The History of Contact Lenses

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Introduction

For over 700 years, spectacles faced no major challenge as the best device for improving vision. About 70 years ago the contact lens made its first appearance and started to challenge the role of spectacles in vision correction for refractive errors. The first contact lenses were attributed to Adolf Fick. Eugene Kalt, and August Muller are credited as simultaneously and independently inventing the corneal contact lens in the late 1980s. The early lenses were made of hard transparent plastic composed of methylmethacrylate, which required precise fitting to the individual eye. There were critical limits to the length and time they could be worn and some difficulties in tolerance. Many people could not adjust to wearing the hard contact lens at all. Of the millions who bought them, it is estimated more than 50% became discouraged and ceased to wear them.

Over 50 yeas ago, an amazing new soft plastic was developed in Czechoslovakia, which revolutionized the wearing of contact lenses and the safety of contact lenses. It was called the 'soft lens.' Technology has rapidly improved not only the material, but also the design, shape, sterility, and manufacturing processes that have popularized the soft lens. Over the years there were many contributors, practitioners, and companies who raised the bar and increased contact lens safety in not only indications for refractive errors but in the management of appearances, such as colored cosmetic contact lenses, bifocal lenses, therapeutics for diseased eyes and vision for keratoconic patients.

Historical Development

Two major innovations contributed to making contact lenses successful. In 1937, Theodore Obrig increased the degree of success obtained with rigid lens plastic material. This was an improvement over glass contact lenses that had been in vogue at the time. The new material offered advantages because it was light in weight, inert to body secretions and was able to retain its transparency in the same way as optical glass. Its safety was also beneficial, as a plastic lens was unbreakable in all types of accidents and injuries that a person might experience.

The second major modification was introduced by Kevin Tuohy, who introduced the corneal lenses as a small lens, which covered only the transparent portion of the protective coating of the eye. Changes were rapidly introduced in this lens until finally a working product emerged that was safe, could be worn all day, and had superior optics to conventional spectacles. Their major charm was that they were invisible and they concealed the wearer's weak eyes from the rest of the critical world. They could be worn with abandon throughout turbulent weather and were especially useful for playing sports. They did not bounce on the nose like spectacles, with running or jumping, nor could they be easily dislodged.

Celebrities, athletes, salespeople, executives, politicians, and business people all wanted them. Eventually these people, along with students and office workers, formed the bulk of contact lens consumers and popularized the contact lens.

Although hard lenses attract thousands of converts, they do not really threaten to make glasses a historical curiosity. Their primary fault is that they are simply inconvenient. One requires motivation to wear hard lenses. They also require a more complicated and sophisticated fitting. Along with discomfort, wearers often experienced tearing and excess sensitivity to light, which are all normal reactions when a hard lens is placed on the cornea. Contact lens persistence is found mainly in the very young. Most people do not have the inclination or a strong sense of purpose to wear hard polymethylmethacrylate contact lenses.

The Invention of the soft lens

In 1958, Otto Wichterle, head of the Macro molecular Institute of the Czechoslovakian National Academy of Science, along with Dr. Drahoslav Lim, a polymer chemist, developed a new soft plastic that could be cut, ground, and molded into a variety of shapes. However, when this plastic was placed in water or any aqueous solution, the tough rigid plastic became soft and pliable. In the wet form it could be bent between the fingers until the edges met, but it could also snap back to its original shape quickly. When allowed to dry, the supple water-logged material became as brittle as a corn flake and could be crushed to a powdery dust if smashed. The material was then subjected to rigorous biological tests. and was found to be inert and fully compatible with human tissue. One of its main features was that it was highly elastic when wet, but remained strong and able to hold its shape.

The contact lens world is also indebted to Dr. Robert Morrison, an optometrist from Harrisburg, Pennsylvania. He was not only an expert in contact lenses, but he was an innovative, creative, and astute observer who was among the first to recognize the importance of hydrogel materials to the development of soft contact lenses. While in Czechoslovakia, an optical firm told him about a new type of material that was being developed in Prague. He headed to Prague to visit with Dr. Wichterle who was then perfecting the hydrogel material. It was initially applied in the manufacturing of an artificial

mandible, but Dr. Wichterle soon found that he could spin cast it into a contact lens. He felt it had excellent properties for fitting a contact lens with hydrophilic properties, unlike other contact lens materials at that time which were hydrophobic. Dr. Morrison witnessed Dr. Wichterle spinning this hydrogel material using a type of phonograph platform, so that the material had varied shapes depending on the spin pattern and the amount of material used. Dr. Morrison was astute, and recognized this major breakthrough in the contact lens field. He was in the right place at the right time!

He, along with National Patent convinced Dr. Wichterle to release the patents for worldwide use. Although Dr. Morrison did not benefit financially in this patent development, he did go on to fit the heads of Europe and the Middle East with lenses. His first client was the King of Belgium and later the Queen of Holland. Later he also fitted the Princess Grace and Prince Albert of Monaco. Further referrals took him to the Shah of Iran, the Prince of Saudi Arabia and the Prince of Kuwait. Fitting royal families gave credibility to this new polymer as a wonderful contact lens for public appearances by heads of states.

In 1960, the National Patent Corporation, founded by two young lawyers, acquired the rights to this wonderful plastic and sub-licensed it to Bausch & Lomb for manufacturing purposes. Bausch & Lomb sold contact lenses made from this material. Before Bausch and Lomb developed this, Griffin laboratories — under the Buffalo optometrist Dr. Allan Isen and Dr. Stanley Gordon (the originator of Union Optical) — developed and started locally manufacturing the material for their customer base. I was fortunate to have an early start with the material.

In 1966, Dr. Stanley Gordon and I (Dr. Harold Stein) designed and fitted individual, custom made, aphakic contact lenses. This was a boon to many cataract surgery patients, in particular monocular (one-eyed) patients, who were completely abandoned as surgery would result in horrible diplopia. The development of an aphakic or post-cataract lens resulted in a disparity of only 11% between the un-operated eye and the operated eye; this was a tolerable amount of disparity. Spectacles created a 33% disparity between the two eyes and the diplopia was intolerable.

B&L Polularizes the Soft Lens

In 1966, Bausch & Lomb developed the spin cast method for manufacturing soft lenses. This was a break through in technology in so far as they could mass-produce soft lenses, which not only expanded the market, but created reproducibility via a custom-made laboratory technique. This was a major departure from the 'one at a time' method. The process comprises a revolving mold that whirls liquid plastic at higher speeds thereby giving the lens its outside curvature, while the inside curvature is formed as a result of the degree of speed rotation. Centrifuging various surface tensions of the liquid and using the pre-calculated mathematical relationship between gravitation and rotation results in a parabola whose inside curvature shortens or lengthens depending on the speed of rotation.

The popularity of contact lenses spread throughout the world as the spin cast process produced a highly reproducible lens with a very smooth surface. This meant that all replacement lenses would duplicate the original, regardless of where in the world they were produced. This would seem an easy feat to a soft drink or bottle manufacturer, but it was a revolutionary triumph for the contact lens sector. The smooth even surface also insured that bacteria and other offensive germs could not easily burrow into the plastic.

These particular soft contact lenses superceded glass and hard polymethylmethacrylate lenses that were standard; soft contacts made them both seem obsolete. The majority of patients could be fitted with soft lenses. As technology developed the lenses were improved; oxygen could now to permeate the material. The raw material was supplied by Japan, the United States, and Europe. Many major advances followed in the type of materials that were invented. The manufacturing materials were made thinner and thinner to provided greater oxygen flow. It took a few years, but in 1971 Bausch & Lomb had their Soflens lenses approved and their stocks soared.

Another flexible lens that appeared at the same time was a silicone rubber lens made by Dow Corning, which was tried for several years. They soon found that it could suction itself to the cornea, and in fact, caused some corneal disasters. While silicone was an excellent material, if the lens was made of pure silicone it was not without problems and so it was abandoned. Consequently, silicone was amalgamated with the soft hydrogel lens material, thus the birth of the silicone hydrogel lens that eventually improved the oxygen transmission through the lens and improved the success rate.

In the next issue of *Eye Care Review*, we will review more of the history of contact lenses.

Please note: This series is in part adapted from two chapters in:

1. Stein H, Slatt, BJ, Stein R, Freeman M. Fitting Guide for Rigid and Soft Lenses. 4th Ed. Elsevier Publishing. 2004.
2. Stein H, Slatt BJ. Why Wear Glasses. Simon and Shuster. 1968.

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