



Backstage Part 1

Do we know what is happening behind a soft lens?

In daily contact lens practice, eye care practitioners (ECPs) take the eye's shape into consideration when fitting contact lenses. Therefore, we should respect the anterior ocular surface shape. This is true for all types of lenses and for every individual.

By Eef van der Worp and Vincent Molkenboer

Similar to gas permeable (GP) lenses, soft lenses can have an impact on the cornea and on corneal shape if fitted incorrectly. Corneal deformations as a result of suboptimal soft lens fittings are not as uncommon as many may think. If practitioners would remove soft lenses at every follow-up visit and perform corneal topography, they would be surprised by the amount of unwanted changes that can take place beneath a soft lens (figure 1) [Schornack et al, Contact Lens & Anterior Eye (2003)]. But how much, and what kind of change?

In refractive surgery clinics, it has become clear that it is critically important to cease soft lens wear for a substantial period of time to let the cornea settle before laser surgery can take place. According to a study by Ng et al [in Optometry & Vision Science (2007)], it takes on average 10.7 ± 10.4 days before a stable refractive state is reached after cessation of soft lens wear.

If we use the keratometry value as the criterion, then it takes an average of 16.2 ± 17.5 days for the cornea to become stable. Using corneal topography, it takes 28.1 ± 17.7 days. For the mentioned methods, a change of 0.5D or less between two examinations is used as the criterion. If pachymetry (corneal thickness measurement) is used as a method, then it takes on average 35.1 ± 20.8 days before stability is reached in a soft lens wearer (with an arbitrary $8\mu\text{m}$ change at the thinnest point on the cornea as the criterion). From a clinical perspective, it is interesting to note the large spread within these outcomes – and for contact lens practices: some subjects take significantly longer compared to the average eye to reach stability.

CHANGE

To better understand the changes that are happening under soft lenses, we decided to retrospectively look at a group of normal successful lens wearers in a large contact practice in the Netherlands. Of 55 patients who had been fitted with contact lenses in the last year, the pre-soft lens fitting corneal topography (Medmont E300 Corneal Topographer, Nunawading, Australia) was taken and compared to the post-soft lens fitting data. A difference map was generated, in the same fashion as a difference map between “pre” and “post” fitting is created in orthokeratology, to see whether a consistent pattern was present in the potential changes that are occurring during soft lens wear.

Out of the group of 55 lens wearers, both left and right eyes were imaged ($n = 110$). As this was a “real life” experiment performed as part of a normal routine in a large contact lens practice, many types of lenses were included: different lens powers (low to high minus and plus prescriptions), lens designs (including toric and multifocal designs), replacement frequency (everything from daily disposables to monthly replacement lenses) and even wearing modality (extended wear [EW] and daily wear [DW] of lenses).

WHETHER WE LIKE IT OR NOT - WE DO INDUCE CORNEAL CHANGES WITH OUR CURRENT SOFT LENSES

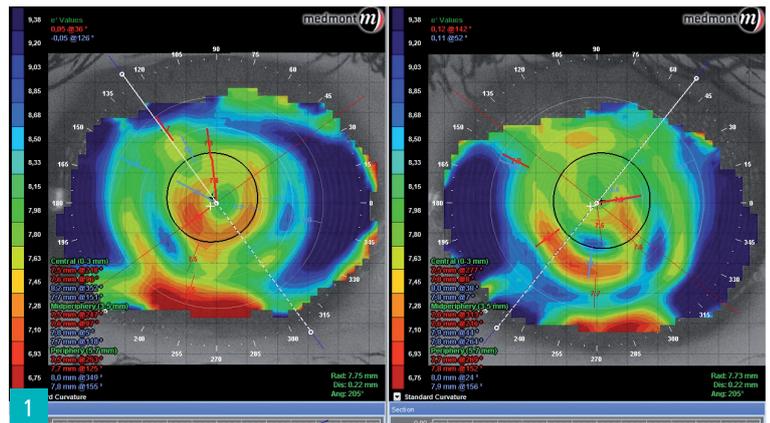


Fig. 1: Corneal changes after soft contact lens wear

The only thing all lenses had in common was that they were made of silicone hydrogel materials. All subjects included in the study were neophyte lens wearers (no previous contact lens experience or prolonged periods of no lens wear).

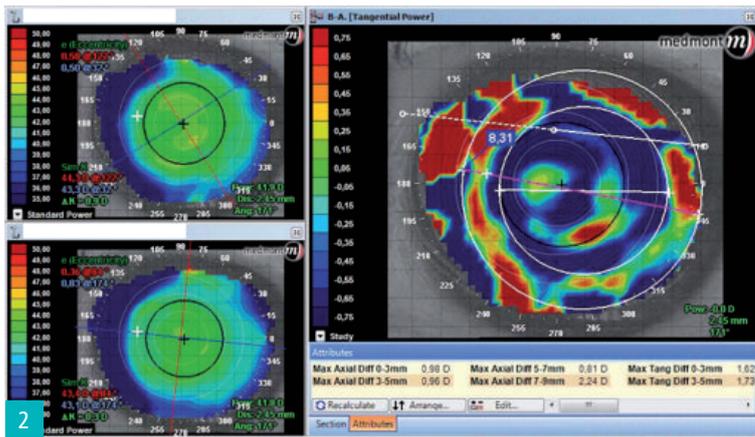
The major disadvantage of analyzing topographical changes in this way is that in the pre-soft lens fitting topography map, a pristine, undisturbed pre-ocular tear film was present. In the post-soft lens fitting topography map, the lens was removed (typically by the lens wearer, on occasion by the ECP), and within

a few minutes of lens removal the topography map was taken. Every second-year optometry student knows that tear film disturbances can influence the topography with Placido disk systems. However, as this was a retrospective study performed in a real-life commercial setting, this disadvantage could not be overcome. To keep this effect to a minimum, selected topography maps were screened by an experienced ECP and excluded from the study if any signs of surface irregularity were detected (by looking at the raw Placido ring picture, and by taking four measurements of each eye and excluding any outliers). In defense of the study methods: every contact lens specialist in his practice would to a large extent face the same limitations in analyzing topographical changes beneath soft lenses.

IN ANY CASE

More than analyzing the exact change in diopter or mm curvature, this experiment aimed to identify whether a pattern could be detected regarding soft lens alterations to the ocular surface.

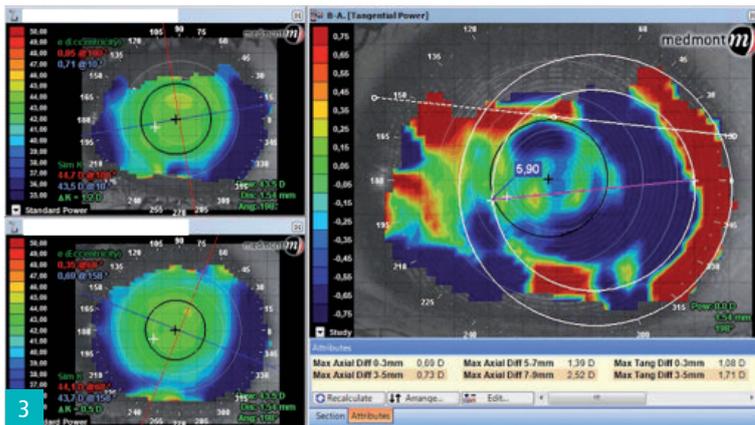
We will share in this paper for GlobalCONTACT a number of case reports, as this is an important topic to consider for every soft contact lens manufacturer. The cases presented are just a snapshot of the large cohort of subjects in our experiment. However, as can be seen from these few cases - some similarity in the difference maps was observed. This study may also teach us a thing or two about corneal topography, and how to use that instrument – which is not always as straightforward as it appears.



and the peripheral red ring extends from 5.89mm out to 8.31mm. Interestingly, the surface irregularity index (SRI) as presented by the topographer does not show much difference between the first (SRI = 0.53) and the second (0.48) map. A higher SRI number is supposed to indicate a larger level irregularity.

"AVERAGE JOE"

Figure 3 shows the right eye of "Joe". In this topography map, a large, mostly blue zone is also evident, although largely decentered it seems. This "central" zone has a diameter of 5.90mm. Surrounding that, a partial red ring is visible, which would extend out from 5.90mm to 7.91mm if the assumption is made that the partial ring is in fact a ring. The SRI, surprisingly perhaps, seems fairly similar between the two maps and, in fact, improves a bit from 0.56 to 0.45. Let's now look at another subject in the study, that we will call "average Joe": a 22-year-old silicone hydrogel lens wearer on a monthly replacement schedule, which according to the Eurolens research annual survey on lens fits worldwide (Morgan et al, Contact Lens Spectrum Jan 2014) would be the most standard type of lens. Even his power is somewhat standard, as a -2.50D prescription most probably fits the top of the bell-curve of lens wearers in an average practice. His pre-soft lens topography was taken more than 3.5 years ago, his latest map was taken in May 2013.



The pattern of the left eye (figure 4), also involving a -2.50D monthly replacement lens, at first glance is a bit different with an apparent small partial red ring and a small central dot. Another way of looking at it, with a bit of imagination perhaps, would be to draw a large central zone of about 6.09mm, as in the first two examples, and a possible second red ring of about 8.50mm – which in that case would be not too different from the previous two cases. The SRI does get worse in this eye: it changes from 0.45 to 0.62 between the first and second topography maps.

"BY DESIGN"

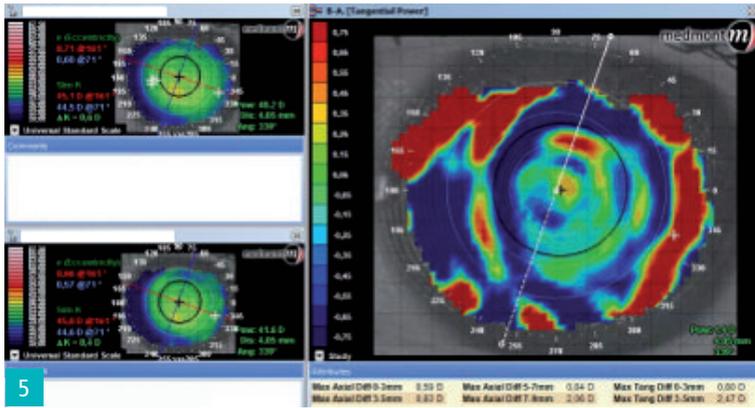
What about toric lenses, which have the basic difference in design of stabilization zones? This case reports on a 45-year-old astigmatic patient wearing a S-0.25 = C-0.75 x 90 toric 2-week disposable silicone hydrogel lens. The first topography maps were taken on November 9th 2013, the second on December 10th 2013. The difference map of the left eye is on display here (figure 5) – showing an arbitrary central 6.02mm flat zone with some confluent central islands, with a partial red ring extending out from 6.02mm to 8.30mm. The SRI moves up from 0.47 to 0.80 in this case, indicating quite a significant increase in irregularity.

"THE DAILY NEWS"

In theory, thicker lenses or lenses with a higher modulus can have the most impact on the corneal topography in soft lens wear, as they may exert the most mechanical pressure. A daily disposable lens generally is thought to be thin with a relatively small impact on the corneal epithelium. So let's pick a daily disposable lens wearer, as presented in figures 5 and 6. This 18-year-old subject

"A QUICKY"

This first case was chosen to show that changes beneath soft lenses do not necessarily take a long time to develop or require a high prescription. It concerns a 55-year-old multifocal silicone hydrogel lens wearer with a prescription of -0.75D and a reading addition of 1.50D. The lens is worn on an extended wear basis, with a difference of only nine days between the initial topography taken just prior to the lens fit and the second topography taken at the first lens checkup. The left eye is presented here (figure 2). At first, a random, irregular pattern appears to be present. But if two rings are artificially drawn into the topography map, a pattern can be seen of – apart from some small central "islands" of steepness – a central flat (blue sea) central zone, as sometimes is seen in orthokeratology, followed by a peripheral red ring with relative steepness. In this case, the artificially chosen ring diameter was 5.89mm for the central zone,



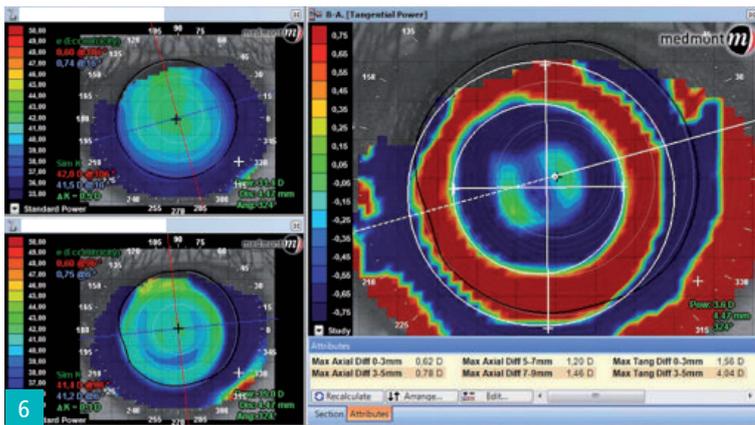
blue zone – but smaller than in the previous examples, at an estimated 4.27mm diameter. Also, a complete, more peripheral red ring (extending out from 4.27mm to 6.67mm) is evident. The SRI quite dramatically goes up from 0.23 initially to 0.78 after lens wear.

The left eye image is remarkably similar to the right eye (figure 7). This eye also represents a -5.00D silicone hydrogel daily disposable lens. Again, two small central islands are visible, with a small but very well centered central “flat” zone (with a diameter of 4.27mm) and a red peripheral ring extending out from 4.27mm to 6.62mm. The SRI again goes up quite dramatically in this subject (indicating an increase in surface irregularity), from 0.22 to 0.75.

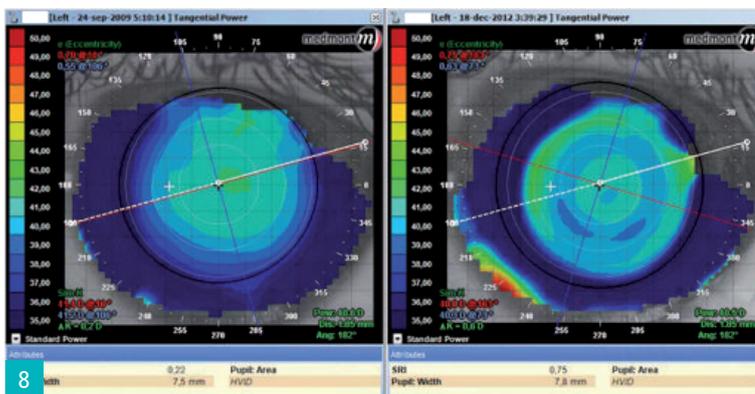
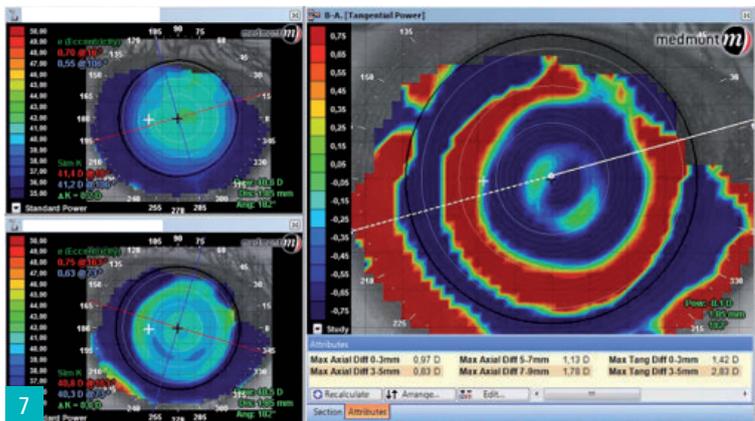
Even the basic (figure 8) pre- (left) and post- (right) topography maps show significant differences, and the concentric ring structure is quite obvious in the image on the right.

IN SUMMARY

According to our observations, corneal topographical changes do occur in every day contact lens practice, is the conclusion from our relatively small experiment looking at silicone hydrogel soft lenses and our suggestion is it occurs in most contact lens wearers of this kind to some extent, independent from lens power, replacement frequency, lens manufacturer and lens design used as we observed them in plus, minus, toric, monthly, 2-weekly and even daily disposable lenses of different manufacturers. In part 2, in the next edition of Global Contact, the possible causes are evaluated and the impact it could have on daily practice will be discussed. Stay tuned for the second 'act' of this backstage tour..



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was successfully wearing -5.00D silicone hydrogel daily disposable lenses. The time difference between the first and second map is 33 months, and the effect is quite remarkable. The difference map of his right eye (figure 6) shows a regular concentric pattern of, besides two small central islands, a central

About the Author / Placeholder