(Non) contact lenses

Lentes de (não) contato

Cristina Cagliari[1] https://orcid.org/ 0000-0002-1416-1695
Paulo Schor[1] https://orcid.org/0000-0002-3999-4706

It is necessary acquiring knowledge in order to change, science is based on curiosity, on what we understand, build, change and propose; thus, technology takes knowledge as the basis to define our actions. We create things based on selfless attempts to improve the world. Lunar aircrafts, autonomous cars, submarine drones, clothes made with thermal wire guided by body sensors, actuators that make us experience the sensations of others, all these innovations start with the playful restlessness triggered by the unknown and sustained by the environment, which always offers and demands more in a faster way. Thus, it is worth presenting the concept of functionalization, which lies on modifying something to give it properties different from the original ones. Accordingly, we functionalize not only initially-inert materials but also bodies, organs and cells.

We, physicians, learn and practice physiopathology as the basis for evidence-based understanding and treatments. In addition, the very core of our training lies on deviations from what is expected, although preventing diseases is philosophically and theoretically more natural than remedying them. What if medicine was not only aimed at healing and keeping individuals healthy, but at effectively improving their functionalities? Based on this idea, treating and improving physiological functions could enable better quality and performance. After all, most individuals are not ill, but healthy, most of the time.

Individuals have been using prostheses and substances in order to regain performance since ancient times. The first corrective lenses capable of enabling them to see clearly date back to Classical Antiquity [1]; however, the first contact lenses were only produced at the end of the 18th century. [2] A great innovation at the time, the so-called corneal shells were made of ground glass, but nowadays, in the middle of the smartphone era, they gain new meanings. Tools available in the consumer society we live in are sold as panacea; we do not give too much thought about "what" we want or need, but rather about what to do with something we have. Thus, "dehumanized" products and strategies emerge; they are little, or not at all, based on users and primarily focused on the market effect. Our question, as ophthalmologists, could be: what is really useful in the current high-tech routine?

Several functions, such as bio-sensors capable of measuring intraocular pressure or glycemic levels in tears, have already been successfully implemented in contact lenses; [3] based on recent developments, there will be a considerable expansion in this range of applications within the coming decades. [4] Our colleague Dimitri Azar, who nowadays works at Verily (a company belonging to the Google group), builds sensors powered by locally stored energy, which can perform optical modifications and restore functions, such as reducing accommodation in presbyopic patients. DARPA (American defense research agency) has been investigating smart contact lenses for more than a decade in order to provide field benefits to American soldiers based on augmented reality systems.

Jean-Louis de Bougrenet de la Tocnaye leads the optics research team at IMT Atlantique. In 2019, he developed the first contact lens with flexible micro battery, which can transform it into an eye tracker physically attached to users' eyes. [5] Earlier this year, Mojo Vision (Californian electronics company) released its smart prototype equipped with 14,000 ppi display (the iPhone 11 has 326 ppi), image and motion sensor, radio and smartphone connection ... both cases refer to scleral contact lenses (SCL), which belong to a less conventional contact lens modality that has been much in evidence in recent years.

SCLs have gained renewed interest in the past decade. They were initially used in eyes that had been severely compromised by high ametropias or corneal ectasias [6,7]; nowadays, their range of action has expanded to less compromised, or even healthy, eyes. SCLs were initially considered inappropriate because they remained immobile and did not enable tear exchange; however, they proved to be an excellent option in case of changes in the ocular surface [8]. In addition, they show low rates of adverse effects and medical complications when they are used in compliance with medical instructions about proper hygiene and handling procedures. [9,10]

The reason for the increased popularity of SCLs lies mainly on their diameter and scleral anchoring system, which allow the non-contact between the lens and the cornea and enable continuous ocular humidification. The efficiency of these lenses opens several integration possibilities - the fact that they are a comfortable and discreet alternative can enable interesting applications. There are 3 alternative scleral lens available in the Brazilian market; they significantly differ from each other in materials and personalized adjustment patterns, which allow users to experience a unique type of lens that were exclusively designed for their eyes. So ... why should we not expand SCL use?

Imagine a strategy focused on enabling us to blink just 3 times a minute instead of 20 ... would it enable us to pay more attention to things, as well as to improve our focus and reading performance? What if, besides that, the same strategy protected our cornea from trauma or filtered the light in a personalized way? How about flying without using glasses or experiencing fogging and still be able to see with increased contrast at dusk? Think about it...

We thought about it and interviewed 30 healthy individuals who actively work with screens and different technologies. These individuals spend, on average, more than 8 hours a day in front of computers, cell phones and game consoles; 25% of them already use some device or artifact, such as energy drinks or glasses with colored filters, to improve their performance. More than 65% of

[1]Universidade Federal de São Paulo

interviewees reported to experience some visual discomfort, such as tiredness and dry eye sensation, over the hours; they also said that these symptoms hinder their performance throughout the day. Most interviewees would be interested in using some mechanism capable of relieving their symptoms; they believe that special contact lenses would be an interesting device to be used in this context.

The concept of time is no longer the same. Technological range increases in geometric progression and it is hard for us to keep the same pace, since organic and physiological evolutions taking place in our body cannot follow this race at such speed. The time has come when remedying is not enough. Prevention is necessary, but it is possible, and we dare say allowed, reinventing, increasing, functionalizing ... finding the balance between what is organic and new (and tireless) technology standards! Based on dense and fantastic scientific methodologies, we can abuse curiosity and leave our comfort zone in order to hopefully reach that magical place of infinite possibilities. We know that the medical academy remains basically focused on diseases (or on medications used to treat them) and that there is lack of interest and subsidy to enable such a change; however, we have good ingredients ... trained professionals, encouraging leaders, beautiful international examples and even entrepreneurs in pursuit of disruptive innovations. Let's do it!

References

1. Cashell GT. A short history of spectacles. Proc R Soc Med. 1971;64(10):1063–4.
2. Efron N, Pearson RM. Centenary celebration of Fick's eine contactbrille. Arch Ophthalmol. 1988;106(10):1370–7.
3. Phan CM, Subbaraman L, Jones LW. The use of contact lenses as biosensors. Optom Vis Sci. 2016;93(4):419–25.
4. Kobashi H, Ciolino JB. Innovative Development of Contact Lenses. Cornea. 2018;37 Suppl 1:S94–8.
5. Nasreldin M, Delattre R, Ramuz M, Lahuec C, Djenizian T, de Bougrenet de la Tocnaye JL. Flexible Micro-Battery for Powering Smart Contact Lens. Sensors (Basel). 2019;19(9):2062.
6. van der Worp E, Bornman D, Ferreira DL, Faria-Ribeiro M, Garcia-Porta N, González-Meijome JM. Modern scleral contact lenses: A review. Cont Lens Anterior Eye. 2014;37(4):240–50.
7. Nau CB, Harthan J, Shorter E, Barr J, Nau A, Chimato NT, Hodge DO, Schornack MM. Demographic Characteristics and Prescribing Patterns of Scleral Lens Fitters: The SCOPE Study. Eye Contact Lens. 2018;44 Suppl 1:S265-S272.
8. Romero-Rangel T, Stavrou P, Cotter J, Rosenthal P, Baltatzis S, Foster CS. Gas-permeable scleral contact lens therapy in ocular surface disease. Am J Ophthalmol. 2000;130(1):25–32.
9. Tan DT, Pullum KW, Buckley RJ. Medical applications of scleral contact lenses: 1. A retrospective analysis of 343 cases. Cornea. 1995;14(2):121–9.
10. Harthan J, Nau CB, Barr J, Nau A, Shorter E, Chimato NT, et al. Scleral lens prescription and management practices: the SCOPE Study. Eye Contact Lens. 2018;44 Suppl 1:S228–32.

ERRATA

■ In the Editorial **"Lenses of (non) contact"**, by Cristina Cagliari and Paulo Schor published in issue number 2 - volume 79 of the Revista Brasileira de Oftalmologia, March-April 2020, pages 89-90, with DOI 10.5935 / 0034-7280.20200018. The name of one of the authors was incorrectly published, **where it reads:** Cristina Cagliar. **Read:** Cristina Cagliari.