



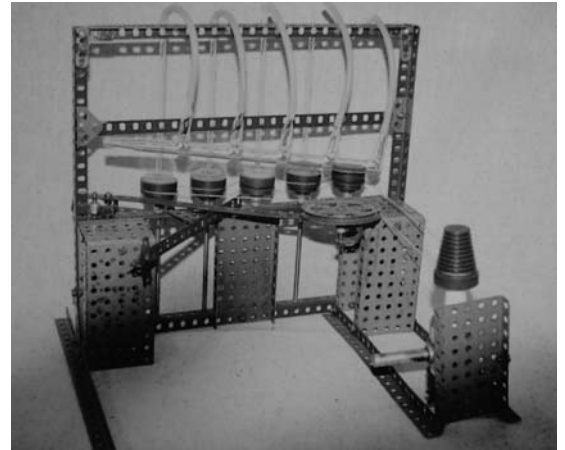
Soft lenses – then and now

Andrew Gasson and Tim Bowden look back at the history of the soft contact lens, following on from their talk on the subject at the BCLA Pioneers Conference

Soft contact lenses have now been with us for almost exactly 50 years. For the first 40 of those years they have been dominated by the insight and brilliance of just one man, Professor Otto Wichterle (1913-1998). He gained the first patent for soft lenses in 1953 following his invention of the first water swellable gel in 1952. He had created his first, very unsatisfactory soft lenses in 1957 using closed polystyrene moulds; but on Christmas day 1961 he produced soft lenses he could wear, made on a device constructed from a Meccano set, a bell transformer and powered by the dynamo from his son's bicycle. By New Year he had written his patent application and produced over 100 lenses by spin casting. He subsequently built several new machines from Meccano with more and more spindles which required the stronger motor from his gramophone. By 1962 the basic carousel machine took shape for mass production and the first soft lenses became available in the UK. He later gained the first patents for tinted, coloured and toric lenses and foresaw the desirability of disposable lenses.

In 1961 the original Spofa lenses were sealed in glass ampoules which were broken open to retrieve the lens. Modern packaging is geared to disposable lenses and is almost entirely blister packs. The latest innovation, the Menicon Magic, is wafer thin.

The first non-HEMA lens, Bionite, arrived in 1968 with a water content of 55 per cent. Invented by Allan Isen



Professor Otto Wichterle (left) produced wearable soft lenses on a device made from Meccano

and Ken O'Driscoll it proved very comfortable but had serious problems with reproducibility and durability. The material was acquired by American Optical and subsequently by CIBA Vision which used it for the Focus Visiint.

In 1966 Bausch&Lomb acquired the rights to produce the Czech Spofa lens, finally launched with FDA approval in March 1971. The development of the spin casting process for HEMA cost about \$18m but B&L achieved sales of \$1m within the first six months. By 1975 it was producing 20,000 lenses a day. It was the first to use resealable Pyrex pharmaceutical vials for lens storage. The lens design was based on a posterior apical radius (PAR) with a fixed diameter. The original C Series was soon superseded by the N (normal) and F (flat) designs. The latest Bausch+Lomb lenses are

disposable and based on the silicone hydrogel Purevision 2 material.

In 1973 the first Hydron lenses, using lathed HEMA, were introduced to the UK as a joint venture with Smith and Nephew. They were fitted according to the more usual criteria of radius and diameter. Hydron was the subject of a management buyout which was ultimately bought by CooperVision. Today the Hydron brand survives as the Z6 Toric in HEMA and the 70 per cent Omniflex.

Also in 1973 Sauflon lenses with a 70 per cent water content were introduced by Contact Lenses Manufacturing. These were followed by Sauflon 85 for 'permanent wear' and Sauflex 55. The original Sauflon no longer exists but the name is perpetuated by the equally innovative Sauflon Pharmaceuticals company of today.

The Permalens was introduced in 1972 together with the concept of



Spofa lenses in glass ampoules



Bionite, the first non-HEMA lens



The lathed Hydron lens



Sauflon in the 1970s



Early Permalens



extended wear for several months. Lenses were manufactured by the UK company Global Vision which was ultimately taken over by CIBA Vision. Well over a million Permalenses had been sold by the time of their discontinuation in 2011.

Extended wear today is treated with greater caution and is nearly always achieved with disposable silicone hydrogels.

By 1975 there were several makes of lens available as shown in the figure (right). Today we have a vast range of lenses available in terms of materials, designs, disposability, toric and multifocal. Nearly all are disposable and available only in blister packs, mass produced by modern moulding techniques from the large international companies at one end of the scale and individually manufactured by specialist independents at the other.

Early solutions

Flexol (disinfection), Preflex (cleaning) and Normol (rinsing) were the first proprietary, non-peroxide solutions. They were introduced by Burton Parsons in 1975 to replace heat disinfection. These and similar products such as Hydrosoak, Hexidin and Hydrocare used either chlorhexidine or thiomersal. While successful for the majority of patients, there were significant numbers that produced a severe reaction with corneal staining and red eyes.

Modern multipurpose solutions no longer use these chemicals and are based on PHMB or polyquad with far fewer adverse reactions. There has also been a return to one-step, non-preserved oxidising solutions whereas heat is now almost never used.

1974 saw the launch by Titmus Eurocon of the first soft toric using dynamic stabilisation. This technique was developed by Peter Fanti of Hamburg and became the basis of several other more modern front surface torics. The majority of today's torics are moulded and disposable from large international companies but several specialist laboratories are able to provide lenses for very high powers and cylinders outside of the mass production range.

First disposable lens

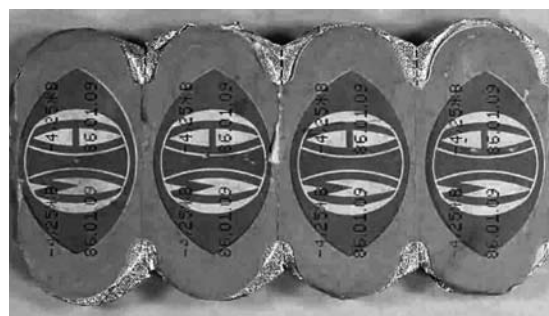
Increasingly concerned about the problems he was seeing with extended wear lenses, Danish ophthalmologist Michael Bay decided that the best solution was to discard the lenses on a shorter, regular basis. In 1982



Lenses from 1975; (l-r) Mollitor; Wöhlik Hydroflex; Bausch & Lomb F Series; Sauflon; Permalens; Hydron; the French Aoflex; and, in front, Menicon



First proprietary, non-peroxide solutions



Blister pack of MIA disposable lenses

he founded the MIA-lens Company producing the first disposable lenses. He invented the wet-cast moulding system, or stabilised soft moulding, which gave far better reproducibility. Lenses were known as the Danalens in Denmark and Bay and his team developed the blister pack, weekly or two-weekly extended wear, monthly payments by direct debits and home shipments.

In 1983 Johnson & Johnson bought Bay's technology and drew on its extensive manufacturing ability to develop the brand. It improved the blister and changed the material to etafilcon A with a limited US launch in 1987 of the Acuvue Disposalens.

Distribution was expanded in 1988 to the rest of the US and the UK.

In 1995 daily disposable lenses became available followed in 1999 by the first of the silicone hydrogels. The first daily disposable silicone hydrogel lens was introduced in 2008, recently followed by the first daily disposable silicone hydrogel toric, Sauflon's Clariti 1 day toric. 2010 saw the first daily disposable aiming to reduce the development of myopia, a major shift in emphasis in contact lens fitting.

There are now 3.6 million contact lens wearers in the UK, around 120 million worldwide, with world production of some 10 billion lenses per year. Industry analysts estimate the global contact lens and solutions market will exceed \$11.7bn (£7.5bn) by 2015. Soft lenses have evolved from small home-style innovation to a multi-million pound industry; from specialist medical application to commodity; from thick low Dk HEMA to high Dk silicone hydrogel; and from boiling to multipurpose solutions. Finally, with the advent of daily disposables, Otto Wichterle's original concept that a soft lens should never be re-used has now come to pass. Not bad from a Meccano set! ●



Johnson & Johnson introduced the Acuvue Disposalens