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Artificial Intelligence (AI) in LASIK and Other Eye Surgery Elevates Vision Results To The Next Level

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I remember it clearly. Twenty five years ago, I stood in a sunlit room on the second floor of the POA building in front of a room full of police officers and spoke about vision and the latest advances (at that time) in laser eye surgery. Since that day, our team at Pacific Vision Institute have had the honor of improving eyesight of many SFPOA members and their family. Using the most advanced LASIK and other laser vision technologies, as they became available over the years, we have successfully helped eliminate glasses and contacts in many people's lives, to achieve safety and comfort both on the job and off.

The field of laser refractive surgery has undergone many advances allowing for unprecedented results and safety. There are now multiple devices available to screen patients and many techniques and technologies that surgeons can use to help patients see great without glasses or contacts. To integrate the data from multiple diagnostic and treatment sources and guide the patient toward procedure that's best for them, Artificial Intelligence (AI) has now been increasingly deployed. Laser refractive surgery is about precision. Whether it is screening or surgery, there is no room for errors. Patient selection and the type of technique is, therefore, paramount to ensure optimal results.

What is AI in medicine?

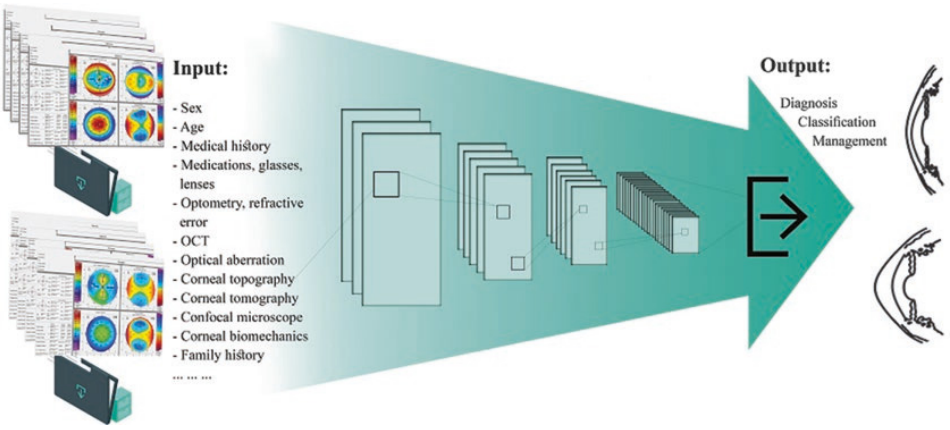
It can be seen in the multitude of industries that have already been transformed by it. Whether you should "Alexa" or "Siri" or whether you use Waze to help you get to your destination - it is all around us. Advances in eye imaging and treatment technologies combined with an accelerated interest during the pandemic have resulted in a recent boom in development and application of AI in vision correction surgery. AI - in the true sense of being human-like, has not yet been fully realized. When we say AI in medicine, we are talking about Machine Learning. Machine Learning (ML) creates decision algorithms based on new data input into the program. When there is an enormous amount of data, the algorithm needs to "know" what data is relevant. Deep Learning (DL) is a subset of ML where there are several deeper layers to the programming much like a human brain with multiple connected neurons. With DL, the algorithm is given raw data and then, based on previously

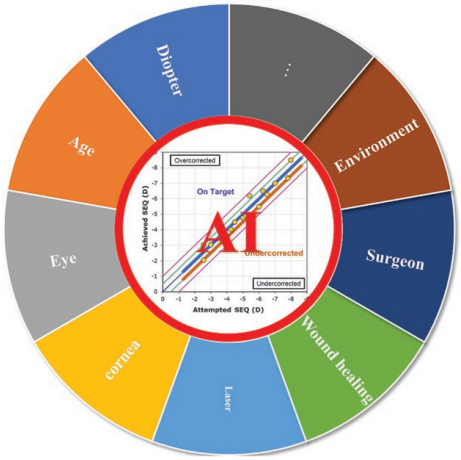
established learning networks, it decides what features are relevant. Such digital assistants help surgeons by processing vast amounts of data to design evidence-based treatment plan for each individual patient with great accuracy.

AI plays important role in patient screening and procedure selection

Many different types of vision correction procedures are now performed. LASIK is one type of vision correction procedure. It involves lifting the top layer of the cornea (called the "flap"), followed by laser reshaping of the inner layers of the cornea, and then replacing the flap allowing the eyes to heal quickly and accurately. We currently have four different types of lasers to make the flap and four other types of lasers to reshape the cornea. Each type of laser can be coupled with several corneal mapping devices to create a reshaping contour customized to each individual's specific eye features. PRK is another type of vision correction procedure. It allows for reshaping of the cornea without lifting of the top corneal layer. Just like LASIK, PRK surgery can be customized to each individual's specific eye features. A third method of vision correction is called SMILE. It is performed using both a laser and a manual corneal excision technique. Unlike LASIK and PRK it can not currently be customized. But in select patients, it may be useful. In addition to using lasers for vision correction surgeries, we can use lens technologies to help patients see better without glasses or contacts. This year, FDA approved a lens implant EVO ICL for vision correction in patients 21 to 45 years old. Typically, these patients are either not candidates for LASIK, PRK, or SMILE or they chose to have EVO ICL surgery for other reasons. Patients who are 55 years old and older can have their vision corrected with Refractive Lens Exchange (RLE) surgery that involves replacing the aging lens of the eye with an artificial lens implant which can often be customized to help patients see both far and near with minimal dependance on reading glasses.

To help guide each patient toward the procedure that's right for them, we rely on multi-source diagnostic methods which include various sophisticated devices to image cornea and the rest of the eye. The data generated includes five different categories: corneal shape, thickness, biomechanics, clarity of cornea and the lens, and distance between vital structures inside the eye. Each category includes multiple sub-categories. Using AI algorithms, the data is synthesized to assist clinician in decision-making. Instead of replacing the clinician, AI allows us to manage a vast amount of data to help design a personalized treatment plan for each patient. For example, patients whose corneas are uneven





(based on the results from different types of diagnostic devices), will do best with PRK. Patients whose prescriptions are too high for their corneal thickness or whose corneas are too uneven, will be do best with EVO ICL surgery.

AI improves surgical accuracy of LASIK, PRK, and other vision correction surgery

In addition to screening for refractive surgery, AI is used to ensure accuracy and predictability of outcomes with each type of surgery. A rigorous software engine is deployed to integrate numerous patient-specific factors, such as age, prescription, corneal and other eye characteristics as well as environmental factors, such as temperature and humidity of the procedure suite. As a result of such integration, AI generates formulas that guide the treatment plan. For LASIK and PRK, for example, AI-generated formulas guide laser programming for each eye of each patients. For lens implant surgery, such as EVO ICL and RLE, AI is deployed to calculate lens implant power. Analysis and input of postoperative results back into AI software, refines Deep Learning circuits optimizing future performance.