Contact Lens Update
CLINICAL INSIGHTS BASED IN CURRENT RESEARCH

Contact Lens Material Properties

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There are a number of important contact lens material properties that can have an impact on a patient's ocular health and wearing experience and these properties can vary widely, depending upon the material being tested (e.g., traditional hydrogel, silicone hydrogel).[1-3] While this article is unable to elaborate on every aspect of contact lens design, it will summarize many of the commonly described contact lens material properties. It will also briefly describe how some properties are believed to influence each other and how the various contact lens properties may impact their clinical performance.

1. **Contact lens oxygen permeability (Dk)** is a description of oxygen's ability to passively diffuse through a contact lens material while **oxygen transmissibility (Dk/t)** adds in oxygen's ability to move through the thickness of a contact lens.[1] Original contact lens materials were impermeable to oxygen, which lead to negative clinical outcomes like corneal swelling.[1] Vast innovations in material technology have led to the development of hydrogel (low to moderate Dk/t) and later silicone hydrogel materials (high Dk/t).[1] Traditional hydrogel materials generally meet the open-eye oxygen requirements (~24 Dk/t) for avoiding central corneal swelling, while silicone hydrogel materials typically surpass the oxygen levels (~87 Dk/t) needed for avoiding central corneal swelling during closed eye conditions.[1] While Dk/t levels of silicone hydrogel contact lenses are generally considered more than adequate, even higher transmissibility levels may be beneficial because some aspects of cornea health (e.g., avoiding epithelial acidosis) require Dk/t values greater than 87 to maintain normal homeostaisis.[1] While the advent of high Dk/t materials has reduced corneal swelling, these innovative materials have not reduced infection rates or remarkably improved contact lens comfort.[1]

2. The **modulus** (cross-sectional stress/strain) of a contact lens is a measure of the material's stiffness.[4] Modulus should be a concern for the contact lens practitioner because materials with a higher modulus are associated with mechanically induced complications such as giant papillary conjunctivitis and superior epithelial actuate lesions.[4] Low water content soft contact lenses usually have higher moduli, and high water content contact lenses typically have lower moduli, though there are exceptions to this trend.[4] Material modulus can also vary slightly with temperature.[4]

3. A contact lens' **contact angle** (angle formed between a surface and drop of liquid) is a measure of the wettability of a contact lens; smaller angles indicate that materials are more wettable while larger angles indicate that a material is less wettable.[5] Contact lens contact angles are material dependent, with no clear difference between traditional and silicone hydrogel contact lenses.[6] With that said, improved contact lens wettability has been associated with better contact lens comfort.[7]

4. Contact lenses may undergo **dehydration** (water loss) over the course of a wear day, a phenomenon that likely increases in dry and windy environments.[3, 8] Dehydration of traditional hydrogel contact lenses can reduce oxygen transmissibility, which may increase the chances of hypoxic complications, while the opposite relationship is

true for silicone hydrogel contact lenses.[3] Silicone hydrogel contact lenses dehydrate less than hydrogel contact lenses, and there is currently no clear relationship between contact lens comfort and contact lens dehydration.[3]

5. The **coefficient of friction** can be defined as the "ratio of lateral to normal forces acting between two surfaces in relative motion."[9] The coefficient of friction for soft contact lenses is highly material variable (no clear differences between traditional and silicone hydrogel contact lenses), but it may increase with increasing amounts of contact lens deposits.[9] Higher coefficients of friction are also believed to result in lower levels of contact lens comfort.[9]

6. Contact lens **deposits** can be introduced by the external environment (e.g., makeup) or from bodily sources like the tear film.[2, 10] The most commonly studied contact lens deposits are tear proteins and lipids.[2] In general, studies indicate that traditional hydrogel contact lenses accumulate high levels of protein deposits and low levels of lipids, while the reverse trend has been found for silicone hydrogel contact lenses.[2] Again, there are exceptions to this rule.[11] Deposits have the potential to lead to decreased ocular comfort, decreased visual acuity, and ocular diseases like giant papillary conjunctivitis.[2, 7, 12] Therefore, when using reusable contact lenses, contact lenses should be thoroughly cleaned with a care system that involves a rub and rinse step.[13-15]

Currently marketed contact lenses have been developed to work in synergy with the eye and to allow for healthy and regular use. This has been accomplished by taking into account the many contact lens properties described above. Furthermore, the continual need to improve upon biocompatibility and ocular comfort has resulted in a myriad of contact lens prescribing options. On the surface, a multitude of very similar soft contact lenses may seem redundant and unnecessary; however, small differences in the materials properties described above may lead to a big perceived difference for our patients that will likely not be consistent across patients, and because of this there will likely always be a need for a variety of soft contact lenses materials in the market, a concept that should always be considered when dealing with those hard to fit patients.

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