The laser eye surgery health and social care essay

Mary HughesDept of IT and Lawm. hughes2@nuigalway. ieAbstractAnyone who does not have the luxury of 20/20 vision and requires the aid of glasses or contact lenses for corrective vision has been a regular to an optometrist for eye care. The use of technology within the Optometry industry has impacted people’s lives immensely. The use of a computer is used for simple tasks such as word processing, writing referral letters to specialists. Also keeping patients records secure on file on a computer database. Computer and software applications are also used, For example, they use computerized optometry equipment such as keratometers, phoropters, tonometer’s, visual field instruments and digital cameras to assess patients' visual acuity and eye wellbeing. These Products have evolved through technology and are used every day in an optometrist practice. The use of laser eye surgery for an example has rid people from the burden of wearing corrective lenses on a daily basis. There is nothing worse than stepping out on a rainy day and have you glasses fog up. It has major benefits to a person’s life. In this paper I will look at the technological changes in Optometry throughout time and the technological products available to those who work in this practice and the benefit it has for patients. As a person who wears glasses for corrective vision I understand the burden corrective lenses have on a person life and the benefit such technologies as laser eye surgery would have on a person’s life. The use of Information Technology in Optometry practices is widespread and likely to continue to increase in the years ahead. Information Technology may be a key element in the future success of optometry practices in an increasingly competitive marketplace.

1. Introduction

The 20th century is denoted by the constant of an ever-increasing technology base that facilitates eye care specialists to do more for more people. An accredited optician provides individuals with a variety of vision aids such as contact lenses or glasses. Optometrists are able to perform intricate eye surgeries and provide patients with other types of care. Someone working as an accredited optician must oversee vision tests to establish the source of an individual's eye predicaments. These tests typically include the patient having to read a series of lines of text that contains variously sized letters. Based on the exam results, the optician may establish that the patient is short-sighted, long-sighted or suffering from some other kind of vision imperfection. A licensed optician will write a prescription for contact lenses or glasses of the correct strength and type to improve the patient's sight. The term " optometry", this comes from the Greek word optos (vision) and metria (measurement). The practice of optometry dates back to the 13th Century. In 1263, Roger Bacon first declared lenses as being useful to those who suffered with weakness of sight. It was another 20 years or so before spectacles were invented in Northern Italy. Johannes Kepler, a German scientist, discovered how the retina in the eye creates vision in 1604. In 1623 the earliest book on the study of the anatomy of the eye as well as how to appropriately create glass lenses to improve vision was authored by Benito Daza de Valdes. Since this pioneering book, numerous improvements have been made in the field of optometry. Cataracts were first effectively removed from the eye in 1748 and millions now undergo the procedure every year. A correction for astigmatism, which I suffer from, was designed in 1827. Astigmatism refers

to any other distortion of the cornea, which bends or warps and causes imperfect vision. The creation of the bifocal in 1760, the growth of optical companies and the development of new diagnostic technology in the 19th century, and the introduction of contact lenses in the late 20th century. The early stages of laser surgery can be traced back to 1983 when Dr Stephen Trokel, a New York eye surgeon, fired lasers into eyes taken from the cadavers of cows in an attempt to discover a more detailed means of refractive surgery. Figure 1: Anatomy of the Eye

2. New Technologies

The use of new technology is changing the ways of optometry. Technological advances in glasses and contact lenses have increased the demand of skilled, knowledgeable eye care professionals. As a result, eye care practitioners deal today with an expanding amount of imaging and analysis equipment that allows opticians to improve their understanding of the ocular structure and function as never before. New imaging devices, surgical procedures, and use of the internet are examples of advances that have made an important impact on ophthalmology. New imaging devices, such as optical coherence tomography (OCT), have allowed opticians to view details of ocular anatomy that up to then were not visible. Optical coherence tomography has become widely used in adults both for diagnosis and monitoring of diseases such as glaucoma. While this technology holds potential in its application to paediatric optic nerve disorders, paediatric normative values are just recently being published for retinal nerve fibre layer (RNFL) and macular thicknesses.

3. Standard Eye Exam

An eye examination is a series of tests performed by an ophthalmologist, optometrist, assessing vision and ability to focus on and distinguish objects, as well as other tests and examinations relating to the eyes. The main instruments in an eye exam are a Slit lamp, a Phoropter, Tonometry and a KeratometerThe slit-lamp examination examines the structures at the front of the eye. The slit-lamp is a low-power microscope combined with a high-intensity light source that can be focused to shine in a thin beam. Patients undergoing an eye exam sit in a chair with the instrument placed in front of them. A persons chin and forehead is rested on a support to keep your head steady. The optician will proceed to examine the eyes, especially the eyelids, cornea, conjunctiva, sclera, and iris. More often than not, a yellow dye known as fluorescein is used to assist the examination of the cornea and tear layer. The dye is usually added as a drop. The dye rinses out of the eye with tears as one blinks. Next, drops may be placed in the eyes to dilate the pupils. The drops take several minutes to work. The slit-lamp examination is then repeated using another small lens held close to the eye, in order to examine the back of the eye. This test is used to examine the conjunctiva, corenea, eyelids, iris, lens and sclera. http://www. merckmanuals. com/media/home/figures/EYE_slit_lamp. gifFigure 2: Slit LampA Phoropter is an instrument used during an eye examination to measure refractive error and determine eyeglass prescriptions. Usually, the patient sits behind the phoropter, and looks through it at an eye chart. The optometrist then changes lenses and other settings, while asking the patient for feedback on which settings give the best vision. PhoropterFigure 3: A PhoropterTonometry is the method eye care professionals use to determine

the intraocular pressure, this is the fluid pressure inside of the eye. This test is important in the assessment of patients at risk from diseases such as glaucoma. Most tonometers are calibrated to measure pressure in millimeters of mercury (mmHg). It blows puffs of air into the eye. http://hooptometrist. files. wordpress. com/2011/09/tonometer. jpgFigure 4: TonometryA keratometer, also known as a ophthalmometer, is a diagnostic instrument for measuring the curving of the frontal surface of the cornea, particularly for assessing the degree and axis of an astigmatism. http://www. saveonkit. com/ekmps/shops/saveonkit/images/kelvin-ophthalmometer-keratometer-om-200-optician-opthalmic-eye-examination-7179-p. jpgFigure 5: A Keratometer

4. Laser Eye Surgery

Laser eye surgery is the restructuring of the cornea, the translucent ‘ window’ at the front of the eye, by using an excimer laser. This then amends focusing complications. To help faster recovery and enhanced results the thin outer surface layer of the cornea is moved aside before the laser treatment is executed. The surface layer is then gently moved back into place. The rectification of short-sightedness, a condition also known as myopia, is the most common use for laser eye surgery. Laser eye surgery is also used in the treatment of long-sightedness and mild astigmatism. It is not however suggested for correcting reading prescriptions, also known as presbyopia, because these prescriptions change as you get older and may result in you still needing reading glasses. Also some high prescriptions are not suitable for laser surgery. While they may possibly be adjusted via a method of non-laser eye surgery. The majority of people who opt for laser

eye surgery are happy with the results. The most common types of treatment used are LASIK and LASEK. These methods differ in the way the surface layer is moved aside. There is another type of treatment called PRK, but this is not often used. There are two types of surgery available, Standard and Advanced CustomVue WaveFront. Like a persons fingerprint, their vision is unique to them. Advanced CustomVue WaveFront improves vision according to the individual imperfections of a persons eyes. This means that each laser treatment is specific to the person undergoing the procedure. This technology was initially established for use in high powered telescopes to decrease distortions when observing distant objects in space. Advanced CustomVue WaveFront uses an remarkably advanced scanner called the WaveScan which produces a precise map of how light passes through the eye. This map, and the measurements acquired are 25 times more accurate than measurements acquired during a routine sight test. It delivers measurements of your prescription but also the natural imperfections unique to each of a persons eyes. These imperfections have a momentous influence on vision and have been linked to glare and halos, especially at night time. Benefits of this technology include better quality night vision than previously available. Since WaveFront technology permits us to correct specific perfections, it has the potential to correct vision to an even better level than possible with glasses or contact lenses.

4. 1. LASIK

Lasik is the most recognized and widespread form of laser eye surgery, so much so that it's almost used as a common term for the procedure. But there are actually several different procedures that a doctor can perform

when it comes to using a laser to correct your vision. Laser-Assisted In-Situ Keratomileusis (LASIK) has become the most commonly worked form of refractive surgery to date. The aim of this surgical procedure is to alter the anterior corneal shape by ablating tissue from the stroma via excimer laser after creating a hinged corneal flap. This way, we are able to change the refractive status of the patient, providing better unaided vision. Continuous improvements in the original technique have made the surgical procedure safer, more accurate and repeatable. Continuous improvements in the original technique have made the surgical procedure safer, more accurate and repeatable. These progressions are due to the development of novel technologies that are the responsible for new surgical instrumentation, which makes the surgical procedure easier for the surgeon, and better excimer laser ablation algorithms, which increase the optical quality of the ablation and thus the safety of the vision correction procedure. This article aims to describe the more relevant advances in LASIK that have played an important role in the spread and popularity of this technique. The IntraLase method is also available to those who chose LASIK. The IntraLase Method is the most advanced and accurate manner in which to create the flap during your LASIK procedure. The blade-free method uses Femtosecond pulses of laser to create the flap. The IntraLase method delivers outstanding results and it has been shown to improve outcomes for more patients. IntraLase delivers outstanding results. It has been shown to improve outcomes for more patients. Patients generally experience faster recovery, fewer LASIK flap-related complications and fewer induced higher order aberrations. Figure 4: LASIK Eye Surgery

4. 2. LASEK

Laser-Assisted Sub-Epithelial Keratectomy (LASEK) is a procedure very similar to LASIK. During surgery, a considerably thinner piece of the cornea is taken away. LASEK is a procedure your doctor may vouch for if for some purpose you cannot have LASIK surgery. People who have very thin corneas, for example, occasionally opt for LASEK. People with thinner corneas choose LASEK over LASIK since it's a less intrusive and seen as a less risky procedure because it doesn't go as deep into the tissue bed. LASEK is often referred to as EPI-LASEK. LASEK procedures are said to be slightly more uncomfortable than LASIK and there is a longer healing time. Revolutionary surgery is now enabling blind people to see again with the inserting of an artificial retina, an electronic chip positioned at the back of the eye which can then transmit images. Figure 5: LASEK Eye Surgery

4. 3 PRK

PRK (photorefractive keratectomy) is a style of refractive surgery to correct nearsightedness, farsightedness and astigmatism. PRK was the first type of laser eye surgery for vision correction. PRK works by restructuring the cornea using an excimer laser, allowingthis allows the light entering the eye to be properly focused onto the retina for clear vision. In PRK the cornea's complete outer layer is detached to expose the area and no flap is created, the excimer laser then shapes the stromal layer of the cornea to correct your refractive error. PRK is executed by the surgeon first eradicating a central area of corneal epithelium with an alcohol solution, a polishing device or a unsharpened surgical instrument. Afterward, an excimer laser is used to accurately restructure the curvingof the cornea's surface. This

computer-controlled, highly specific laser provides pulses of cool ultraviolet light that remove microscopic amounts of tissue in a precise arrangement. A soft contact lens known as a bandage is then positioned on the cornea to help shield the eye. New epithelial cells normally grow back within five days, after which the bandage contact lens is removed by the eye doctor. http://t3. gstatic. com/images? q= tbn: ANd9GcTIUUjEfkKBFxI-u_id7bkKJZPdpLHKxD6ngBJSEgp8bLrdpgYfdgFigure 6: PRK Eye Surgery

5. Health

Ophthalmologists are capable of identifying health disorders, for instance diabetes, vascular disease, hypertension and some tumors within the brain by inspecting the retina and observing changes that occur due to these ailments. Smart technology permits the use of complex equipment to observe minor variations and note differences earlier than ever before. A newly established electronic system that screens for diabetic retinopathy uses Smart technology that permits primary care physicians to review retinal alterations that lead to blindness in diabetic patients. The capability to evaluate retinal changes without referring a patient to an eye care specialist controls medical costs, improves early screening compliance, and enables early referral and treatment if a change is discovered. For numbers of individuals unable to pay for or access regular eye exams from an onsite ophthalmologist, it may soon be viable to check for refractive eye problems using the camera on your mobile phone device. Refractive errors are the most familiar conditions needing corrective eyeglasses for illnesses such as near or far sightedness. While presently in early experimenting, smart technology lets a simple portable devise to be clipped onto your mobile

phone and is exercised to test for refractive errors as precisely as in office testing. Results are gained within one to two minutes and prescriptions sent to your phone. This will lower the cost of otherwise costly in office testing and raise the number of people who are able to access early screening options.

6. Technological Developments

There are many new technological developments available to those in the eye care profession which include VisionCare’s Implantable Miniature Telescope, Optovue iVue Optical Coherence Tomography, TearScan, Contrast Sensitivity Testing, Color Vision Testing and Vitamin E Infused Contact Lenses. There is also a color blindness test application available for your smartphone. The Implantable Telescope Technology policy includes wide-angle micro-optical lenses in a Galilean telescope design. Built on this patented technology, VisionCare’s main invention (Implantable Miniature Telescope by Dr. Isaac Liphitz), along with the cornea, increases images in fore of the eye approximately 2. 2 or 2. 7 times their normal size (depending on the model used). The magnification permits central images to be propelled onto healthy perimacular areas of the retina instead of the macula alone, where collapse of photoreceptors and damage of vision has occurred. This helps lessen the 'blind spot' and permits the patient to differentiate and determine images that may have been unrecognizable, distorted or difficult to see. http://www. blindness. org/blog/wordpress/wp-content/uploads/imt. jpgFigure 7: Implantable Miniture TelescopeOptovue has obtained FDA authorisation for its iVue compact SD-OCT (spectral-domain optical coherence tomography). Optical coherence tomography uses the dispersion

of light in tissue to construct elevated resolution 3D images, however is restrained to visualizing tissue 1 to 2 mm beneath the exterior. The iVue system can image both the cornea and retina. It is the replacement to the RTVue system from the same company contributing a more dense system with related scanning expertise. http://media. ophthalmologyweb. com/m/27/Article/miscellaneous/top5_ivue. JPGFigure 8: The iVueAcademics at the University of Florida in Gainesville have created Vitamin E immersed contact lenses. This forceful antioxidant is boxed in clusters within the contact lens and is gradually discharged onto the eye. The Vitamin E compositions act like ‘ nano-bricks’ through which drug fragments cannot pass, but instead must go around. These nano-bricks are so significantly larger than drug molecules and they invent an obstacle course for the drug molecules so that they need to travel a much longer route. This expands the length of the drug delivery from the lens and exposure to the eye. These lenses can be devised for continuous wear for up to one month. These lenses can be worn to heal glaucoma as well as other eye disorders such as cataract and dry eye. Not only will these lenses extend delivery to the eye, but also they should reduce systemic absorption and thus systemic side effects that can be seen with anti-glaucoma treatments. Vitamin E is a recognised nutraceutical that in trivial quantities is beneficial for the eye. This Vitamin also stops UV light without any decrease in transparency, making this Vitamin not only advantageous for treatment of disease, but prevention as well. While these lenses are not presently on the market since further clinical trials are required, this technology will be something to watch out for in years to come. http://t0. gstatic. com/images? q= tbn: ANd9GcTOS7uIY6ilM4jBaebCEXdnHwc3Sp2-

pY7xmNC1THVqp9sPi6Cj1AFigure 9: Vitamin E immersed contact lenseTearScan from Advanced Tear Diagnostics can provide a one-step ocular diagnostic test by measuring tear lactoferrin—the only available diagnostic biomarker to determine aqueous deficiency. The company believes that tear fluid holds the source material needed to identify aqueous deficient dry eye, assist in diagnostic differentiation between aqueous-deficient and evaporative dry eye, and develop effective treatments. TearScan also provides data that enables the provider to grade the level of dry eye severity and monitor the effectiveness of treatment. The test, which uses reflectance photometry, takes approximately four minutes and provides measurements with 98% specificity. http://teardiagnostics. com/wp-content/uploads/2012/12/TearScan-Both. jpgFigure 10: TearScanThe computerized Smart System contrast sensitivity testing function from M&S Technologies provides comparable contrast sensitivity values to the Pelli-Robson chart, according to a new study at the University of Toronto. The researchers also found that the computerized Smart System contrast sensitivity function provides accurate, reproducible and consistent results. M&S ChartFigure 11: Contrast Sensitivity TestingBy recognizing these tiny shifts in color sensitivity, the ColorTrac anomaloscope can help clinicians detect early eye disease, monitor changes over time and manage disease for functional improvement, the manufacturer says. This portable, one-pound device can be easily toted from one exam room to another and used at health fairs and screenings. It doesn’t require any special training. ColorTrac shows the patient an array of seven match points simultaneously; and the patient is asked to select the vertical pair that is the closest color match. The match-range is centered on the normal point, and is segmented into

increments of just noticeable differences, which allow positive, accurate responses in less than 60 seconds. http://www. revoptom. com/CMSImagesContent/2013/1/088_ro0113_products-1. gifFigure 12: AnomaloscopeThe test presents a series of simple geometric shapes, a circle, square or diamond, each camouflaged by a random pattern of dots of varying size and brightness. The color of the dots is the only visual cue that allows users to identify the shape. When the test starts, the hidden shapes are very easy to see because there is a stark difference between the foreground and background colors. As the test proceeds, the plates get more challenging. At the end, the app provides users with an assessment of their color vision including the type and extent of the deficiency, if any. http://opticalcms. jobson. com/CMSImagesContent/2013/1/088_ro0113_products-2. gifFigure 13: Color Blindness Test App

8. Conclusion

From this paper it is clear that technologies have enhanced greatly within the optometry industry. From a simple eye test to Laser eye surgery there are many instruments that have evolved thanks to the developments in technology throughout the years. These technologies have clearly had a positive impact on the lives of those who require visionary aid, myself included. I Personally took the plunge and underwent Laser Eye Surgery. I suffer from shortsightedness and underwent the LASIK wavefront intralase procedure. The procedure was quick and painless and I would highly recommend it. From a personal experience I can say that the developments

in technology within the Optometry industry are amasing and no doubt they will continue to rapidly change and benefit this industry.