Contact Lens Selection in the Time of Coronavirus… and beyond

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Introduction

The year 2020 brought the world fires, floods, hurricanes, locusts, murder hornets, famine, civil unrest and the COVID-19 pandemic.
It will surely go down in the history books as changing almost everything about how lives are lived worldwide (Figure 1).[1,2]

The most pressing question around the prescribing of contact lenses in the time of COVID-19 revolves around finding a lens system that is safe, quick and easy to implement and associated with assurance of uninterrupted levels of outstanding on-eye performance. The key considerations here are lens wearing and replacement schedule, lens material, lens design and parameter availability.
Some decisions are easier to make than others based on evidence at hand.

Lens wear and replacement options

The least contentious decision revolves around the question of daily wear versus extended wear. Research over several decades has confirmed the increased risk microbial keratitis (MK) with the use of overnight wear, with a loosely dose-dependent relationship – occasional overnight wear is worse than daily wear only, and extended wear worse than occasional overnight wear.[3] So, if you are looking to minimize serious complications...**no sleeping in lenses – even occasionally.**

If we next consider replacement schedules—daily wear with reusable lenses versus daily disposable/single use wear—the concern about microbial keratitis revolves primarily around hygiene and compliance factors – hand washing[4], rubbing and rinsing prior to lens storage,[5] solution type,[5,6] topping off solution,[7,8] exposure to water[8] and perhaps the most important, the contact lens storage case. A model set forth by Stapleton that looks at population attributable risk predicts that disease load in daily wear reusable lenses could be reduced by almost two-thirds by attending to just TWO factors: storage case hygiene and storage case replacement.[5]

Daily disposable lenses do not eliminate risk entirely… careful and consistent attention to good instruction and ongoing surveillance of care and hygiene practices are still critical. But they do minimize the opportunity to transfer microbes to the eye, and have been shown to reduce the severity of severe disease if it does occur.[5] So, our next step on the road to contact lens success in the time of COVID-19 is…**prescribe more daily disposable contact lenses.**

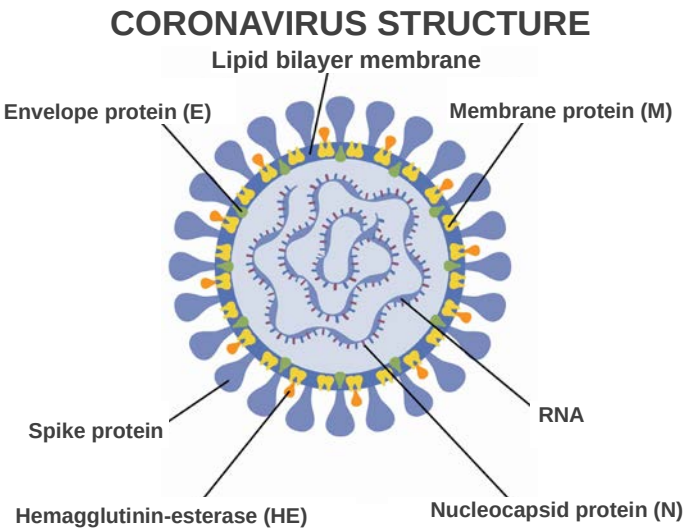
Next, practitioners must make decisions about material and design within the daily disposable space. Again, with a focus on achieving and sustaining high levels of performance and looking to the literature, we find several interesting studies regarding material properties that can guide us.

Material Selection

Lens comfort factors

Given the inability to differentiate by the purely health and safety measures and knowing that comfort is a key driver of patient satisfaction, looking at inputs to

Figure 1: The way forward in the time of the COVID-19 pandemic: potentially more telemedicine to manage appointments and non-urgent cases and instituting changes to office spaces and hygiene practices to prevent inadvertent transmission of the SARS-CoV-2 coronavirus



comfort is a logical next step. Surveys of existing contact lens wearers, both daily disposable and reusable, find that performance declines throughout the day for nearly 6 in 10 wearers (Figure 2).[9] The most common symptoms experienced are tired eyes and feelings of dryness.[9] When patients are uncomfortable, they tend to touch their eyes and lenses or use eye drops – all of which are things we'd like to avoid these days.[10] This reported change in comfort shouldn't be surprising in some respects… a soft contact lens placed on the eye effectively splits the tear film, and interrupts the natural communication of the membrane mucins originating in the cornea from communing with their free-floating counterparts in the tear film. The quest to recreate a more natural environment is one that occupies scientists and researchers around the world.

Lubricity

One of the areas with numerous scientific publications in evidence is the concept of friction or lubricity. Brennan first reported on the inverse relationship between lubricity and comfort in 2009,[11] and he and other authors continued to add data to corroborate the original data (Figure 3).[12–14]

While there is no current standard for lubricity measurement on contact lenses, several researchers have produced insights of note.[15] Because friction is dependent on the interaction between two surfaces and any lubricants between them, and not just the surfaces themselves, measurement conditions can have a significant impact on the data. It is important to create an environment that closely mimics that of the ocular environment, but that allows a fair comparison between different materials. Sterner and colleagues have concluded that the commonly reported coefficient of friction (CoF) is not always applicable to soft materials such as hydrogels due to the frequently observed nonlinearity between lateral and normal forces. They therefore advocate the concept of average work to help understand the relationship between clinical comfort of soft contact lenses and material properties.[16]

To that end and to return to the goal of recreating a system as close to the natural eye as possible, using the natural cornea as a standard to assess lubricity seems prudent. In 2005 researchers in the UK reported that senofilcon A, a silicone hydrogel incorporating long chain high molecular weight polyvinylpyrrolidone (PVP) had a coefficient of friction approaching that of the cornea.[17] And as the eye blinks an estimated 12,000-14,000 times per day the ability to sustain low levels of friction is undoubtedly also important. When friction was measured at multiple times over the course of a simulated day using contact lenses with a long chain PVP molecule incorporated evenly throughout the lens matrix, frictional energy was low and quite consistent, versus an increasing

Figure 2: Pattern of decline in performance (aggregate of vision, satisfaction and comfort responses) from real time digital surveys of current contact lens wearers, and the symptoms reported by those experiencing declining performance (59% of 243 wearers surveyed)

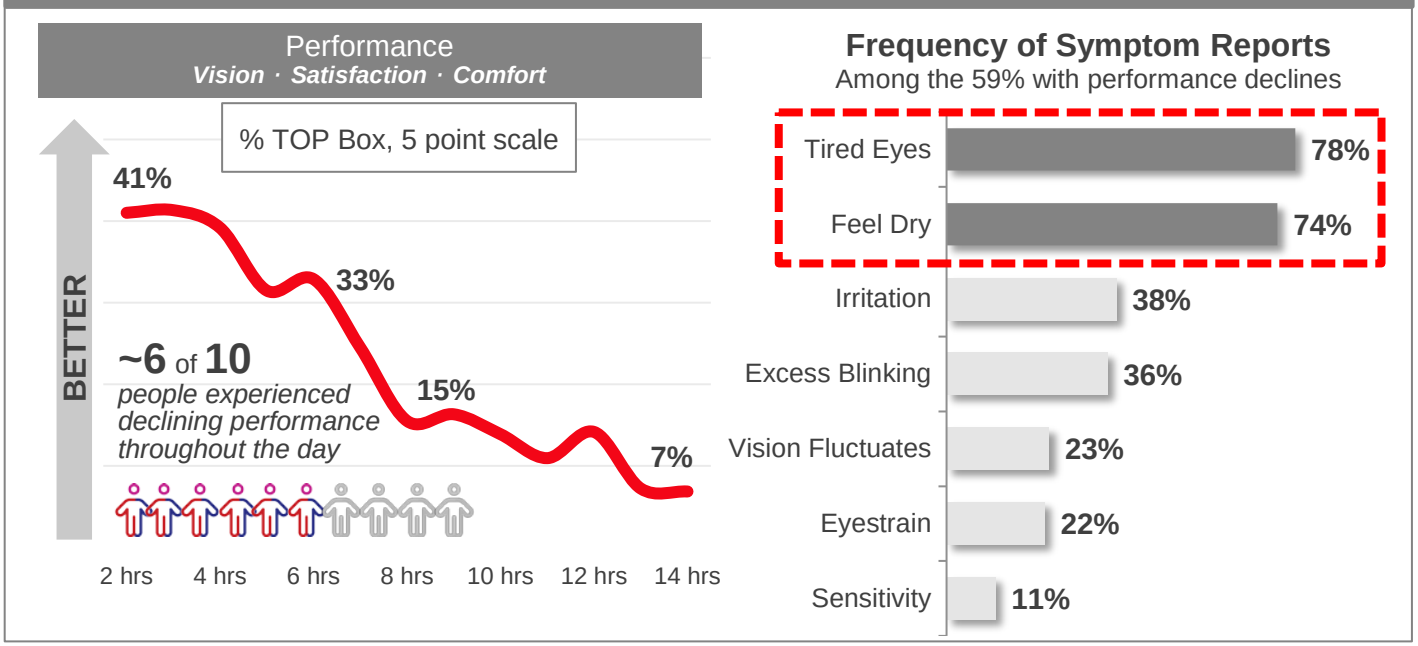
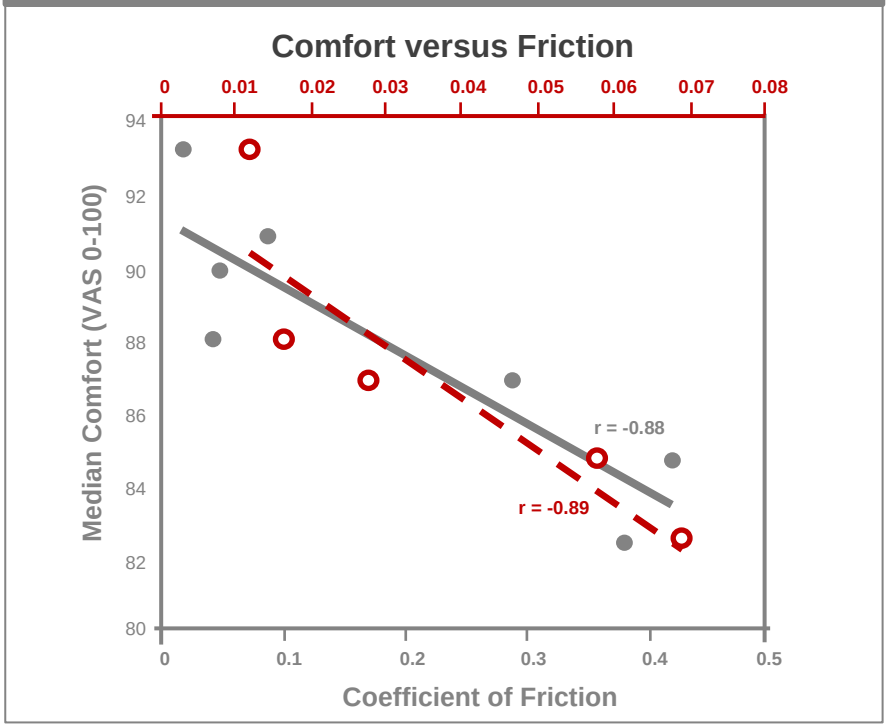


Figure 3: Plot of median endo-of-day comfort from Brennan[14] and Coles[15] (visual analog scale) versus coefficient of friction reported by Ross[18] (open circles, dashed line, top scale) and Roba[19] (closed circles, solid line, lower scale).



level of both variability and amount of friction with the water gradient technology (Fgure 4).[18]

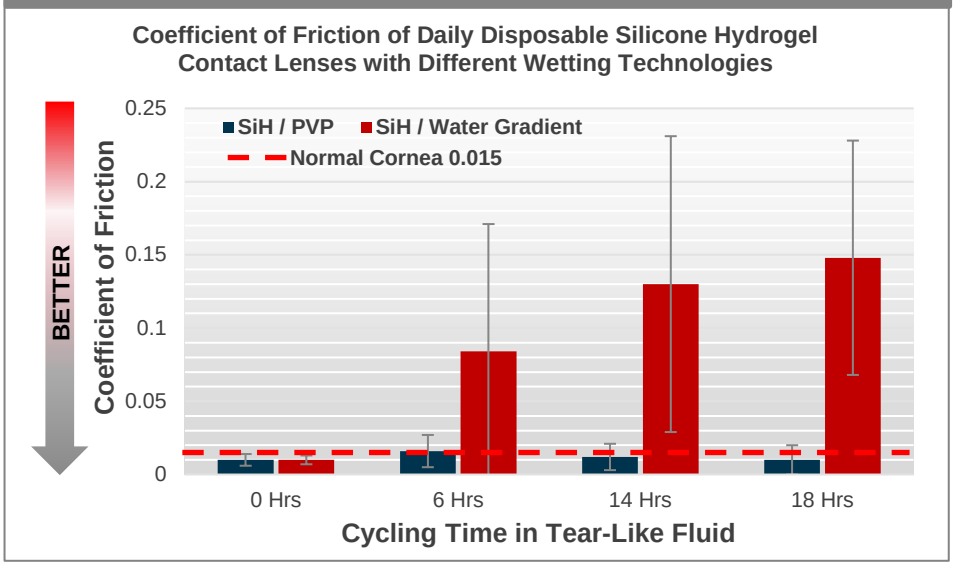
The thinking is that less friction may result in higher and/or more sustained levels of comfort, particular during sustained digital device use where blink rate drops dramatically.[19] The long chain PVP embedded in the lens may help re-establish a proxy for the normal tear film environment before it was interrupted by the placement of a contact lens by functioning somewhat like the membrane bound mucins in the cornea which interact naturally with the free-floating mucins in the tear film. PVP has many properties that are similar to mucins: it is amphiphilic or having both hydrophilic and lipophilic structures and biologically relevant properties that promote spreading and stability of all layers of the tear film. And as demonstrated by Sterner, long chain/high molecular weight PVP is better able to lower friction.[20] So, when it comes to evaluating a material, **select a material with a robust and lubricious wetting technology.**

Design Considerations

Lens modulus and thickness profile

Other material and design factors have less obvious impacts on sustained lens wearing comfort and can be considered "necessary but not sufficient", but practitioners should be aware of potential impact. Modulus and lens design work together to impact comfort. Modulus is a property that is intrinsic to the material, and is not influenced by lens geometry.[21] Stiffness, however, is a structural property influenced by the geometry of the lens as well as the material of which it is comprised – a thin lens will be more flexible than a thick one. This relationship was well illustrated in work looking at the impact on edge shape and thickness on conjunctival staining. Maissa found that a thinner "knife" edge design was more comfortable than thicker "chisel" or rounded edge shapes, and when edge shape was controlled, the lower modulus design trended more

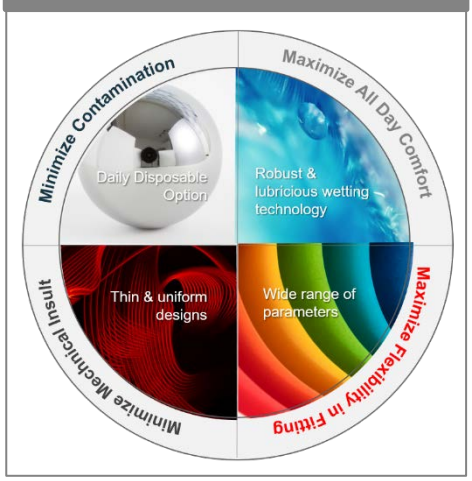
Figure 4: Friction over 18 hours of simulated wear of two daily disposable silicone hydrogel contact lenses incorporating differing wetting technologies with the cornea as a reference.



comfortable.[22] Modulus also plays a role in toric lens design, where a differentially thick zone such as in a prism ballast design will make the lens more difficult to flex and may impact lens removal. Additionally, the thick inferior portion will induce vertical prism and in cases of monocular astigmatism the impact on binocular vision should be considered*[23,24].

As pointed out in the TFOS report, all the characteristics discussed probably impact comfort in some way,[25] but the various lenses of a given manufacturer tend to share many properties, and it is conceivable that the gestalt of the properties is more influential. And in fact, these "clusters" of properties by manufacturer can aid you in moving between materials and modalities. Consistency in design and material characteristics across a manufacturer's products combined with a wide parameter range and choice of replacement frequencies can make lens choices and changes much easier. Have a look at the summary graphic in Figure 5 for some recommendations to help you select your "pandemic and beyond" lens family of choice. And stay safe out there!

Figure 5: A judicious selection of material, design, parameters and replacement frequency can lead to fitting success in a time when "low-touch" eye care is a health concern.



*Vertical heterophoria possibly caused by prism dissociation due to the prescne of induced optical prism is a relevant factor for practitioners to consider when fitting toric contact lenses for monocular astigmats or those requiring a mix of toric soft contact lens designs.[26,27] Clinical studies have not been done to fully characterize the clinical effects of differences in base down prism among different contact lenses.

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Important safety information:
ACUVUE® Contact Lenses are indicated for vision correction. As with any contact lens, eye problems, including corneal ulcers, can develop. Some wearers may experience mild irritation, itching or discomfort. Lenses should not be prescribed if patients have any eye infection, or experience eye discomfort, excessive tearing, vision changes, redness or other eye problems.

Consult the package insert for complete information. Complete information is also available from <insert legal entity, phone number and/or website info> Johnson & Johnson Vision Care, Inc. by calling 1-800-843-2020, or by visiting www.jnjvisionpro.com.

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