaloid to the foveal center during early MH formation was demonstrated, indicating the potential for the exertion of anteroposterior traction.[19]

Idiopathic MHs are described according to a classification scheme that characterizes the evolution of an idiopathic MH into systematic clinical stages.[20] Though Gass' classification is still most commonly used by clinicians to describe the clinical staging for MHs, Gass' original theory has been reconsidered.[20] Research and technological advances in retinal imaging have led to a better understanding of the pathogenesis of an idiopathic MH.[21] OCT is one such technology that has helped to elucidate the role of the vitreofoveal interface in idiopathic MH formation.[21,22] See **Table 1** to correlate Gass' stages of development with the corresponding OCT appearance. Recently, the International Vitreomacular Traction Study (IVTS) Group developed a new classification system based on anatomic characteristics of disease of the vitreomacular interface (VMI) using OCT.[2] They describe vitreomacular adhesion (VMA) that correlates to a

Table 1

Classification and Characteristics of Idiopathic Macular Holes[7,16,20,22,44]

Stage of Development	Visual Acuity	Biomicroscopic Appearance	OCT Findings
Stage 1A	20/20 to 20/60	Central yellow spot	Foveal pseudocyst or split in the inner retinal layer associated with a perifoveal posterior vitreous detachment (PPVD)
Stage 1B	20/20 to 20/60	Yellow ring	Progression of the foveal pseudocyst with disruption of the outer retinal layer and a PPVD, the roof of the pseudocyst remains intact
Stage 2	20/40 to 20/100	Round or oval full-thickness macular hole <400 microns	Full-thickness macular hole with or without operculum, posterior hyaloid may be incompletely detached from hole edge, vitreopapillary adhesion
Stage 3	20/60 to 20/200	Round full-thickness macular hole >400 microns	Full-thickness macular hole with or without operculum, complete posterior hyaloid detachment over macula, vitreopapillary adhesion
Stage 4	20/60 to 20/400	Round full-thickness macular hole >400 microns, Weiss ring	Full-thickness macular hole, complete posterior vitreous detachment

Stage 0 macular hole.[2] On OCT evaluation this entity shows a partial detachment of the vitreous in the perifoveal area without any retinal abnormality.[2] Patients in this stage have no visual symptoms, and the vitreous may separate spontaneously without incident.[2] VMA can be classified as focal (≤ 1500 μm) or broad.[2]

OCT examination provides a detailed picture of a perifoveal posterior vitreous detachment (PPVD), where the posterior hyaloid detaches around the macula but a focal vitreofoveal attachment remains.[19,21-22] A prospective study by Haouchine et al., which utilized both clinical and OCT examinations, demonstrated that a foveal pseudocyst may be the initial feature in an eye with a MH, and the pseudocyst is always found in conjunction with a PPVD on OCT.[23] The same study found that a stage 1A MH corresponds with OCT findings of a pseudocyst that occupies the inner fovea, while in a stage 1B MH the pseudocyst extends posteriorly and disrupts the outer retinal layers at the fovea.[23] The IVTS Group defines vitreomacular traction (VMT) as detectable retinal anatomic change on OCT with concurrent PPVD, but with remaining vitreous attachment within 3mm of the fovea.[2] VMT correlates to a Stage 1 macular hole, and it appears on OCT as a change in the contour of the foveal surface, intraretinal pseudocyst, or elevation of the fovea from the RPE.[2] Like VMA, VMT can also be classified as focal (≤ 1500 μm) or broad.[2]

When VMT persists and causes the roof of the cyst to open, it is classified as a stage 2 full-thickness MH.[19] In a stage 2 MH, the posterior hyaloid remains attached to the roof of the cyst or the incompletely detached operculum, which is still continuous with the inner retina.[19] Rarely, the roof of the foveal pseudocyst opens while the photoreceptor layer, or outer retinal layer, remains intact; this is referred to as a lamellar, or partial-thickness MH.[23] A stage 3 MH occurs when the posterior hyaloid is no longer attached to the hole's edges, and this has been demonstrated on OCT with complete separation of the posterior hyaloid from the retina throughout the posterior pole, except at the optic disc.[19] A stage 4 MH results when the vitreous is completely separated from both the entire macular surface and the optic disc (i.e., a PVD is present).[6,18] Takahashi et al. confirmed the absence of the posterior hyaloid membrane with OCT in all eyes studied with stage 4 MHs.[24]

The IVTS classification subdivides full-thickness MHs by size, using spectral domain OCT to measure the aperture size at the hole's narrowest point.[2] A small hole is measured as less than 250 μm, a medium hole between 250 and 400 μm, and large as greater than 400 μm.[2] MHs are also classified as having or not having concurrent VMT.[2] Furthermore, MHs are classified as being primary or secondary.[2] Idiopathic MHs are referred to as primary in the IVTS classification.[2]

Natural history and treatment

Stage 1A and 1B MHs may initially go unnoticed in the primary eye if the fellow eye is normal.[20] A stage 1A or 1B MH can spontaneously close, remain stable, or continue to progress into a full-thickness MH.[8] Gass found that approximately 45% of patients who presented with a stage 1A or 1B MH experienced a spontaneous vitreofoveal detachment, which resulted in release of traction and improvement of acuity to near normal levels.[6] The Vitrectomy for Prevention of Macular Hole Study (VPMHS) Group explored the question of whether surgical intervention to relieve VMT would stop the progression of an impending MH (stage 1A or 1B) to a full-thickness MH.[5] The authors of this study concluded that the benefit from vitrectomy for either type of stage 1 MH was minimal and was unlikely to outweigh the surgical risks and cost, thus a conservative approach was recommended for stage 1A and 1B MHs.[5] Stage 1A and 1B idiopathic MHs have been characterized as "transient,"[5] and Gass noted that most of these holes either progress or had a spontaneous vitreofoveal separation within several weeks or months.[6] The VPMHS Group found the progression time from a stage 1A or 1B hole to a full-thickness MH to be an average of 4.1 months.[25] Haouchine et al. demonstrated that stage 1A MHs may remain unchanged for up to 26 months.[23]

Recently, a nonsurgical option in the form of a pharmocolytic agent, called ocriplasmin, has been made available as an option for intervention to release VMT.[26] Ocriplasmin is "a recombinant human serine protease plasmin with proteolytic activity against the protein components of the vitreous and vitreoretinal interface," which facilitates vitreous liquefaction and, thus, separation of vitreous from the retina.[27] The efficacy of ocriplasmin was explored in two phase III clinical trials, which demonstrated that a greater proportion of patients treated with intravitreal ocriplasmin achieved resolution of VMT (26.5%) at 28 days than those treated with placebo (10.1%).[28] This same study achieved nonsurgical closure of MH with VMT in 40.6% of eyes treated with ocriplasmin, as compared to 10.6% of placebo treated eyes.[28] According to the IVTS Group, MHs with VMT are considered for pharmacologic vitreolysis, with small holes (less than 250 μm) being the most responsive.[2] MHs without VMT are not candidates for treatment with ocriplasmin.[2] Ongoing studies continue to explore the use of ocriplasmin for VMT with MH.[26] The role of ocriplasmin for clinical use is still being determined as more specific indications are established.[26]

Stage 2 MHs are very likely to progress to stage 3 or 4 when left untreated, though they can stabilize.[29-31] Kim et al. showed that 74% of stage 2 holes in their observation group progressed to stage 3 or 4 holes within a year.[31] Another small study found that all of the 15 eyes with stage 2 MHs that were being observed progressed to stage 3 or 4 MHs.[29] The Vitrectomy for Macular Hole Study demonstrated that surgical intervention in stage 2 MHs was associated with a much lower incidence of hole enlargement and a better outcome in visual acuity as compared with observation alone.[31] Therefore, strong consideration for surgical therapy is suggested in stage 2 MHs.[31]

Long-term observation of stage 3 and stage 4 MHs demonstrates they are very unlikely to close spontaneously.[8,29] Observation of 22 stage 3 MHs revealed that 36% remained at stage 3 and 67% were stage 4 at a five-year follow-up.[29] In fact, progression of the size and stage of full-thickness MHs without surgical intervention is likely to occur until vision stabilizes at the level of 20/200 or

20/400.[29] One study determined there is a significant benefit of surgical management for stage 3 and 4 MHs compared with observation.[32]

Prior to 1991, idiopathic MHs were considered untreatable.[33] Surgical treatment was initially reported in 1991 by Kelly and Wendel, who demonstrated that it was possible to close a full thickness MH.[33] The principles behind surgical management of idiopathic MHs are relief of VMT with subsequent intraocular tamponade to assist in flattening and reappositioning of the edges of the hole.[34] The rate of anatomical closure as well as visual function drastically improves in eyes with full-thickness MHs that have undergone vitrectomy and intraocular gas tamponade.[34] Today, the typical surgical procedure performed for repair of an idiopathic MH consists of a pars plana vitrectomy, removal of the posterior cortical vitreous, peeling of any epiretinal membranes present, a fluid-air exchange, followed by a gas tamponade with FDP of the patient for a minimum of one week postoperatively.[33,34]

Intraoperative and postoperative factors

Modifications in the surgical strategies for MH repair continue to emerge. Surgical adjuncts have been explored for their potential to stimulate wound healing around a MH.[8] Although the anatomical closure rate was reported as higher with some of these adjuvants, to date the functional visual outcome has not demonstrated a statistically significant benefit for any of these interventions.[35-37] Peeling of the ILM was another more recent modification to MH surgery that was thought to promote healing and improve the outcome by removing any potential tangential traction that may have played a role in the development of the MH.[34] ILM peeling is a technically difficult surgical technique,[34] and it was demonstrated that numerous unsuccessful attempts at ILM peeling can lead to decreased visual success.[38] This led to the use of vital dyes, such as indocyanine green (ICG), that selectively stain the ILM in order to aid in its identification.[34] Though anatomic success was reported, an increase in atrophic changes to the RPE was observed post-surgically, and there are concerns that the ICG may damage the RPE through a toxic or phototoxic mechanism.[39] New dyes continue to be explored. Trypan blue has demonstrated better visual recovery and a lower rate of persistent scotoma than ICG.[40]

Face-down posturing of the patient has long been a part of postoperative management for MH repair.[41,42] However, it is difficult for many patients, especially the elderly and those with physical and other limitations, to maintain this prone positioning.[42] Recently, the necessity and duration of FDP has been called into question.[41,42] Good functional and anatomical results have been demonstrated without FDP when the vitreous cavity is completely filled with a gas bubble.[42] Silicone oil is currently used as an alternative method of tamponade for those who cannot maintain FDP. However, this does require a second surgery to remove the oil, and a few droplets may remain in the vitreous cavity, which can be detected by patients as small floaters.[43] Though some feel that MH surgery may eventually advance toward the elimination of FDP,[44] many surgeons continue to feel that, until evidence proves otherwise,[41] one to two weeks of FDP are still important for a predictable and successful outcome of MH surgery.[8]

Discussion

This section focuses on different aspects of the patient's examination in order to highlight various discussion points. The discussion moves through the exam step by step, following the clinical thought process throughout.

The patient's case history was very broad and did not help to narrow down the differential diagnosis list. A blurry vision complaint would most likely lead a clinician to initially consider a refractive etiology. No improvement with pinhole indicates that a refractive cause would be unlikely as the cause of decrease in vision. This was eventually confirmed when refraction did not improve the vision in the left eye. Routine entrance testing includes some basic neurological tests that help to further narrow down this patient's diagnosis. Normal pupils suggest that there is unlikely to be any type of optic nerve disease, and this was reaffirmed by the normal results of the red cap desaturation test. The patient had a significant family ocular history, including keratoconus in her mother and glaucoma in her father. Her keratometry readings were within a normal range and the patient was well past the typical age of onset for keratoconus.[45] Additionally, the onset of vision loss and symptoms from keratoconus would not likely occur in such a short time frame, as this patient had normal vision at her exam 18 months prior. Furthermore, the slit lamp exam revealed that the media was clear and the cornea was free of scarring, striae or thinning. Only mild nuclear sclerotic changes were present in the lens. The need to rule out glaucoma arose from the patient's positive family history and her own anatomical narrow angles. Her confrontation visual fields were normal, gonioscopy revealed no signs of angle closure, average intraocular pressures were measured, and the patient reported no eye pain. Therefore, vision loss from acute angle-closure glaucoma was ruled out. The Amsler grid was the most useful test performed before dilation that hints at a macular etiology.

Careful dilated fundus examination quickly revealed a macular cause for this patient's decrease in acuity. The macular lesion observed had to be differentiated from other foveal and macular lesions including an epiretinal membrane with pseudohole, lamellar MH, solar retinopathy, macular degeneration and chronic cystoid macular edema with a prominent central cyst. Diagnostic accuracy with a MH is extremely important in order to avoid incorrect or unnecessary surgery.[46] The Watzke-Allen test is a quick test performed behind the biomicroscope with a fundus lens and can be easily utilized in a clinical setting.[47] The test is performed by using a biomicroscope lens (e.g., 78D or 90D lens) and projecting a very narrow vertical slit beam of light onto the fovea directly over the area of suspected MH.[47] The patient is asked to describe the beam of light and specifically if the beam is regular in outline or if it is distorted in any way.[47] Most patients with a large full-thickness MH report a break or gap in some part of the central portion of the line.[47] Patients who describe bowing, pinching or a discontinuous slit beam are more likely to have small macular cysts or other macular

lesions.[47] The Watzke-Allen test was performed when this patient initially presented with decreased vision and she reported a significant narrowing of the light beam in the center, but denied a total break in the light beam. The lack of a complete break in the slit beam is potentially due to the light beam not being placed directly over the center of the hole, or the width of the slit beam used not being larger than the actual hole. In this case, the light beam would appear narrowed as opposed to broken. The false negative result of this test reinforces the benefit of objective testing (e.g., OCT) over subjective testing.

The advent of OCT has produced a whole new perspective on examining the retina in vivo with high resolution cross-sectional images.[34] OCT details the retinal layers and their pathology, which has allowed for insights into the pathogenesis of macular disease.[34,41] A 1995 study, conducted shortly after OCT was introduced, concluded that OCT is a useful and noninvasive diagnostic technique for visualizing MHs and distinguishing them from partial thickness MHs, macular pseudoholes and cysts.[21] The diagnosis and staging of a MH is one instance in particular where OCT becomes invaluable.[34] It is essential to differentiate a full-thickness hole from a pseudohole or other lesion in order to determine the appropriate treatment.[21] An optometrist should be prepared to make this distinction by interpreting the results of OCT. This patient was a perfect example of a case that prior to OCT would have been a judgment call, and the choice may have been made erroneously to monitor for progression. If the hole eventually progressed and surgery was performed in a more delayed time frame, it could have resulted in poorer post-surgical vision. Additionally, this case demonstrates how OCT was used to evaluate the patient's fellow eye and monitor macular changes that were not clearly evident with biomicroscopy. Ultimately, the OCT allows for a quantitative characterization of macular holes.[21]

Other questions to consider in this case include what stage MH did the patient initially present with in the left eye, how long had the MH existed at the time of the patient's presentation, and how would these two factors affect the potential surgical outcome of this case? The OCT provided direct evidence of a full-thickness defect in the macula. **(Figure 2)** The patient's best-corrected visual acuity upon initial presentation with the MH was 20/80, which falls into the typical range for either a stage 2 or stage 3 MH. The posterior hyaloid appears to be completely detached from the fovea in the OCT, thus there is evidence that the patient's full-thickness MH would be classified as stage 3. There was no PVD evident on the patient's fundus evaluation when she presented with the MH, so a stage 4 MH in the left eye is ruled out. There is no way to know exactly how long the macular hole existed prior to examination. The patient had received a comprehensive eye exam a year and a half prior and there were no signs of a macular hole. The patient was unsure of the duration of the decrease in vision, but she estimated the onset was approximately two months prior. A study by Kang, et al. suggests that once a full-thickness neuroretinal defect occurs (stage 2), MH repair surgery should be performed as early as possible.[7] The same study found that better preoperative acuities and smaller diameter holes result in more favorable surgical outcomes.[7] This study also noted a trend for a better surgical outcome in holes that existed for a shorter preoperative length of time.[7] Another study concluded that stage 2 MHs would benefit most from surgical intervention because these patients have more vision to lose than those with stage 3 and 4 MHs.[29]

An interesting aspect of this patient's case was the bilaterality of her MHs. Aaberg, et al. reported that 17% of MHs were bilateral, but noted their study outcome may be high because it took place at a referral center.[15] A more recent study that looked at bilaterality of MHs in normal fellow eyes initially without a PVD found an incidence of 7.5% at 18 months and 15.6% at five years.[16] The patient's OCT scan of the right eye at initial presentation displays an intact macula with evidence of a PPVD and VMA. **(Figure 2)** Approximately six months post-repair OS, the patient presented with new symptoms and the appearance of a foveolar yellow spot OD. The OCT OD showed intraretinal foveal splits and a small foveal detachment beneath the central fovea; however, the inner layer breaks had not completely progressed to the outer layer yet, classifying it as a stage 1A MH. **(Figure 3)** The best-corrected VA OD at this time was 20/40, which puts her at lower risk for developing a full-thickness MH according to the VPMHS.[25] The reported delay in bilateral involvement averages 19 months, which makes a strong case for close monitoring and long-term follow-up.[15] This patient's fellow eye presented with a stage 1A MH approximately seven months after the initial eye presented with a full-thickness MH. It resolved spontaneously after one month.

Patient education is essential throughout the duration of the diagnosis, referral, surgical, and follow-up period for a MH patient. A thorough explanation of what a macular hole is and the options for management based upon evidence-based medicine should be presented to the patient. This is the responsibility of the diagnosing and referring doctor, thus will often fall on the shoulders of an optometrist. Since it has been reported that a shorter preoperative duration of the MH achieves higher rates of better post-surgical vision,[7] the diagnosing doctor plays an important role in facilitating a timely referral and making sure the patient understands why time is of the essence. The patient should be acquainted with the basics of the post-surgical regimen; however, it is recognized that this is highly dependent on the surgeon and specifics of each individual's case. It is appropriate to advise the patient on the possibility of FDP and provide him or her with resources in order to assist him or her in accomplishing this successfully, should it become necessary. Finally, the patient should be made aware that the occurrence of nuclear sclerotic cataract after vitrectomy is common, and it may have a negative effect on visual outcome[33,48] Therefore, it is likely that an additional surgery will be necessary to address this secondary complication. However, if the MH surgery was initially successful, the visual prognosis once the cataract is removed is excellent.[48]

Conclusions

This teaching case report discusses the diagnosis and management of a full-thickness idiopathic MH from the per-

spective of a primary eyecare provider. It focuses on the interpretation and application of OCT, which is highly diagnostic for this particular pathology. This article demonstrates how to clinically apply the classification for accurate diagnosis and identification of the stage of a MH. Also featured is the scenario of the fellow eye being affected. Now more than ever, optometrists have the tools to closely follow the natural course of the fellow eye and, when treatment is indicated, make a timely referral to maximize the outcome. MHs are often a treatable cause of central vision loss, and, though the treatment is primarily surgical, the optometrist plays an important role both before and after surgery. Additionally, throughout the course of care, the clinician must educate the patient on the natural course of the disease, including the potential secondary manifestations after surgery, and emphasize the importance of long-term follow-up care.

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Case-Based Student Performance: Socratic Method vs. Passive Presentation

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Abstract

Background: *Presentation of patient case examples is often used in healthcare education to facilitate clinical thinking in the classroom. The question arises as to whether a passive (instructor-only presentation) or Socratic (encouraging student discussion) approach is more effective when presenting patient case examples.* ***Methods:*** *Student exam performance and perceptions from passive and Socratic approaches were assessed.* ***Results:*** *Little difference was seen in examination performance using either approach; however, students subjectively preferred the Socratic approach rather than passive instruction.* ***Conclusions:*** *Socratic or passive case-based approaches provide comparable examination outcomes. Students tend to prefer the Socratic approach when presented patient cases.*

Key Words: *case-based learning, Socratic method*

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Background

Many educators in optometry (and other professions) can relate to situations where some students have displayed difficulty grasping fundamental knowledge concepts in certain areas, irrespective of academic performance. This usually becomes apparent through direct questioning of students on a one-on-one basis, or less often during their early clinical rotations. More frequently, the application of this fundamental knowledge is deficient, as certain students may not know "what to do next" for a particular patient. Encouraging discussion and feedback from students in both the didactic and clinical arenas can often be challenging, and this limits the instructor from knowing what the student or intern is truly thinking on a critical basis, and how solid his or her knowledge foundation is.

Case-based presentation has been shown to be an effective means for learning in the classroom setting.[1-3] For the purpose of this article, "case-based" instruction will refer simply to the use of a patient case example as the only element provided in the class. The advent of case-based or problem-based learning has helped in developing basic and applied knowledge; however, there are still students who may "slip through the cracks" in benefiting from this instructional format. Is passive classroom participation alone contributing to this learning stagnancy? Specific case-based strategies, including active discussion/debate among class participants vs. instructor-only presentation in the process of case presentation, has shown variable results.[4-9]

In contrast to an instructor-only method (i.e., without feedback or dialogue from students) the Socratic method involves inquiry and discussion, usually with varying viewpoints, among the participants in a class.[10,11] The instructor provides questions and/or comments for debate and serves to facilitate the formulation (or ruling out) of main concepts and hypotheses from class participants, as well as foster creativity and critical thinking.[12,13] This pedagogical approach is termed a Socratic Circle (or Socratic Seminar), in which the class is driven by student dis-

cussion and debate, rather than by the instructor. Several formats of Socratic Seminars are possible, such as an inner and outer circle of students that debate, pairs or triads of students that consult one another, or small groups of students who self-direct discussion before sharing with the entire class. Regardless of the format, active learning is encouraged.[14] While basic knowledge (that requires rote memorization of the subject matter) is a foundation for learning, the Socratic method also attempts to promote application of knowledge towards solving problems. This adaptive approach to problem-solving has shown positive correlation with medical licensing exam success, and may relate to the critical thinking that occurs in a clinical setting.[15,16]

The purpose of this study was to compare the effectiveness of the Socratic (active) vs. passive case presentation techniques in a classroom setting, by evaluating student written examination performance after each presentation style, as well as by a student exit survey rating each style. It was anticipated that the Socratic approach would lead to better performance in basic and applied knowledge than the passive approach and would be more favorably perceived by students.

Methods

With institutional approval, optometry students in their second year and third year of academic study who consented to participating were recruited on a volunteer basis. Participants received credit (in the form of student continuing education hours required) towards their respective patient care didactic courses. The article's lead author served as the sole instructor for the students. Case-based presentations were conducted during lunch hours over the course of six weeks. After initial introduction of the case presentation schedule and weekly session expectations, a preliminary baseline multiple-choice exam (10 questions, four choices per question) was given to all participants on a novel patient case not presented in class. Half of the exam questions tested for basic knowledge (e.g., "What is the diagnosis?", "What clinical sign is this?") while the other half of the questions tested application of knowledge (e.g., "What is the best treatment?", "What differential diagnosis can this test rule out?").

Currently at this institution, second-year students have a predominantly didactic (classroom, laboratory) curriculum, with patient exposure in the form of five weeks of half-day internal school clinical assistance as well as school optical and external community vision screening assignments. Third-year students have a relatively less heavy didactic load, which is balanced by two days per week of direct patient care (one day of which is a specialty clinic such as ocular disease, contact lenses, pediatrics, vision therapy and low vision) in the internal school clinics, as well as similar optical and external screening assignments as the second-year students. While classroom instruction is overwhelmingly lecture-based for both second- and third-year students, the third-year students also have a required 'grand rounds'-based core course that emphasizes patient case presentations and attendee discussion.

For the study, second- and third-year students were grouped together, with the option of participating in either Tuesday or Thursday lunch hour sessions. Many students were available for either day, and in this case were randomly assigned to either day, with the goal of equal size groups between days. Effort was made to equally distribute second-year and third-year students between and within the groups. **(Table 1)**

Four distinct patient cases were presented over the duration of the study, on which students were tested on each subsequent week. Cases presented covered the areas of pediatrics, low vision, contact lenses, binocular vision and ocular/systemic disease.

Case presentation order was from anterior to posterior anatomical location (i.e., the first case involved an eyelid condition, the second case an oculomotor condition, the third a corneal/contact lens condition, and the fourth a retinal/neuro-ophthalmic condition) as this followed general course topic order for students. Each case was presented using PowerPoint (copyright Microsoft Corp., Redmond WA, USA) slides, and was comprised of the following elements, with special tests only pertinent to each specific case also included:

1. Case History

   Patient age, sex, race, chief complaint, secondary complaint(s), ocular and medical history, surgeries, medications, allergies, habitual visual correction
2. Entrance Tests

   Visual acuities, pupils, motilities, cover testing, near-point of convergence, accommodative testing, screening visual fields
3. Refraction

   Objective, subjective, near add
4. Visual Function

   Phorias, vergences, accommodative tests, oculomotor tests, fusional tests
5. Anterior Segment

   Biomicroscopy findings, intraocular pressure
6. Posterior Segment

   Ophthalmoscopic findings
7. Special Tests

   Perimetry, anterior segment and/or retinal imaging and biometry, electrodiagnostic testing, color, binocular/accommodative tests, other
8. Assessment
9. Plan/Follow-up
10. Billing/Coding

Table 1
Participant Distribution

Participant	TuesdayGroup	Thursday Group	Total (n = 54)
Second year	14	19	33
Third year	9	12	21

In the Socratic method, specific elements above were withheld in order to better facilitate query/discussion by the class participants. Examples of facilitation by the instructor include:

> "What are you suspecting as differential diagnoses based on the case history?"
>
> "What other questions would you ask?"
>
> "What is the most important finding with this case?"
>
> "What is causing this finding?"
>
> "What other tests may be helpful here?"
>
> "Are there any other elements important to the case?"
>
> "Please discuss with your group what the best management would be for this patient."
>
> "Why do you recommend that management?"
>
> "Is there anything about the management that is questionable?"
>
> "Would anyone like to provide another viewpoint in treating this patient?"
>
> "Is there any other education to give the patient?"
>
> "Any other comments/questions to share?"

Students provided both independent input as well as discussion together in pairs or small numbers (fewer than five) with their classmates and presentation to the room as a whole. The instructor was positioned in the center of the students in order to establish a more circular physical conversing arrangement. Students were encouraged to debate diagnoses and treatment strategies, as well as reasoning behind certain viewpoints. New questions and pertinent information from participants were also allowed. The instructor allowed individuals and groups who volunteered their input to speak for an equal amount of time in order to facilitate equitable discussion by both second-year and third-year students.

In the passive method, all case elements were presented to the participants by the instructor only, without student questions or discussion during or after the presentation. While the exact case content was presented as in the Socratic presentation, the instructor did not give any further information or insight aside from providing the diagnosis, management and follow-up information. The instructor was positioned in the more traditional lecture location, at a podium in front of the students.

Each subsequent week at the beginning of each session, students were asked to take a multiple-choice exam (10 questions, four choices per question) relating to the classroom case presented the week prior. As with the baseline exam, half of the questions tested for basic knowledge, while the other half tested for applied knowledge. Questions were written for consistent difficulty level between each examination. The same case was presented using the Socratic method over one session with one group of second-year and third-year students, and presented using the passive method over another session with the other group of second-year and third-year students. In order to minimize class performance bias, each subsequent case had the student groups switch methods. The specific weekly schedule showing case-based presentation type is shown in **Table 2**.

Electronic devices were not allowed during the presentations, and students were instructed not to discuss any aspects of the presentations or exams with other students outside of their scheduled sessions for the duration of the study. However, students were allowed to take notes during each session and were each given a basic point-form summary of the case from each session for independent home study.

At the conclusion of the last case exam, all participating students anonymously completed an online exit survey (SurveyMonkey.com, copyright SurveyMonkey, Palo Alto CA, USA) that asked the following questions to be answered using a 1 (very low) to 5 (very high) Likert scale for both active and passive instruction formats:

Which class format:

1. provided the best learning experience for you?
2. gave you the best eye condition/management information?
3. provided clinically useful pearls/tips/strategies?
4. stimulated creative approaches to patient care?
5. encouraged clinical thinking?
6. would build your confidence in the clinical setting?

The exit survey also asked for written feedback regarding the benefits/drawbacks/observations of either instruction format, as well as ways to improve either presentation style. This was in the form of open text fields in the online survey wherein students could anonymously provide free-form comments without length limitation. In order to reduce bias, students were not given the results of any of their exam scores until completion of their exit survey.

Statistical analysis utilized was a four period crossover ANOVA with two treatments, with the pre-test serving as a covariate that adjusted for individual

Table 2
Weekly Case Presentation and Exam Schedules

Week (case)	Tuesday Group Presentation	Thursday Group Presentation
0	Baseline exam for both groups on initial case (no prior presentation) Randomly assigned students into two groups of equal size	
1	Active	Passive
2	Passive; exam based on Case 1	Active; exam based on Case 1
3	Active; exam based on Case 2	Passive; exam based on Case 2
4	Passive; exam based on Case 3	Active; exam based on Case 3
5	Exam based on Case 4; exit survey	Exam based on Case 4; exit survey

Active (Socratic) or passive (instructor-only) presentations were alternated each week for equitable exposure to both presentation types for each group. The same cases were used for each group.

student differences. Results were illustrated with bar graphs indicating means and 84% confidence intervals. 84% confidence intervals were chosen because they were equivalent to the least significant difference t-test such that non-overlapping intervals were significant at an unadjusted p<0.05. Analysis of exam performance between the two teaching methods was shown in the following areas:

- Overall exam scores
- Weekly exam score trend
- Basic knowledge score
- Applied knowledge score

Analysis of the exit survey was performed using t-test comparison (with statistical significance of p<0.05) between passive instruction vs. active instruction styles. Written student perspectives were prioritized according to identifying the most common (three or more students having similar-themed comments) provided in the survey.

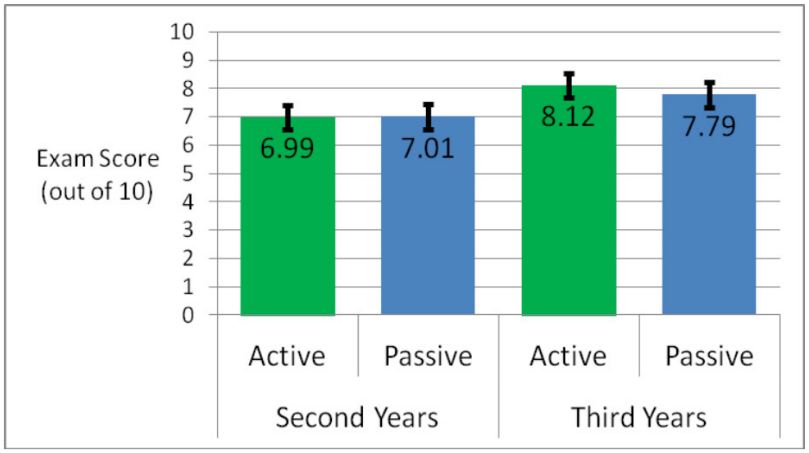
Results

Overall exam scores showed significantly better mean performance for third-year optometry students vs. second-year optometry students (F=12.9, p=.001). There was no statistically significant difference in scores whether active or passive instruction was utilized, regardless of year of optometric study (F=.465, p=0.50). **(Figure 1)**

Similar to the overall exam score, the weekly exam score trend showed no statistical difference in exam scores across the four weeks of case presentations whether active or passive instruction was utilized (Type by Test F=1.62, p=.187), and regardless of year of optometric study (Class by Test F=1.7, p=.63). The one exception was the third-year optometry student exam performance in the fourth week exam. In this case, active instruction showed a significantly better (p<0.05) exam score (8.4/10) than passive instruction exam score (7.2/10). **Figure 2** shows the weekly exam score trend across the four weeks of case presentations, comparing active and passive instruction.

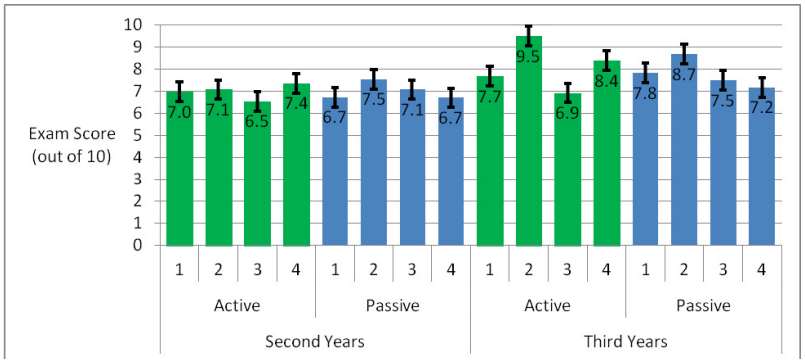
Comparison of active vs. passive instruction style with the basic knowledge question performance is seen in **Figure 3**. Basic knowledge question

Figure 1
Overall Exam Results
for Active (Socratic) vs. Passive (instructor-only) Presentation



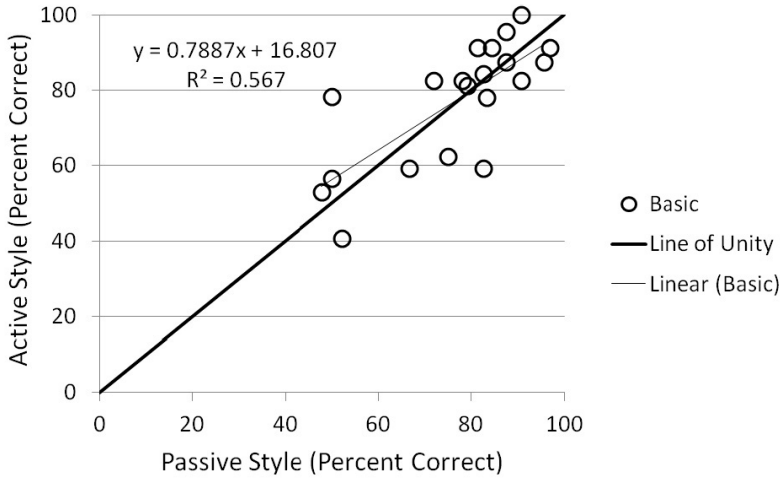
Exam average (out of 10 possible points) is noted near the top of each bar. Non-overlapping vertical bars (84% CI) indicate significant differences at an unadjusted p<0.05.

Figure 2
Exam Result Trend



Numbers along the horizontal axis indicate weekly exam number. Exam average is noted near the top of each bar. Non-overlapping vertical bars (84% CI) indicate significant differences at an unadjusted p<0.05.

Figure 3
Active vs. Passive Instruction Style: Basic Knowledge



Each point represents the percent correct answers for each basic knowledge question (P = 0.81). Points falling on the heavy black line represent questions with the same score on either type of presentation. Scores falling above the heavy line suggest better performance with the active style presentation. The lighter black line is the best fitting straight line.

performance was statistically similar regardless of the instruction style utilized.

Figure 4 compares the active and passive instruction styles with applied knowledge question performance. In this analysis, the linear regression line suggests a greater advantage towards the active style for more difficult (i.e., lower percent correct) applied knowledge questions, although the slope was not significantly different from 1 (t=.65, p>,10).

In the exit survey, students showed a strong preference ($p<0.001$) for the active instruction style. Questions focused on clinical applicability and were ranked according to a 1-to-5 Likert-based scale. The results were consistent in preference regardless of year of optometry school. Overall survey results are seen in **Figure 5**.

The exit survey revealed numerous comments from students regarding each presentation style. A total of 45 comments were received, of which the main themes (those where there were at least three similar comments among participants) were:

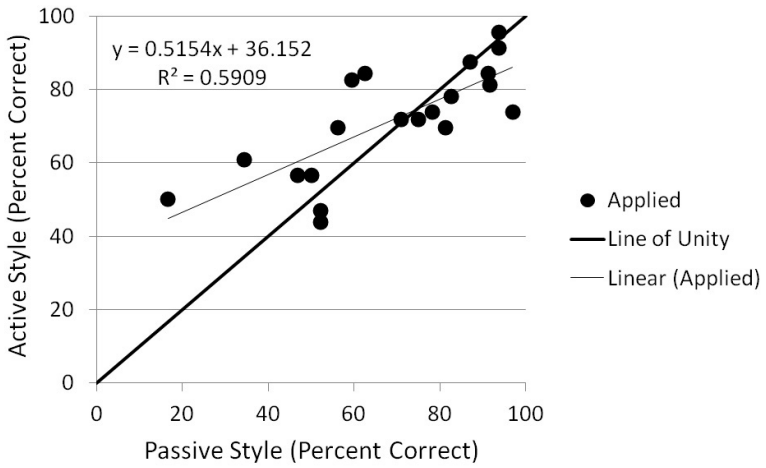
- Increasing clinical/critical thinking with the Socratic method
- Bringing clarity of case elements using the Socratic method
- Deviation off the main topic using the Socratic method
- Longer time involved when using the Socratic method

The comments in **Table 3** represent a sample of the comments along with the main associated theme each comment supports.

Discussion

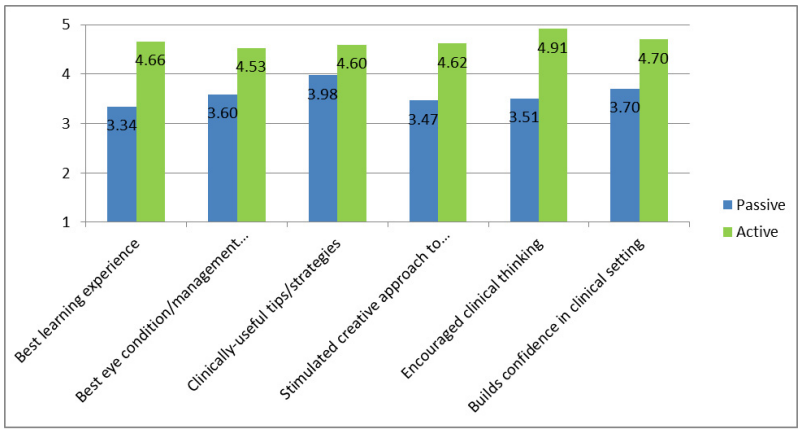
The results of this study demonstrated that overall examination performance did not significantly differ between the Socratic and passive instruction styles. This finding is consistent with those of Cao and colleagues, who evaluated exam performance from traditional vs. case-based learning with ophthalmology students,[17] as well as those of Adamas-Rappaport and colleagues, who compared surgical intern exam performance from unguided vs. guided case-based instruction.[18] In addition, our study found (aside from one third-year exam result) that the trend of all exam

Figure 4
Active vs. Passive Instruction Style: Applied Knowledge



Each point represents the percent correct for each applied knowledge question (P = 0.38). Points falling on the heavy black line represent questions with the same score on either type of presentation style. Scores falling above the heavy line suggest better performance with the active style presentation. The lighter black line is the best fitting straight line.

Figure 5
Exit Survey



Exit survey Likert-based preference scale results comparing active vs. passive instruction (1 = very low, 2 = low, 3 = neutral, 4 = high, 5 = very high). Average is noted near the top of each bar. Statistical significance between each instruction style was p<0.001% for each question (x-axis).

Table 3
Representative Student Comments on Socratic Instruction

Main Theme Associated with Student Comments	Student Comment Example from Exit Survey
Increasing clinical/critical thinking with the Socratic method	"It was interesting to kind of bounce ideas off of one another and the presenter. Because we were asked to participate, it really made us think of how we would handle the situation."
	"I appreciated the input from other students, especially third year students who have clinical experience. Their ideas helped me think more clinically."
Bringing clarity of case elements using the Socratic method	"The group discussion brought points of emphasis and allowed for clarity of points that may have been ambiguous."
	"The discussion made the case far more memorable and more likely to be retained for clinical purposes."
Deviation off the main topic using the Socratic method	"I enjoyed both learning formats, however sometimes I preferred the more straightforward presentations because in a discussion format at times it's easy to skew away from the format and get a bit distracted."
Longer time involved when using the Socratic method	"I do like having the discussion aspect- but it definitely does take longer to get through a case."

Main themes regarding Socratic-based instruction obtained from written student comments in the exit survey. Example comments representing each theme are shown.

performance over four weeks did not show an advantage to either presentation format. In relation to our findings, Mounsey and Reid noted long-term stagnancy of exam performance from case-based instruction of medical students, suggesting only short-term immediate benefit.[19] A meta-analysis of 104 papers summarized that case-based presentation alone does not commonly increase learning, but that additional instructional factors may play a role in building foundational knowledge.[20]

When one looks at basic knowledge vs. applied knowledge, our study suggested (though not statistically significantly) that the Socratic approach may provide a slight advantage for performance with complex applied knowledge questions. This potential for improved application of knowledge using the Socratic method has been discussed in prior research. A recent study evaluating multiple instructional techniques found that a Socratic Seminar technique showed significant critical thinking disposition over other techniques, when quantified through tests.[21] Current findings from Yadav and colleagues support this conceptual understanding advantage,[22] as do those of Yang and others, who noted enhancement of critical thinking skills using the Socratic method.[23,24] An occupational medicine study noted improved test performance when applying interactive case-based instruction vs. paper-form only cases.[25] While basic knowledge was not shown to improve regardless of instruction style in our study, there did appear to be potential for enhancement of critical thinking and applied knowledge using the Socratic approach.

Based on the exit survey quantitative results, student perception of the instruction styles was statistically significant in preference for the Socratic case-based style over the passive case-based style (all questions $p<0.001$). Questions were posed to primarily address clinical applicability over academic learning, and students preferred the Socratic approach for each of these questions. This trend was seen in numerous prior studies. Burder and colleagues found that, along with improved critical thinking exam scores, students felt an improved understanding of science and reviewing scientific literature, and a more positive attitude towards the material when Socratic discussion was utilized.[26] Similar exam and instruction perception results were noted by Lee and colleagues in a medical clerkship setting.[27] Other authors found less favorable evaluations of case-based learning when the instructors reverted to a less interactive presentation style.[28,29]

Along with Likert rating, students' written survey responses showed preference for the active case-based instructional style, based on the number and type of comment themes received. These comments, some of which were seen in the results, were similar to comments obtained from students by Brown in his study evaluating case-guided inquiry in an undergraduate setting.[30] One of his student responses illustrated this theme: "This class forces you to involve yourself with others as a means of problem solving, which is an ideal environment for anyone going on to professional school or, like myself, graduate school."

Student comments brought up the occasional deviation from subject matter by participants during the Socratic sessions, as well as the greater amount of time involved in Socratic instruction. This emphasizes the importance of instructor facilitation in the Socratic format, both in terms of maintaining content focus as well as time management. As Robertson commented, the ideal instructional approach for student motivation to learn may be a balance of the traditional instructor-only and Socratic Seminar styles.[31]

Limitations of this study include its small number participants and a short timeline for longitudinal analysis. The small number and variety of patient cases may also have been a limiting factor, as well as the limited number of examinations. While presentation by a single instructor allowed for consistency, this prevented any inter-instructor analysis of each presentation method. Assessment using more instructors and student participants over a longer duration of instruction, with greater variety of cases and examinations, is recommended.

Conclusions

While case-based/grand rounds or problem-based learning has been shown to be a strong instructional tool, the importance of active vs. passive audience participation using this tool needs further evaluation. In this age of unprecedented access to information, creativity and adaptive thinking may become more valuable in helping patients in a clinical setting. In addition, it may allow students further self-direction through discussion and query, providing a more active means of learning. This study serves as a starting point to explore this teaching pedagogy in optometry further, and opens additional future avenues to evaluate direct benefit to patient care.

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Scholarly Productivity Related to Academic Rank in Optometric Faculty

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Abstract

Background: *Achievement in scholarship has become an integral component in a faculty member's success within an institution. The purpose of this study was to evaluate optometric faculty productivity specifically in the area of peer-reviewed journal publications with regard to success in academic achievement.* ***Methods:*** *Survey questionnaires were emailed to 198 optometric faculty members to elicit information related to career facts such as dates of promotions, tenure and type(s) of advanced degree(s). Scholarly productivity then was assessed using an Internet database search.* ***Results:*** *The data indicated several trends and characteristics of faculty who have reached the level of full professor. The median number of publications associated with advancement from assistant to associate was: 2.5 for the OD group, 1.5 for the Master's group, 6 for the OD/Other Doctorate group, and 5 for the PhD group. The median number of additional publications in advancing from associate to full was: 4.5 for the OD group, 7 for the OD/Master's group, 8.5 for the OD/Other Doctorate group, and 8 for the PhD group.* ***Conclusion:*** *Information provided by this study can be used as a guide for junior faculty, review boards and mentors.*

Key Words: *scholarly productivity, optometric faculty, scholarship, academic promotion*

Introduction

At most optometric institutions, advancement in academic rank and tenure require that faculty members contribute in the areas of teaching, service, scholarship and clinical practice. These expectations have the potential to impact faculty retention rates, a faculty member's success within a particular institution and ultimately a student's education. In most healthcare professions, achievement in scholarly activity (scholarship) has become an integral component of a faculty member's success within an institution.[1] Richard Kennedy defines scholarship as the "creation, discovery, advancement or transformation of knowledge."[2] He notes that "The fruits of such efforts are evidenced only when that knowledge is assessed for quality by peer review and made public."[2]

Scholarly achievements were not always an integral component of a faculty member's responsibilities. Historically, the responsibilities of teachers focused on teaching and the growth of the intellectual and moral minds of students.[3] The early colonial college focused on "building character and preparing new generations for civic and religious leadership."[3] At that time the primary responsibility of a professor was teaching. The evolution of higher education followed the development of the country. As the country progressed through the agricultural and industrial revolution, the need developed for educational institutions to support and serve the public. Consequently, the concept of faculty providing service to the community was added to the teaching responsibilities of faculty.

The development of scholarship paralleled the development of service. Early researchers such as Thomas Jefferson and mathematician Nathaniel Bowditch were outside of the academic institutions.[3] Educator Dael Wolfle wrote "Professors were hired to teach the science that was already known − to add to that knowledge was not expected."[4] As the country evolved, the need for new discoveries that could enhance industrial and agricultural productivity began to emerge. In 1895, University of Chicago President William Rainey Harper required "each appointee to sign an agreement that his promotions

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in rank and salary would depend chiefly upon his research productivity."[5] In addition to service, scholarship was now a component of a faculty member's responsibilities. In a 1989 national survey by the Carnegie Foundation for the Advancement of Teaching, 42% of the nation's faculty members strongly agreed that it is difficult to achieve tenure without publishing.[3]

The expectation for most faculty members is to contribute to the knowledge base of the profession. At most optometric institutions, success in the promotion/tenure process requires contributions and leadership in all relevant areas evaluated: teaching, service, scholarship and clinical practice. Promotion and tenure is the process of formal evaluation, which recognizes a faculty member's contributions.[2] Tenure has the added feature of an indefinite term of appointment.[2] Optometric institutions independently determine the criteria and weight of each of these accomplishments in regard to promotion and tenure. In the medical literature, academic promotion is closely linked to scholarly productivity represented by peer-reviewed publications.[6,7] Personal experience and informal conversations with other optometry faculty members across the nation have revealed that peer-reviewed journal publications are heavily weighted in evaluating the scholarly contributions involved in promotion and tenure decisions in optometric education. Peer-reviewed articles represent publications that have been reviewed by impartial experts (peers) in the topical area of the publication.[8] The reviewers evaluate accuracy of information as well as methodology and procedure. Peer-reviewed articles exemplify scholarly validity and rigor and the best research practices in a field.[8] The focus of this study was on scholarship, specifically peer-reviewed journal publications.

The area of scholarship can be challenging to optometric faculty because most are chosen for their clinical expertise and receive little formal training in scholarship. Lack of experience in scholarship has the potential to impact a junior faculty member's ability to be successful within the promotion system. Success in promotion and tenure often impacts the entire institution as well as the faculty member. Having a team of mid- and upper-level faculty who can act as mentors, academic historians and leaders within an institution is often beneficial to the institution. Retention of faculty can be impacted by the success of faculty within the promotion/tenure system. Many institutions have a limited or terminal contract associated with the failure to achieve tenure.

In the professions of pharmacy and medicine, some research has been done in the area of faculty productivity and academic rank.[9,10] Within the profession of optometry there is a paucity of information available on faculty productivity and academic rank. A search of PubMed, VisionCite and Educational Research Information Center (ERIC) using the mesh terms "optometric faculty" or "optometry faculty" and/or publications, academic achievement, scholarship revealed only a few articles, none dealing with the topic of faculty productivity related to academic achievement. The purpose of this study was to evaluate optometric faculty productivity specifically in the area of peer-reviewed journal publications with regard to success in academic achievement. The goal was to provide career-planning guidance to junior faculty and guidance to review committees establishing criteria for advancement.

Methods

Faculty members from optometry schools in the United States, including Puerto Rico, who achieved the rank of full professor (tenure or non-tenure track) by July 2013 were eligible for inclusion in this study. The faculty members were identified through the Association of Schools and Colleges of Optometry (ASCO) faculty database. The study did not include faculty identified by the ASCO database as clinical full professors. Survey questionnaires were emailed to 198 optometric faculty members who met the criteria. The survey sought information about dates for promotions, tenure if applicable, type(s) of advanced degree, postgraduate residency, institution at time of advancement and current institution. Information was also solicited on names used in publications, such as a maiden name, middle name or middle initial. A second and third survey were sent out 1 month and 4 months later to non-responders.

The scholarly productivity of faculty members was assessed in two ways. Survey respondents had the option of providing the principal investigator with a complete list of their publications. Five percent of the respondents chose this option. Alternatively, a literature search for scholarly publications was conducted using Google Scholar and three databases: PubMed/Medline, VisionCite and ERIC. PubMed/Medline, developed and maintained by the National Center for Biotechnology Information at the National Library of Medicine, was chosen because of its comprehensiveness.[11] Medline contains citations and abstracts from more than 5,600 biomedical journals dating back to 1946.[11] The majority of publications in Medline are scholarly journals.[12] The VisionCite database was chosen because of its concentration in vision science literature and its ability within a search strategy to identify types of articles such as editorials, letters to the editor, etc. The VisionCite database is maintained by the Illinois College of Optometry.[13] It indexes 114 journals containing more than 320,000 articles from 1984 to the present.[13] The database focuses on vision science literature including optometry, ophthalmology, reading and learning disabilities, practice management and other vision-related subjects.[13] The ERIC database contains educational literature, more than 1 million abstracts of documents on education and practice, and 900 journals dating back to 1966.[14] It was included because education articles contained in ERIC are not contained in PubMed/Medline and may not be included in VisionCite. Google Scholar was included because of its ability to crawl other databases to produce articles and information, which insured completeness.[15] Google Scholar, which is part of the Google search engine, has been available since 2004. Google Scholar produces information and citations on a wide range of topics but is particularly strong in the sciences.[15]

Each of the databases and Google Scholar were searched using the faculty member's name and any variation of the name, such as last name with first and middle initials for peer-reviewed

publications. Peer-reviewed publications were recognized as publications in peer-reviewed journals. Peer-reviewed journals were identified in several ways. When possible, only peer-reviewed journals were searched within a database. Unfortunately, this was only available on a limited basis. Journals not recognized by the author as peer-reviewed were evaluated by comparison to the American Academy of Optometry's (AAO) list of acceptable peer-reviewed journals for maintenance of AAO fellowship,[16] researched on the journal's website, or the journal's editor was contacted. The following types of publications were excluded: books, editorials, meeting abstracts, letters to the editor, book chapters, articles in non-peer-reviewed journals and teaching manuals. Publications from clinical studies where authorship for the publication was listed as a study or writing group were also excluded. The list of articles from all the databases and Google Scholar were manually reviewed to determine a unique database of peer-reviewed publications for each of the respondents.

The list of publications was then categorized into rank of authorship and chronologically categorized according to the information provided by each respondent for dates of promotion/tenure. The categories were "before rank of assistant," "assistant to associate," "associate to full," "assistant to tenure" and "post full." Post full indicates achievement of the rank of full professor until the end of the data gathering, December 2013. To allow for consistency, all ranges of years for a specific rank were broken up in the same manner. For example, if a professor became assistant professor in 1998 and became an associate in 2004, the range for assistant was documented as 1998-2003, and then the range of associate began with 2004.

The data provided by some respondents (randomly chosen) were spot-checked for accuracy in identification of peer-reviewed articles, categorization and the counting of the articles. This entailed the primary investigator rechecking databases to identify peer-reviewed articles and recounting numbers of articles in each time frame (assistant to associate, etc.) and category (first author, second author). A 100% accuracy rate was found for the identification of peer-reviewed articles and categorization. A 90% accuracy rate was achieved in the counting of articles. An estimate of the inaccuracies in counting was +/-2 articles.

Three faculty members who represented unique specialty areas (vision science research, public health/low vision and optometric education) were used as test cases to refine the search process and determine the accuracy of the process. Their submitted lists of publications were evaluated against the lists generated by the search process. In each case, 100% of the publications were accurately retrieved using the search strategy.

Descriptive statistics and non-parametric Wilcoxon rank sum test were used to analyze the data. The alpha level for Wilcoxon analyses was equal to 0.05.

This study was reviewed by the Institutional Review Board at the New England College of Optometry and was given an exempt status.

Results

One hundred and ninety-eight surveys were distributed to faculty members who met the study criteria. Seventy-four completed surveys were returned. Of the 74 responses, two were eliminated from the analysis because the respondents obtained promotion from institutions outside the field of optometry. The response rate for usable data was 36%. Respondents' entries into academia were as follows: 35% (25/72) entered from 1966-1981; 39% (28/72) from 1982-1992; and 26% (19/72) from 1993-2003.

The data were analyzed utilizing several different categories, degree obtained, gender and tenure status. Degrees obtained were identified as Doctor of Optometry (OD) only, OD plus any Master's-level degree (OD/Master's), OD plus any other Doctorate-level degree (OD/Other Doctorate), and Doctor of Philosophy (PhD) only.

Table 1 and **Table 2** indicate the total and first-authored publications over a faculty member's entire career up to December 2013. This includes publications before entry into academia. Data analysis showed that total publications independent of degree ranged from 1-320 publications. When broken into degree earned, faculty in the PhD group demonstrated the highest median with 69 total publications. For first-authored publications, faculty with a PhD published a median of 16 publications, and those with an OD/Other Doctorate had a median number of 20 publications.

Table 1
Total Articles Over Entire Career

	N	Min	Max	Median	Mean (SD)
OD	20	1	92	17	24.35 (24.07)
OD/Master's	19	4	82	24	31.79 (24.55)
OD/Other Dr.	22	7	320	32	72.59 (80.27)
PhD	11	9	85	69	53.82 (28.95)

Table 2
First-Authored Articles Over Entire Career

	N	Min	Max	Median	Mean (SD)
OD	20	0	57	7	13.45 (14.81)
OD/Master's	19	0	65	15	18.37 (18.77)
OD/Other Dr.	22	2	106	20	31.41 (29.97)
PhD	11	1	43	16	17.91 (13.22)

Table 3 indicates the total number of articles published before level of assistant, between assistant and associate, between associate and full, before achievement of tenure (assistant professor to tenure), and post full professor until December 2013. **Table 4** represents the same categories for first-authorship articles. Before the level of assistant professor **(Table 3a)** the OD and OD/Master's groups had similar numbers of total publications with a median of 0. The OD/Other Doctorate and PhD groups had more publications at that point, with medians of 3 and 9.5 respectively.

In advancing from assistant to associate **(Table 3b)**, the median numbers of publications associated with advancement were 2.5 for the OD group, 1.5 for the OD/Master's group, 6 for the OD/Other Doctorate group, and 5 for the PhD group. For additional publications in advancing from associate to full **(Table 3c)**, the OD group had a median of 4.5, the OD/Master's group a median of 7, the OD/Other Doctorate group a median of 8.5, and the PhD group a median of 8.

In the group that achieved tenure, (assistant to tenure, **Table 3d**), the median numbers of publications were 5 for the OD group, 3 for the OD/Master's group, 7 for the OD/Other Doctorate group, and 10 for the PhD group. **Table 5** represents comparisons between genders in total articles, first-authored articles and years to reach academic rank. The Wilcoxon analysis did not reveal a statistically significant gender difference for total articles to achieve the level of full professor, Wilcoxon rank sum (p = 1.0), or first-authored articles, Wilcoxon rank sum (p = 0.94). Additionally, the Wilcoxon analysis did not reveal a statistically significant dif-

Table 3
Total Articles Published

Total articles published before level of assistant (3a), between promotions, assistant to associate (3b), associate to full (3c), achievement of tenure (assistant professor to tenure) (3d) and post full professor (3e)							
3a Before Level of Assistant Professor including Before Entry as an Optometric Educator							
	N	**Min**	**Max**	**1st Quartile**	**Median**	**3rd Quartile**	**Mean (SD)**
OD	20	0	6	0	0	1	0.95 (1.54)
OD/Master's	19	0	10	0	0	1	1 (2.36)
OD/Other Dr.	22	0	29	0	3	6.25	4.32 (6.30)
PhD	11	0	33	0.75	9.5	20.5	11.7 (11.78)
3b Assistant to Associate Professor							
	N	Min	Max	1st Quartile	Median	3rd Quartile	Mean (SD)
OD	18	0	11	0.75	2.5	5.25	3 (3.03)
OD/Master's	18	0	8	0	1.5	3.25	2.44 (2.71)
OD/Other Dr.	21	0	24	2	6	11	7.52 (6.77)
PhD	6	0	16	2.25	5	13	6.83 (6.01)
3c Associate to Full Professor							
	N	Min	Max	1st Quartile	Median	3rd Quartile	Mean (SD)
OD	20	0	28	1	4.5	15.25	8.05 (8.39)
OD/Master's	19	0	35	3	7	11	9.21 (9.31)
OD/Other Dr.	22	0	42	4	8.5	15.5	10.77 (9.37)
PhD	8	4	13	4.25	8	12	8.25 (3.73)
3d Achievement of Tenure (Assistant Professor to Tenure)							
	N	Min	Max	1st Quartile	Median	3rd Quartile	Mean (SD)
OD	11	0	13	3	5	7	5.45 (3.91)
OD/Master's	16	0	25	1	3	5	4.94 (6.18)
OD/Other Dr.	17	0	45	4.5	7	15	10.88 (10.66)
PhD	7	2	21	6	10	12	10.14 (5.96)
3e Post Full Professor Status							
	N	Min	Max	1st Quartile	Median	3rd Quartile	Mean (SD)
OD	20	0	63	0.25	2	14	9.65 (15.67)
OD/Master's	19	0	73	2	9	26	15.11 (19.35)
OD/Other Dr.	22	0	200	2.75	11.5	66.25	41.91 (59.29)
PhD	11	5	67	11	21	35	27 (20.75)

Table 4
First-Authored Articles Published

First-authored articles published before level of assistant, (4a), between promotions, assistant to associate (4b), associate to full (4c), achievement of tenure (assistant professor to tenure) (4d) and post full professor (4e)							
4a Before Level of Assistant Professor including Before Entry as an Optometric Educator (first author)							
	N	**Min**	**Max**	**1st Quartile**	**Median**	**3rd Quartile**	**Mean (SD)**
OD	20	0	5	0	0	0	0.55 (1.32)
OD/Master's	19	0	6	0	0	0	0.53 (1.42)
OD/Other Dr.	22	0	13	0	1	4.25	2.5 (3.35)
PhD	10	0	28	0.75	4.5	7.75	6.5 (8.89)
4b Assistant to Associate Professor							
	N	Min	Max	1st Quartile	Median	3rd Quartile	Mean (SD)
OD	18	0	6	0	1	3	1.67 (1.75)
OD/Master's	18	0	8	0	1	3	1.94 (2.48)
OD/Other Dr.	21	0	19	1	3	7	4.76 (5.01)
PhD	6	0	5	1.5	2.5	4.25	2.67 (1.75)
4c Associate to Full Professor							
	N	Min	Max	1st Quartile	Median	3rd Quartile	Mean (SD)
OD	20	0	23	1	2.5	10.25	5.55 (6.5)
OD/Master's	19	0	27	1	3	8	6.42 (8.11)
OD/Other Dr.	22	0	14	2	3	9	5.05 (4.09)
PhD	8	0	9	1.25	3	7.25	3.88 (3.27)
4d Achievement of Tenure (Assistant to Tenure)							
	N	Min	Max	1st Quartile	Median	3rd Quartile	Mean (SD)
OD	11	0	11	2	2	5	3.36 (3.04)
OD/Master's	16	0	21	1	3	4	3.88 (5.12)
OD/Other Dr.	17	0	21	3	5	10	6.65 (6.00)
PhD	7	0	9	1	4	6	4 (3.06)
4e Post Full Professor							
	N	Min	Max	1st Quartile	Median	3rd Quartile	Mean (SD)
OD	20	0	25	0	1	3	4 (7.44)
OD/Master's	19	0	36	0	3	9	6.32 (9.32)
OD/Other Dr.	22	0	73	1.75	4.5	16	14.18 (21.38)
PhD	11	0	18	2	4	7	5.18 (4.90)

Table 5
Gender Comparison

Gender Comparison (Total Articles, Achievement of Full Professor) Wilcoxon rank sum (p = 1.0)					
	N	**Min**	**Max**	**Median**	**Mean (SD)**
Male	52	0	66	9.5	13.56 (13.30)
Female	20	0	25	11	11.55 (7.83)
Gender Comparison (First-Authored Articles, Achievement of Full Professor) Wilcoxon rank sum (p = 0.94)					
	N	Min	Max	Median	Mean (SD)
Male	52	0	33	4.5	8.08 (8.45)
Female	20	0	20	5.5	6.80 (5.94)
Gender Comparison of Years from Assistant to Associate Wilcoxon rank sum (p = 0.38)					
	N	Min	Max	Median	Mean (SD)
Male	47	1	13	4	4.49 (2.30)
Female	16	2	8	4	4.88 (1.96)
Gender Comparison of Years from Associate to Full Professor Wilcoxon rank sum (p = 0.49)					
	N	Min	Max	Median	Mean (SD)
Male	51	2	19	6	7.37 (4.05)
Female	18	2	14	7	7.33 (2.68)

Table 6
Tenure Comparison

Total Articles to Achieve Full (Assistant to Full) Wilcoxon rank sum (p = 0.02) significant					
	N	**Min**	**Max**	**Median**	**Mean (SD)**
Not Tenured	21	0	35	7	8.61 (9.38)
Tenured	51	0	66	12	14.80 (12.58)
First-Authored Articles to Achieve Full (Assistant to Full) Wilcoxon rank sum (p = 0.01) significant					
	N	Min	Max	Median	Mean (SD)
Not Tenured	21	0	29	2	5.24 (7.10)
Tenured	51	0	33	6	8.75 (7.93)
Publication Rate to Achieve Full (Assistant to Full) Wilcoxon rank sum (p = 0.01) significant					
	N	Min	Max	Median	Mean (SD)
Not Tenured	21	0	6.25	0.54	1.00 (1.56)
Tenured	51	0	7.33	1.00	1.60 (1.54)
Years to Achieve Level of Full Professor (Assistant to Full) Wilcoxon rank sum (p = 0.76)					
	N	Min	Max	Median	Mean (SD)
Not Tenured	21	0	20	11	10.10 (5.52)
Tenured	51	2	27	10	11.47 (5.25)
Years (Assistant to Associate) Wilcoxon rank sum (p = 0.19)					
	N	Min	Max	Median	Mean (SD)
Not Tenured	16	2	13	5	5.19 (2.64)
Tenured	47	1	11	4	4.38 (2.04)
Years (Associate to Full) Wilcoxon rank sum (p = 0.62)					
	N	Min	Max	Median	Mean (SD)
Not Tenured	18	2	12	7	7.17 (2.36)
Tenured	51	2	19	6	7.43 (4.12)

ference between the male and female gender for number of years to achieve the level of assistant to associate, Wilcoxon rank sum (p = 0.38), or associate to full, Wilcoxon rank sum (p = 0.49).

The comparison between tenured and non-tenured faculty **(Table 6)** revealed the tenured group consistently had more publications than the non-tenured group with statistical significance being obtained in total articles to achieve the level of full professor (assistant to full), Wilcoxon rank sum (p = 0.02), first-authored articles to achieve full, Wilcoxon rank sum (p = 0.01), and publication rate (articles per year) to achieve the level of full professor, Wilcoxon rank sum (p = 0.01). The number of years to achieve academic rank was similar between tenured and non-tenured faculty.

Table 7 compares publication rates at the level of achieving full professor (from level of assistant to full) and post full. The median publication rate per year decreased post full for all groups except the PhD group. The Wilcoxon signed-rank test did not show a statistically significant difference between faculty achieving full and faculty after achieving the level of full professor, with p = 0.33.

The number of years to achieve academic rank shown by degrees **(Table 8)** indicated a consistent median and mean from assistant to associate level and a range of 5-8 years from associate to full. The median total years to achieve the level of full professor (assistant to full) ranged from 6 years in the PhD group to 12 years in the OD group.

Discussion

Scholarly productivity is an integral component of the promotion and tenure process at most optometric institutions. Scholarship includes the creation, discovery advancement or transformation of knowledge.[2] This definition of scholarship takes into account Ernest Boyer's broad concept of scholarship, which includes the scholarship of discovery (research), the scholarship of integration, the scholarship of application and the scholarship of teaching.[2] The process of peer review helps to insure quality of the publication. Dissemination allows scholarly information the opportunity to impact the profession.

The data indicated that in the early career years before obtaining the level of assistant professor, the group of faculty with a PhD degree had more experience in publication. This group, along with the OD/Other Doctorate group, continued to demonstrate consistently higher numbers of publications as their careers advanced. The Doctor of Philosophy degree implies specific coursework within a discipline and original research leading to a thesis. Therefore, it is expected that this group enters with a specific skill set in research/publication. Additionally, faculty members in this group do not have clinical responsibilities and may have more time allotted to research over the course of their careers.

Table 7
Publication Rate Comparison (publication rate per year)
Wilcoxon signed-rank, p = 0.33

Assistant to Full					
	N	Min	Max	Median	Mean (SD)
OD	20	0	4.375	0.74	1.03 (1.05)
OD/Master's	19	0.083	2.15	0.71	0.85 (0.67)
OD/Doctorate	22	0.111	7.33	0.94	2.19 (2.13)
Doctorate	11	0	4	1.33	1.58 (1.63)
Post Full					
	N	Min	Max	Median	Mean (SD)
OD	20	0	3.32	0.4	0.68 (0.91)
OD/Master's	19	0	4.29	0.5	1.00 (1.15)
OD/Doctorate	22	0	6.90	0.84	1.96 (2.13)
Doctorate	11	0.33	5	2.33	2.34 (1.44)

Table 8
Years to Achieve Academic Rank

Total Years to achieve Full (Assistant to Full)					
	N	Min	Max	Median	Mean (SD)
OD	20	2	20	12	12.25 (4.33)
OD/Master's	19	8	21	11	13.11 (4.34)
OD/Doctorate	22	4	27	9	10.41 (5.29)
Doctorate	11	0	18	6	6.73 (6.390
Years from Assistant to Associate					
	N	Min	Max	Median	Mean (SD)
OD	18	1	13	4	4.94 (2.90)
OD/Master's	18	2	9	4.5	4.78 (2.05)
OD/Doctorate	21	2	11	4	4.29 (1.98)
Doctorate	6	3	5	4	4.00 (0.89)
Years from Associate to Full					
	N	Min	Max	Median	Mean (SD)
OD	20	2	19	7	7.80 (3.41)
OD/Master's	19	4	14	8	8.58 (3.56)
OD/Doctorate	22	2	16	5	6.32 (3.80)
Doctorate	8	2	13	6	6.25 (4.23)

The group of OD/Other Doctorate in most categories had similar numbers of publications to the PhD group. Publication levels in the OD/Other Doctorate group occurred despite Doctorate degrees that may not be research-driven and clinical responsibilities throughout a career.

In contrast, faculty members with OD or OD/Master's degrees in the years before the level of assistant professor had very few or no publications in peer-reviewed journals. This indicates the need for immediate faculty development and support to address the limited experience and skills within this group. To help insure success within the academic environment, continual faculty development, mentorship/collaboration, a supportive infrastructure and strategic planning are important support services to provide.[2] Faculty development can give all faculty new or additional skills and knowledge in the areas of research design, implementation, professional writing and funding.

It is interesting that in many categories the OD and OD/Master's groups had similar numbers of publications. In total publications, from assistant to tenure the OD/Master's group had fewer publications with a median of 3 than the OD group with a median of 5 and only slightly more for first authorship. This trend may indicate a diversity of requirements for the Master's-level degree that may not necessarily include research and publication. It could also indicate that those with the OD/Master's degrees undertook more basic science research, which yielded more long-term publications.

The results indicated that some faculty were promoted with no peer-reviewed publications. This may be attributed to differences in expectations at different institutions, significant publications in areas not researched in this project, e.g., in books or non-peer-reviewed journals, or peer-reviewed publications in databases not researched. In conducting

research for this project, it was noted that many faculty had significant publication in non-peer-reviewed journals or were part of a clinical trial that did not specifically list the authors for the publication, e.g., the authors were listed as the Pediatric Eye Investigator Group (PEDIG) writing group.

Intervals between advancement are independently determined by individual institutions. The median length of time to advance from assistant to associate level was consistent between degrees. However, the median time did vary slightly when advancing from associate to full with a range of 5-8 years. The need for strategic planning exists at all levels of advancement because time intervals between promotion steps and tenure are structured and in some cases not flexible.

Strategic planning should take into account types of project, time frame, where to publish and target audience. A combination of short- and long-term projects may be beneficial for demonstrating continual productivity. The scholarship of discovery, which usually represents research, focuses on discovery, creation and advancement of knowledge. This type of scholarship is important to move a profession forward and in career advancement. However, research projects are often more long-term projects. Projects that can be completed in a shorter time also need to be utilized. Case reports, teaching case reports, review articles, etc., which represent the scholarship of application and integration, address important topics and questions such as "what does it all mean?" and "how can it improve patient care, quality of life or teaching?"[2] These projects can usually be completed in a shorter time frame than some research projects. Projects involving the scholarship of teaching usually reflect creative delivery of material, assessment of outcomes, or novel innovation within teaching. These projects can be either short- or long-term.

Studies have demonstrated that faculty are more likely to publish if they are involved in a collaborative effort.[17] Collaborative efforts can involve peers, consultants or mentors. Mentors are usually in a more advanced stage of their careers with skills and experience in a particular area. Successful faculty members should be expected to serve as mentors to more junior faculty. Mentors have the opportunity to offer networking opportunities, provide advice, offer research opportunities, offer practical suggestions for career development and provide insight into the academic environment.

Guidelines are in place for establishing authorship of a manuscript when the project is collaborative. Authorship implies a fundamental role in the creation of the product, which may include contributions to "conceptualization and design, data collection, data analysis, and creation of the product."[18] In publications with multiple authors, each author should clearly identify his or contribution and role in the product. The guidelines for determination of rank of authorship are vague and left to individual disciplines or professional organizations. In most organizations, first authorship is related to the magnitude of contributions to the final product and is perceived as the most prestigious.[18] First authorship for publications can be a means of demonstrating leadership and should be part of a strategic plan for promotion and tenure.

When determining where to publish, faculty should take into consideration the type of journal (general vs. specialty), likelihood of manuscript acceptance, turnaround time, type of review process (peer, editor, none), indexing and impact factor. In the profession of optometry, when considering where to publish, faculty value the peer-review process and target readership in their area of focus.[19] Indexing, impact factor, turnaround time and overall size of readership are reported to be less important factors.[19] At all times, institutional expectations for faculty must be communicated in a concrete, specific and clear manner.[2] Expectations for publication and promotion must be transparent and clearly set by the institution or faculty review boards.[2]

There does not appear to be any large differences in number of publications or time interval between ranks between male and female faculty. The findings suggested in regard to peer-reviewed publications that institutions follow the same criteria independent of gender. This would contribute to a fair and equitable promotion process. Years to achieve promotion also remained consistent between genders, which may reflect a structured time frame set by the institution. Faculty composition with regard to gender has been changing. ASCO reports that over the past 10 years there has been a 50.9% increase in 1.0 full time equivalent (FTE) female faculty (from 232 to 350) and a 2.6% decrease in 1.0 FTE male faculty (from 351 to 342), while the increase in 1.0 FTE faculty of both genders was 18.9% during that same period.[20,21]

Publication rates for tenured faculty were higher than for non-tenured faculty, which was statistically significant. Eighty-one percent of the optometry institutions in the continental United States and Puerto Rico offer tenure track positions.[20] The achievement of tenure usually represents additional accomplishments and the institution's investment in the future of a faculty member.

After achieving the level of full professor, most faculty were still productive but at a lesser rate. The exception was the group who held a PhD. The decrease in publication rates may reflect projects that are more complex with a longer time frame or it may reflect a shift in senior faculty members' responsibilities. Senior faculty may direct time away from research and publication and into other areas such as mentorship or administration.

The limitations of this study included response rate and human error. The response rate could indicate a bias; only faculty with higher numbers of publications may have chosen to participate. Therefore, the results may not be representative of all successful faculty. Additionally, the relatively small size of this study limited the power of the study. Every precaution was taken to ensure accurate counting and searching for publications; however, despite these efforts it is possible that publications were overlooked or miscounted.

Conclusion

Faculty have many responsibilities in the areas of service, scholarship, teaching and clinic. They are evaluated for promotion based on individual institutions' criteria applied to these categories. A successful portfolio for promotion should be diverse with demonstration

of impact and leadership qualities in all areas. The concept of scholarship is broad. Peer-reviewed publications are one contributing component in this area. This study was designed to provide data from successful faculty members on scholarly productivity as it relates to promotion and tenure. Median, mean and quartile information related to number of publications was reported as a guide for faculty.

To further help faculty achieve their goals, more research is needed. Research into productivity in the areas of service, teaching and clinical practice would be beneficial. Additionally, investigating scholarly productivity from a broader perspective that would include non-peer-reviewed publications and authorship of books and other scholarly material would be useful. This project did not evaluate impact or quality of publications but used successful acceptance into a peer-reviewed journal as a benchmark.

Faculty development, mentorship/collaboration, clear expectations, strategic planning and supportive infrastructure are key elements in supporting junior faculty and all faculty members who wish to advance in academic rank and achieve tenure. Quantity of peer-reviewed journal publications is one important piece of the overall portfolio. Evaluating productivity in successful faculty may provide a useful guide for setting expectations for current and future faculty.

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Teaching Case Report

Subconjunctival Hemorrhage and Diabetes: A Lesson Learned

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Matt Lepage, OD

Abstract

Every year in the United States more adults become legally blind due to diabetes than due to any other disease. This teaching case report reviews the etiology, pathophysiology, clinical presentation, management and treatment options of diabetic retinopathy. This case specifically highlights the need for detailed history-taking and adherence to an appropriate dilation schedule.

Key Words: *subconjunctival hemorrhage, diabetes, diabetic retinopathy*

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Background

Diabetic retinopathy is the number-one cause of new cases of legal blindness in the United States among people who are 20 to 74 years old.[1,2] Approximately 28.5% of U.S. diabetics over the age of 40 have some form of diabetic retinopathy and approximately 4.4% of those diabetics over 40 have vision-threatening diabetic retinopathy.[2] This correlates to 3.8% of the U.S. population having some form of diabetic retinopathy and 0.6% of the U.S. population having vision-threatening diabetic retinopathy.[2]

For the patient involved in this case, a crucial dilated exam may have been bypassed because the chief complaint had been properly identified, treated and explained without dilation. She presented with an acute subconjunctival hemorrhage, a common occurrence that often looks much worse than it really is. A brief history revealed recent fits of intense coughing and sneezing. Both are valsalva maneuvers that are common causes of subconjunctival hemorrhages.[3,4,5,6] An in-depth history revealed that the patient was a poorly controlled diabetic, who had been diabetic for 15 years and had not had a dilated eye exam in the last 18 years, although she had had an eye examination without dilation two years prior. Dilated fundus exam revealed proliferative diabetic retinopathy.

This teaching case report discusses the importance of detailed history-taking and the need to treat the whole patient, not just the patient's chief complaint. This case specifically highlights taking a thorough patient history, including history of present illness, health history, social history and history of previous eye care. The eyecare provider can then use that information to properly identify and treat any and all conditions that fall within the scope of practice and efficiently refer the patient to the proper specialists if necessary.

Student Discussion Guide

Case presentation
10/27/2009

The patient, a 52-year-old Caucasian female, presented to the clinic complaining of a "blood red" left eye start-

ing a couple of days ago. The patient noted a scratchy feeling and pain when moving the eye and reported no particular event associated with the beginning of the redness. However, she did report a recent bout with allergies causing excessive coughing and sneezing. The patient's last eye exam was about two years ago but her eyes were not dilated at that visit. Her last dilated exam was more than 18 years ago.

The patient's medical history was positive for type 2 diabetes, hypertension and seasonal allergies. The patient had been diabetic for approximately 15 years and reported "moderate" control with her most recent fasting blood sugar being 180 mg/dL and glycosylated hemoglobin A1C (HbA1c) being approximately 8.0%. The patient's current medications were metformin, valsartan, triamterene/hydrochlorothiazide and fexofenadine. She was unsure of the dosages for any of her current medications. The patient stated that she was allergic to penicillin, sulfa drugs, cats, dogs and dust.

At this point, the working diagnosis of subconjunctival hemorrhage was made based on patient history and external evaluation. However, because the patient was diabetic, had not had any form of eye exam in two years and had not had been dilated in more than 18 years, a comprehensive eye exam was performed.

The entering distance visual acuities, as measured with her habitual spectacle correction, were 20/40 OD with no improvement with pinhole (NIPH) and 20/50 OS with NIPH. Similarly, near acuities were 20/40 OD, OS. Extraocular muscles were full with pain OS when looking in direction of the redness. She reported no diplopia in any direction of gaze. Her pupils were equal, round and reactive to light with no afferent pupillary defect noted. No Amsler grid defects were reported in either eye. Slit lamp examination confirmed the working diagnosis of subconjunctival hemorrhage temporally OS. The rest of the anterior segment was within normal limits OU, with no neovascularization of the iris (NVI) noted. Intraocular pressures taken with Goldmann applanation tonometry were 14 mmHg OD and OS. Blood pressure measured on the right arm with the patient seated was 140/82 mmHg.

The patient was dilated with 1.0% tropicamide and 2.5% phenylephrine. Fundus examination with 78D lens and binocular indirect ophthalmoscope revealed proliferative diabetic retinopathy OU. The patient had multiple dot and blot hemorrhages in all four quadrants OU, hard exudates OU, neovascularization in the posterior pole OU and a vitreous hemorrhage with tractional retinal detachment in the inferior peripheral retina OS. Optic discs had .3/.3 cup/disc ratios OU with possible neovascularization of the disc OU.

The patient was diagnosed with uncontrolled diabetes with ophthalmic complications, proliferative diabetic retinopathy OU, a tractional retinal detachment OS and subconjunctival hemorrhage OS. She was immediately referred to a retinal specialist for further evaluation and treatment of the diabetic retinopathy. The patient was educated on the benign and self-limiting nature of the subconjunctival hemorrhage. The importance of advanced retinal care was stressed, as was the importance of tight control of her diabetes. The patient was scheduled to be seen by a retinal specialist on the following day. A referral letter was sent to the retinal specialist and an additional report was sent to the patient's internist updating them on the ophthalmic manifestations of the diabetes. **Table 1** summarizes the subsequent treatment the retinal specialist provided.

Key Concepts

1. Importance of a thorough patient history
2. Importance of treating the entire patient and not just the chief complaint
3. Management and care of subconjunctival hemorrhage
4. Pathophysiology, stages and management of diabetic retinopathy

Table 1
Summary of Care from a Retinal Specialist Between 10/29/2009 and 08/31/2011

10/29/2009	Visual acuity was 20/40 OD, 20/50 OS Retinal specialist performed intravenous fluorescein angiography (IVFA) OU IVFA confirmed diagnosis of proliferative diabetic retinopathy (PDR) OU and led to further diagnosis of diabetic macular edema (DME) OU Intravitreal anti-vascular endothelial growth factor (VEGF) treatment, bevacizumab, was given OU Retinal specialist suspects the patient will eventually require significant panretinal photocoagulation (PRP) and possibly a vitrectomy in one or both eyes
12/02/2009	Visual acuity 20/30 OD, 20/50 OS Intravitreal bevacizumab injections performed OU
12/16/2009	PRP performed OS
04/14/2010	Visual acuity 20/30 OD, 20/30 OS PRP performed OD
09/14/2010	IVFA performed to monitor progress; test showed stable retinopathy, but that further treatment would be required
10/06/2010	IVFA and optical coherence tomography (OCT) performed; tests showed stable diabetic retinopathy, but that the patient had developed epiretinal membranes (ERMs) OU, with subsequent macular edema Visual acuity 20/40 OU Intravitreal bevacizumab injections performed OU
10/20/2010	PRP performed OD
10/27/2010	PRP performed OS Retinal specialist recommended the patient be monitored every 3 months by an optometrist; patient elected to see her original optometrist
03/29/2011	IVFA performed and showed that PDR and DME were stable Visual acuity 20/30 OD, 20/40 OS
04/27/2011	PRP performed OS Intravitreal triamcinolone acetonide injection performed OS
05/11/2011	PRP performed OD
08/23/2011	IVFA performed and showed that PDR was stable OU, but DME was worse OD
08/31/2011	Focal grid laser photocoagulation performed OD Intravitreal triamcinolone injection performed OD Retinal specialist recommended the patient have IVFA and OCT performed annually to monitor her diabetic retinopathy

5. Role of the primary care optometrist in the management of diabetes and diabetic retinopathy

Learning Objectives

1. To gain knowledge of subconjunctival hemorrhage, including causes, treatment and management options and indication for further testing including lab testing
2. To gain knowledge of diabetic retinopathy, including the grading of diabetic retinopathy, the use of ancillary testing in the management of diabetic retinopathy and when ancillary testing is warranted
3. To gain an understanding of the primary care optometrist's role in the management of systemic diabetes, specifically the questions to ask every patient with diabetes, the normal ranges for common diabetic test results, timing and frequency of dilated eye exams and the pertinent negatives of a diabetic eye exam
4. Introduction to some of the procedures performed by retinal specialists in the treatment of diabetic retinopathy
5. To understand the role that primary care optometrists play in properly monitoring sight-threatening diseases such as diabetes

Discussion Questions

1. Background knowledge of subconjunctival hemorrhage, diabetes and diabetic retinopathy
    a. Describe the pathophysiology of a subconjunctival hemorrhage
    b. List the risk factors for subconjunctival hemorrhage
    c. Describe the retinal findings at each stage of diabetic retinopathy
    d. Describe the pathophysiology of diabetes
    e. Discuss why the eyes are affected by diabetes
    f. List the pertinent negatives of a diabetic eye exam and describe why they are important
    g. What are the different treatments for diabetic retinopathy? What is the ultimate goal of all diabetic retinopathy treatment? Discuss how the different treatments achieve this goal
2. Primary care optometrist's role in the management of this patient
    a. What was the appropriate treatment for this patient's chief complaint?
    b. Discuss the need and the timing of a dilated eye exam after a patient has been diagnosed with diabetes. What accounts for the discrepancy between type 1 and type 2?
    c. Discuss the need for yearly eye exams for diabetics. Should all diabetics be dilated even if they just need new glasses?
    d. Discuss the role of the primary care optometrist in the management of patients with diabetes. What warrants communication with the patient's primary care physician or endocrinologist? What warrants referral to a retinal specialist?
    e. Discuss the management of this patient. Was the referral appropriate and timely? What else, if anything, must be done to ensure this patient's ocular and systemic issues are properly addressed?
    f. Discuss a primary care optometrist's role in the continued management and treatment of this patient
3. Critical thinking
    a. Why would a patient present with a chief complaint as minor as a subconjunctival hemorrhage, but maybe not seek treatment for something as major as proliferative diabetic retinopathy?
    b. What is the role of the primary care optometrist in the management of diabetes?
    c. What do the patient's retinal findings indicate about the patient's systemic health?
    d. What could have been done by this patient's current optometrist, former optometrist and/or primary care physician that could have prevented this ocular progression of the patient's diabetes?
    e. Recreate this situation and give an example of proper patient education for the patient

Educator's Guide

The educator's guide contains the information needed to discuss the case. Individual educators should tailor the information to a level appropriate for students in the first and second year of optometric education.

Subconjunctival hemorrhage

Subconjunctival hemorrhages, such as the one that initially prompted this patient to present to our eye clinic, are diffuse or local areas of focal blood underneath the conjunctiva.[3-5] The area of blood appears bright red and is visually alarming to the patient, but patients are usually otherwise asymptomatic. The blood can completely obstruct the view of the underlying sclera, and 65.1% of all subconjunctival hemorrhages are located inferior-temporally.[7] The prevalence of subconjunctival hemorrhage increases with age, largely due to the increased prevalence of risk factors.[8] It is estimated that approximately two-thirds of subconjunctival hemorrhages occur after the patient rises from a sitting or resting pose.[9] The primary risk factors and/or underlying etiologies include hypertension, diabetes, high cholesterol, anti-coagulative therapy, surgery, bleeding disorders, trauma or valsalva maneuvers.[3-5,9]

The clinical examination should begin with a detailed history of present illness, including any present allergies or flu symptoms (i.e., sneezing, coughing), any recent strenuous activity or valsalva maneuvers, anti-coagulative medications, bleeding disorders and history of recurrences.[3,4] Further examination should include an in-office blood pressure measurement, biomicroscopic evaluation and, in some cases, a dilated fundus examination if the underlying etiology of the condition cannot be determined based on the history.[3,4]

Subconjunctival hemorrhages start off bright red and gradually change to a

yellowish-green color as they resolve, much like a bruise.[6] Rarely, permanent conjunctival or limbal blood staining can occur.[6] Usually no treatment is required and they will resolve on their own within 2-3 weeks.[3-6] Artificial tears and cold compresses can be used to alleviate any mild ocular irritation.[3-5] If appropriate, the use of blood thinning medications, vitamins and herbal supplements should be discontinued. Anti-platelet or anti-coagulant medications prescribed by a patient's medical doctor should not be discontinued. If the use of an analgesic is necessary, then over-the-counter acetaminophen should be recommended because it has analegesic properties without the anti-coagulant properties of other over-the-counter analgesics. Heavy lifting or other strenuous activities should be avoided.[3] If the hemorrhage lasts for longer than three weeks or recurs, the patient should be referred to his or her primary care provider for further evaluation to rule out underlying conditions such as blood clotting disorders or other systemic blood disorders.[5,6] As our patient's presentation was most likely related to her uncontrolled diabetes in addition to her history of sneezing and coughing, the remainder of this discussion focuses on diabetes and diabetic retinopathy.

Diabetic retinopathy

Diabetic retinopathy is the leading cause of preventable blindness in adults aged 20 to 74 in the United States.[1,2] Some degree of diabetic retinopathy occurs in nearly all of those who have been diabetic for more than 15 years.[1] Among U.S. diabetics, the prevalence of retinopathy is greater in men than women, with 31.6% of males and 25.7% of females having some degree of diabetic retinopathy. Diabetic retinopathy is more common in minorities in the United States with 38.8% of diabetic, non-Hispanic blacks developing retinopathy, 34.0% of diabetic Mexican Americans developing retinopathy and 26.4% of non-Hispanic whites developing retinopathy.[2] Other estimates indicate that the prevalence of diabetic retinopathy can be as high as 50% of those with type 2 diabetes, and up to 86% of those with type 1 diabetes.[10] The prevalence of diabetic retinopathy is slowly decreasing in developed countries due to improved control of the risk factors. Unfortunately, the prevalence of diabetic retinopathy is increasing worldwide in developing countries due to changing lifestyles.[10]

The main risk factors for developing diabetic retinopathy include increased duration of diabetes, hypertension, elevated blood glucose levels, high cholesterol and insulin dependence.[2,10,11] Reduction of blood glucose levels, blood pressure and serum lipid levels is likely to reduce the incidence of diabetic retinopathy.[2,10,11] Conversely, while controlling these factors may increase life expectancy, this increased longevity increases patients' chances of developing diabetic retinopathy over their lifetime.[10]

Other risk factors for diabetic retinopathy include intravascular fluid overload, hypoalbuminia and anemia. Intravascular fluid overload secondary to congestive heart failure or renal failure causes increased vascular hydrostatic pressure. Hypoalbuminia due to renal loss of albumin or decreased albumin production can cause decreased vascular osmotic pressure. Anemia causes further retinal hypoxia, which exacerbates diabetic retinopathy.[11] Often these factors are not considered when taking a diabetic history. It is important to ask diabetic patients about any heart failure and about serum lipid levels, and to check for ankle swelling, measure blood pressure and evaluate retinal vessel caliber for hypertensive changes.[11]

Pathophysiology of diabetic retinopathy

The blood vessels, neurons and glial cells of the retina are made up of a variety of different cell types, which help comprise the blood-brain barrier. Diabetic damage to these cells can result in retinopathy from a breakdown of the blood-brain barrier.[11]

In diabetes, endothelial cells and pericytes of the retinal blood vessels can become damaged and lead to diabetic retinopathy.[11] Endothelial cells comprise most of the blood-retinal barrier and help regulate homeostatic blood flow.[11] Pericytes, located between the endothelial cells, are modified smooth muscle cells that aid in dilation and contraction of retinal blood vessels to accommodate blood flow.[11] Diabetic damage to the tight junctions between the vascular endothelial cells causes increased vascular permeability and a degradation of the blood-brain barrier.[10,11] The blood-brain barrier prevents the retinal tissue from coming in contact with the inflammatory and cytotoxic elements found in blood.[11]

The blood-brain barrier is comprised of special proteins called occludins and claudins, which act like adhesive material between the endothelial cells that make up the functional barrier.[11] These proteins span the entire plasma membrane and restrict the flow between endothelial cells. Studies have shown that diabetes can reduce the number of these proteins and cause a breakdown of the blood-brain barrier.[11]

Müller cells and astrocytes are two main types of glial cells of the retina.[11] Glial cells are support cells that help regulate retinal metabolism and modulate the functions of neuroretinal cells and retinal blood vessels. They are similar to tissue macrophages in that they are very sensitive to changes in retinal homeostasis and can rapidly become phagocytic when this homeostasis is altered, as in diabetic retinopathy.[11] Müller cells span the entire retinal thickness and act to regulate extracellular ionic balance, glutamate metabolism and overall neuronal function.[11] Astrocytes are located within the retinal nerve fiber layer and have end feet that wrap around retinal blood vessels and ganglion cells to provide them with support. Astrocytes also express tight junction proteins that contribute to the blood-retinal barrier.[8] Diabetic damage also causes a reduction in glial fibrillary acidic protein (GFAP), altering the structural stability of astrocytes and affecting retinal vascular function. This is thought to exacerbate vascular permeability and cause changes in blood flow.[1,11] Diabetes can also alter Müller cells, causing them to proliferate and form an epiretinal membrane.[11]

Neuronal cells are cells that perform phototransduction, the formation and transduction of nerve impulses from visible light.[11] There are four main types of neuronal cells in the retina: photoreceptors, bipolar cells, amacrine cells and ganglion cells.[11] In states of distress, these neuronal cells can become altered and/or reduced. This reduction of cells

manifests as vision changes that precede the vascular changes detected on funduscopic examination. Early electroretinogram (ERG) changes can be seen in those with diabetes before any clinical retinopathy is present.[1,11] Changes in color vision and contrast sensitivity can also occur before clinical retinopathy is present; these changes are especially present with blue-yellow contrast and in low-light conditions.[1] Some believe these changes can predict a future progression of retinopathy better than clinical characteristics.[1] Early diabetic damage causes apoptosis of retinal ganglion cells, reducing the number of ganglion cells and decreasing the thickness of the inner retina.[1,11] Further diabetic damage results in retinal swelling, which causes the thickening of the inner retina seen in diabetic edema. It was once thought that diabetic retinopathy was solely a vascular disease, but the early damage that precedes any vascular events proves diabetic retinopathy is both a vascular disease and a neurodegenerative disease. After macular edema has resolved, many patients with diabetic retinopathy continue to have decreased vision and this neurodegenerative component of the disease accounts for some of this decreased vision.[1]

The retina has a higher metabolic demand than any other part of the central nervous system. This high oxygen demand combined with the delicate nature of the retinal vasculature causes the retina to be very susceptible to hypoxia.[10] When areas of the retina become hypoxic, a cytokine called vascular endothelial growth factor (VEGF) is expressed by the neurons and glial cells of the retina.[1,10,11] This cytokine is a potent biogenic permeability factor that causes a reduction in the number of occludins and claudins.[1,10] This reduction in proteins results in an increase in vascular permeability, which is designed to be a survival factor for neurons.[1] The vessels become leaky in the body's attempt to deliver more blood to the hypoxic areas. VEGF also induces endothelial cell proliferation, promotes cell migration and inhibits apoptosis by reducing tumor necrosis factor. These processes result in the formation of new capillaries bringing more blood to the hypoxic area.[1] This angiogenesis, or neovascularization, results in new vessels that are very permeable and rupture easily, causing further retinal hemorrhaging and microaneurysms. The angiogenic vessels can also form fibrovascular membranes that cause tractional forces on the retina and create the potential for a tractional retinal detachment.[10]

In addition to the hyperpermeability of retinal vasculature and vascular angiogenesis, retinal hypoxia can also be caused by microthrombosis.[10] Thrombus and/or embolus formation can occur in retinal capillaries and lead to retinal non-perfusion. Thrombosis can be induced by changes in the vascular wall structure, changes in blood components and changes in blood flow.[10] Diabetes can cause abnormal blood flow, coagulation and fibrinolysis, promoting clot formation. Platelets, fibrin, and leukocytes all play an important role in this clot formation, and their expression is altered in diabetes.[10]

Diabetic retinopathy also has an inflammatory component. Chronic inflammation is inflammation of prolonged duration in which active inflammation, tissue destruction and gliosis occur simultaneously.[11] Non-proliferative diabetic retinopathy (NPDR) is characterized by vasodilation, increased blood flow, tissue edema and increased vascular permeability followed by neovascularization and gliosis.[11] Thus, NPDR meets most criteria for chronic inflammation. It is not currently known why diabetes inflicts an inflammatory response in the retina, but it is important to realize that this is occurring so proper treatment, such as corticosteroids, can be administered.[10]

Clinical presentation of diabetic retinopathy

The clinical signs of diabetic retinopathy include a wide array of hemorrhages, new vessel growth and retinal edema. The main symptom of diabetic retinopathy is reduced vision, but this generally doesn't manifest until the retinopathy is advanced and irreversible damage has already occurred.[1,10-12]

The least severe vascular lesions are the microaneurysms and dot/blot hemorrhages. Microaneurysms are focal dilations of the retinal veins, which occur in the inner nuclear or outer plexiform layers of the retina.[12,13] If the microaneurysms rupture they produce dot/blot hemorrhages.[14] Microaneurysms and dot/blot hemorrhages are small and confined to a specific location by intraretinal compression. Because dot/blot hemorrhages are located deep in the retina relative to other types of hemorrhages, they may take slightly longer to resolve.[13] Both are associated with microvascular edema and are caused by defects of the pre-venular retinal capillaries.[13] These lesions can be easily detected via dilated fundus examination. The use of a red-free filter may help improve contrast of the blood against the retina to ease detection of small hemorrhages.

Another relatively minor form of retinal hemorrhage is the "flame-shaped" hemorrhage.[12,13] They are sometimes termed nerve fiber layer (NFL) hemorrhages because they occur in the nerve fiber layer of the retina. These hemorrhages reflect the structure and organization of the nerve fibers because the blood is being squeezed within the axons of the ganglion cells, which causes them to take on a characteristic flame-shaped appearance.[13] These hemorrhages are associated with pathology affecting the superficial and peripapillary capillary beds and usually resolve within six weeks. Flame hemorrhages are also commonly found in hypertensive retinopathy.[13] Flame hemorrhages can also be easily detected by funduscopic examination.

Other hemorrhages that can occur in diabetes are sub-hyaloid hemorrhages and pre-retinal hemorrhages. Sub-hyaloid hemorrhages are located on the surface of the retina, between the posterior vitreous face and the interior limiting membrane of the retina. Pre-retinal hemorrhages are located posterior to the interior limiting membrane, but anterior to the nerve fiber layer, thus contained within the retina.[13] However, it is often difficult to discern exactly where the blood is lying, so these terms are used interchangeably. These hemorrhages are often called "boat-shaped" or "D-shaped" hemorrhages because the blood is pulled inferiorly by gravitational forces and contained by the structure of the curved retinal vessels, taking on a characteristic rotated-D or boat-hull appearance.[13] These types of hemorrhages are associated with pathology affecting the major

retinal blood vessels or superficial capillary beds. Sub-hyaloid and pre-retinal hemorrhages typically result from the rupture of new vessels that are formed in angiogenesis.[13] These hemorrhages usually clear up relatively quickly, but the underlying neovascularization and fibrosis remain.[13] These hemorrhages can be detected by funduscopic examination, but utilization of optical coherence tomography (OCT) technology may help determine their exact location.

Other serious types of hemorrhages that can occur in the retina are sub-retinal or sub-retinal pigment epithelium (RPE) hemorrhages. Sub-retinal hemorrhages are located in the space between the neurosensory retina and the RPE. Sub-RPE hemorrhages are located between the RPE and Bruch's membrane.[13] They are easy to differentiate from sub-hyaloid or pre-retinal hemorrhages because they have a much darker coloration and the retinal vessels can often be clearly seen running over the hemorrhage.[13] Sub-retinal hemorrhages usually have a poorly defined, amorphous shape due to the absence of firm attachments in the space between the neurosensory retina and the RPE, whereas sub-RPE hemorrhages tend to have well-defined borders due to the tight junctions between RPE cells.[13] These types of hemorrhages are of significant concern because they can cause neurosensory or RPE detachments. They resolve very slowly and often cause structural changes in the photoreceptors, which results in permanent loss of vision.[13] These hemorrhages are most commonly caused by choroidal neovascular membranes (CNVM), which arise from the underlying choroidal vascular supply.[13] These hemorrhages can also be detected by funduscopic examination, but use of OCT is also be beneficial to determine the location of the hemorrhage. Intravenous fluorescein angiography (IVFA) can be used to determine whether a CNVM is present, but OCT has limited the need for this procedure because it is faster, easier and less invasive than IVFA.

Non-hemorrhagic findings in diabetic retinopathy include cotton wool spots (CWS) and hard yellow exudates (HYE).[14] CWS are a result of capillary occlusion in the retinal nerve fiber layer. They cause a reduction in axoplasmic flow in the nerve fibers, resulting in the swelling of and then the ischemic death of neural tissue.[14] They have a characteristic fluffy, white, cotton-like appearance and are usually less than 1 disc diameter in size, but can be up to 2 to 4 disc diameters in size.[14] CWS are almost always found adjacent to a major retinal vessel, and are commonly seen in hypertensive patients in addition to diabetic patients. The presence of CWS could indicate rapid progression of retinopathy.[14] HYE are accumulations of serum lipoproteins that have leaked out of damaged retinal vasculature and are condensed in the outer plexiform layer of the retina.[14] As these accumulations become more concentrated, they take on a characteristic hard, waxy appearance. Microaneurysms are the principal source of this fluid plasma leakage into the retina. It is thought that the attachments between Müller cells are the reason that this concentration of lipoproteins occurs.[14] These inter-photoreceptor adhesions restrict the movement of larger molecules, such as lipids and proteins, but allow water to pass towards the choroid so it can become resorbed into circulation, leaving behind the plasma byproducts. It is possible for HYE to become reabsorbed, either spontaneously via phagocytosis by macrophages or following laser photocoagulation treatment.[14]

Other clinical signs of diabetic retinopathy include vascular changes. Early changes include vessel tortuosity and dilation in response to reduced retinal circulation. These changes can be important indicators of potential proliferative disease.[14] Venous beading can occur in conditions of increased retinal hypoxia. More serious vascular changes include intra-retinal microvascular abnormalities (IRMA) or neovascularization.[14] IRMA are the hallmark sign of severe NPDR. IRMA are essentially new vessels that are contained within the retina and have not penetrated the internal limiting membrane of the retina.[14,15] They form secondary to progressive vessel damage, which causes blood to be shunted through small capillary networks that were not intended for such high blood flow.[14] This results in distension and irregularity of these capillaries. If the new vessel penetrates the internal limiting membrane, it becomes true neovascularization, which is the defining trait of proliferative diabetic retinopathy (PDR).[14,15] If this new vessel growth is located on or within 1 disc diameter of the optic nerve head, it is termed neovascularization of the disc (NVD). If this new vessel growth is expressed elsewhere throughout the fundus, it is simply called neovascularization elsewhere (NVE).[14] In conditions of global ischemia, neovascularization can extend anteriorly to the anterior angle or pupillary margin and grow over the surface of the iris; this is called neovascularization of the iris (NVI) or iris rubeosis.[14] These different classifications of new vessel growth all have a similar delicate, wispy appearance, and are sometimes difficult to differentiate from IRMA without utilization of IVFA.[3,4,15]

Given the complexity of diabetic retinopathy, it is difficult to classify its severity. The Early Treatment Diabetic Retinopathy Study (ETDRS) provided the gold standard in classification of diabetic retinopathy. The classification ranges in severity from mild NPDR to high-risk PDR, with several stages of severity in between. **Table 2** summarizes this classification.

Diabetic macular edema (DME) is the primary cause of vision impairment in diabetic retinopathy.[1,10,11,14] As mentioned previously, increased permeability of retinal vessels causes a leakage of plasma fluid. This fluid initially accumulates in the outer-plexiform and inner-nuclear layers of the retina and eventually disperses throughout the entire retina.[14] The underlying cause of DME is no different than the underlying cause of NPDR, but it is classified differently given the specialized structure and function of the macula.[14] DME is more prevalent in type 2 than in type 1 diabetes, but the risk for diabetic macular edema for any diabetic is 30% after having the disease for 20 years.[14] Macular edema is difficult to detect via direct ophthalmoscopy without the depth perception provided by fused binocular vision. Utilization of a diagnostic aspheric lens along with a slit lamp biomicroscope can aid in detecting this condition.[14] If macular edema is suspected, IVFA or OCT should be performed to confirm the diagnosis.

The ETDRS group has defined DME vs. clinically significant macular edema (CSME).[16] **Table 3** summarizes these characteristics.

Optometrist's role in diabetes management

As a primary eyecare provider, optometrists play an important role in the management of diabetes and monitoring for diabetic changes in the eye. Frequently, endocrinologists or general practitioners refer their diabetic patients to optometrists for a dilated fundus examination. This method of examination serves as a non-invasive way to view the retina and the retinal vasculature in real time. The status of the retinal vasculature is a valuable snapshot of the overall systemic control of the patient's diabetes. The presence of diabetic retinopathy may indicate microvascular dysfunction in other organ systems.[2]

A comprehensive diabetic eye examination should always start with a thorough history.[3,4] The doctor should ask what type of diabetes the patient has, and when he or she was first diagnosed. This is important because, as we know, the duration of diabetes is a major risk factor for diabetic retinopathy.[2,10,11] Up to 21% of patients with type 2 diabetes have retinopathy at the time the diabetes is diagnosed. Therefore, it is recommended that type 2 diabetics have comprehensive eye exams within 1 year of diagnosis and yearly thereafter. Type 1 diabetics over age 10 should have at least one comprehensive eye exam within 3-5 years of initial diagnosis and on a yearly basis thereafter. It is very rare for type 1 diabetics to have retinopathy within the first 3-5 years of diabetes or before puberty, but during the first 20 years of the disease nearly all type 1 diabetics develop retinopathy.[17]

The optometrist should ask what the patient's fasting blood sugar and glycoslylated hemoglobin (HbA1c) readings are and when each was last measured. It is important to know what the expected ranges of blood glucose levels are in order to know how controlled the disease is. **(Table 4)**. It is also beneficial to inquire about other systemic factors such as medications, blood pressure, cholesterol levels and renal function.[17]

Four "pertinent negatives" should always be noted in a diabetic eye exam. These clinical signs are pertinent negatives because their presence indicates diffuse ischemia, PDR and the potential for permanent blindness.[17] These signs include CSME, NVI, NVD and NVE.

Treatment and management of diabetic retinopathy

Much of the damage done by diabetic retinopathy, especially the early neurodegenerative damage, is irreversible; therefore, the best treatment is prevention.[1,10] The primary preventative treatment for diabetes and diabetic retinopathy is tightly controlled blood glucose levels through a careful diet and regular exercise.[2,10] Early diabetic retinopathy is often asymptomatic but its presence indicates the need for tighter control through medication and healthier living. Maintaining an HbA1c of less than 7% significantly reduces the risk of diabetic retinopathy.[10] The risk is not eliminated, but the United Kingdom Prospective Diabetes Study (UK-

Table 2
Classification of Diabetic Retinopathy from the Early Treatment Diabetic Retinopathy Study

Diabetic Retinopathy Classification	Findings / Characteristics
Mild NPDR Recommended follow-up 6-12 months [11]	• At least one microaneurysm, BUT not severe enough to fall into a more severe classification (see below)
Moderate NPDR Recommended follow-up 6 months [11]	• Hemorrhages and/or microaneurysms that are greater than or equal to "Standard Photograph 2A," and/or soft exudates, and/or venous beading, BUT not severe enough to fall into a more severe classification (see below)
Severe NPDR Recommended follow-up 2-4 months [11]	• "4-2-1 Rule" • Hemorrhages and/or microaneurysms present in all 4 quadrants on funduscopic view OR venous beading present in 2 quadrants OR intraretinal microvascular abnormality in 1 quadrant, BUT not severe enough to fall into a more severe classification (see below)
Early PDR (proliferative retinopathy that does not meet the high-risk characteristics listed below) Referral to retinal specialist indicated [11]	• New vessel growth BUT not severe enough to fall into a more severe classification (see below)
High-Risk PDR Referral to retinal specialist indicated [11]	• New vessel growth 1 disc diameter in size, within one disc diameter of the optic disc (NVD) • Vitreous and/or pre-retinal hemorrhage accompanied by any new vessel growth at optic disc, or with new vessel growth of ½ disc area or larger anywhere else

Table 3
Classification of Macular Edema from the Early Treatment Diabetic Retinopathy Study

Macular Edema Classification	Findings / Characteristics
Diabetic Macular Edema (DME)	• Hard yellow exudates (HYE) and retinal thickening that involves the macular area
Clinically Significant Macular Edema (CSME)	• Retinal thickening at or within 500 µm of the center of the macula, OR: • HYE at or within 500 µm of the center of the macula, IF they are associated with adjacent retinal thickening, OR: • An area of retinal thickening 1 disc area in size, at least part of which is within 1 disc diameter of the center of the macula • The presence of any ONE of these criteria is sufficient for diagnosis of CSME

Table 4
The American Diabetes Association Recommended Blood Glucose Levels for Patients with Diabetes

	Recommended Range For Patients with Diabetes
Fasting Blood Sugar	70-130 mg/dL
HbA1c	< 7.0%, but more or less stringent goals may be appropriate on an individual basis

PDS) showed that for 1% reduction in HbA1c there is a 30-40% diabetic retinopathy risk reduction.[10,17] The UKPDS also showed that tight glucose control reduces the risk of legal blindness due to diabetes by 16%.[10]

Other systemic risk factors include high blood pressure and elevated serum lipid levels. Hypertension can exacerbate diabetic retinopathy by means of increased blood flow and mechanical damage to the retinal vasculature, which consequently causes an increase in VEGF expression.[10,11] Elevated serum lipid levels are a risk factor for hard exudates and diabetic retinal edema. Retinal lipid deposition also impairs retinal function. The Diabetes Control and Complications Trial (DCCT) showed that the severity of diabetic retinopathy was directly related to increased triglyceride levels and was inversely associated with "good" high-density lipoprotein (HDL) cholesterol levels.[10]

Control of systemic risk factors does not always prevent the development of diabetic retinopathy. If retinopathy becomes severe, medical and surgical intervention is required to preserve vision.[10,14] Laser photocoagulation, anti-VEGF treatment, steroid treatment and surgical vitrectomy can all be used, either standalone or in concert, to treat vision-threatening retinopathy.

Laser photocoagulation is a process in which a laser is used to destroy areas of retina where hypoxia and neovascularization are occurring in order to reduce further angiogenesis. This process causes a reduction in retinal neovascularization and reduces central macular thickening/swelling.[10] Laser photocoagulation has been shown to halt the course of diabetic retinopathy in approximately 50% of cases but often has to be repeated multiple times.[1] The ETDRS indicated that laser photocoagulation could reduce the risk of moderate vision loss by up to 50%.[10]

Intravitreal injection of VEGF-inhibitors can also be used in treatment for retinal angiogenesis. Two common anti-VEGF drugs that are used for intravitreal injections are bevacizumab (Avastin) and ranibizumab (Lucentis).[10] Bevacizumab is a humanized antibody derived from mice that was FDA-approved for metastatic colorectal cancer in 2004, but it is frequently used off-label as an intravitreal injection to treat DME.[10] Ranibizumab is derived from bevacizumab and is specifically formulated for ocular injection. Ranibizumab has a much smaller molecular weight than bevacizumab, which enables it to penetrate the retina much faster.[10] The injection of these drugs into the vitreous humor of diabetic eyes is intended to reduce the expression of VEGF, reducing angiogenesis and ultimately reducing retinal hemorrhages and edema. It is possible for a patient with DME to gain at least 10 letters of visual acuity in a 1-year span, but the patient may need multiple injections.[10]

Steroid treatment is also commonly used to control DME. Sub-Tenon's or intravitreal steroid injections and intravitreal steroid implants have been shown to reduce DME and diabetes-related retinal inflammation.[10] The mechanism is not fully understood, but studies have shown that hydrocortisone can increase the amount of tight junction proteins that line retinal endothelial cells.[10,11]

Vitrectomy is a last resort for preserving vision in patients with diabetic retinopathy. It is considered when the patient has had recurrent or persistent vitreous hemorrhages or in cases of tractional retinal detachments.[10] The vitreous and any associated hemorrhages, proliferative membranes, various cytokines and growth factors are surgically removed from the eye.[10] Laser photocoagulation is often administered to the peripheral and mid-peripheral retina at the same time in order to reduce the angiogenesis after vitrectomy. The Diabetic Retinopathy Vitrectomy Study (DVRS) indicated that performing a prompt vitrectomy in type 1 diabetic patients with severe vitreous hemorrhage resulted in improved visual acuity.[10]

It is very important to perform yearly dilated fundus examinations on all patients but especially on diabetic patients. Follow-up intervals including dilation may be more frequent if retinopathy appears to be advancing or if blood glucose levels are not controlled. As an example, patients with CSME should be referred for treatment and then followed every 3-4 months after treatment. If treatment is deferred by the retinal specialist, generally patients are followed within 3 months.[19] The potential consequence of unmonitored diabetes is irreversible vision loss that could have been prevented and as such careful monitoring is crucial.

Conclusion

The detailed history-taking and wise decision-making of the primary care optometrist likely helped preserve this patient's vision. Cases like this serve as a reminder of the importance of yearly dilated exams for all diabetic patients. If a diabetic patient is not compliant with keeping yearly appointments but presents in the optometrist's office for other reasons, the opportunity should be used to emphasize the importance of retinal health assessment, even if the present chief complaint can be solved without dilation.

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