Back

8th World Congress of Biomechanics

O0362

Novel Intraocular Pressure Measurement Algorithm for Patients with Keratoconus

Ashkan Eliasy[1], Kai-Jung Chen[1], Riccardo Vinciguerra[1,2], Ahmed Elsheikh[1,3]
[1]School of Engineering, University of Liverpool, Liverpool, United Kingdom. [2]St Paul's Eye Unit, Royal Liverpool and Broadgreen University Hospital, Liverpool, United Kingdom. [3]NIHR Biomedical Research Centre for Ophthalmology, Moorfields Eye Hospital NHS Foundation Trust and UCL Institute of Ophthalmology, London, United Kingdom

Abstract

Introduction: The reliable measurement of intraocular pressure (IOP) in patients with keratoconus (KC) has always been a challenge. Until now no device has been able to measure the true IOP in KC patients [1]. This is due to significant alteration in biomechanics of the eye that is associated with the disease, including softer, thinner cornea and abnormal geometry [2]. This study introduces an algorithm for a biomechanically-corrected IOP ($bIOP_{kc}$) for a non-contact tonometer (CorVis ST), which aims to reduce dependence on corneal biomechanics.

Methods: Through finite element modelling of KC corneal geometries and simulating the CorVis air pressure, a parametric study was conducted and an algorithm developed to predict a more accurate IOP based on corneal behaviour under external pressure and basic measurements of thickness and curvature. The algorithm was validated using clinical data included within two clinical datasets; one acquired in Milan and another in Rio, each including both healthy and KC eyes. Participant numbers are shown in Figure 1. For this validation, the results were compared with those of the biomechanically-corrected IOP algorithm developed earlier for healthy eyes and implemented in the CorVis-ST [3].

Results: The main outcome of the study was the absence of significant difference ($p>0.05$) in the values of bIOP obtained for healthy participants and $bIOP_{kc}$ obtained for KC patients. On the other hand, there was a significant difference in CorVis IOP between the two populations ($p<0.001$). Further, the $bIOP_{kc}$ predictions were significantly less affected by both corneal thickness and age than CorVis IOP.

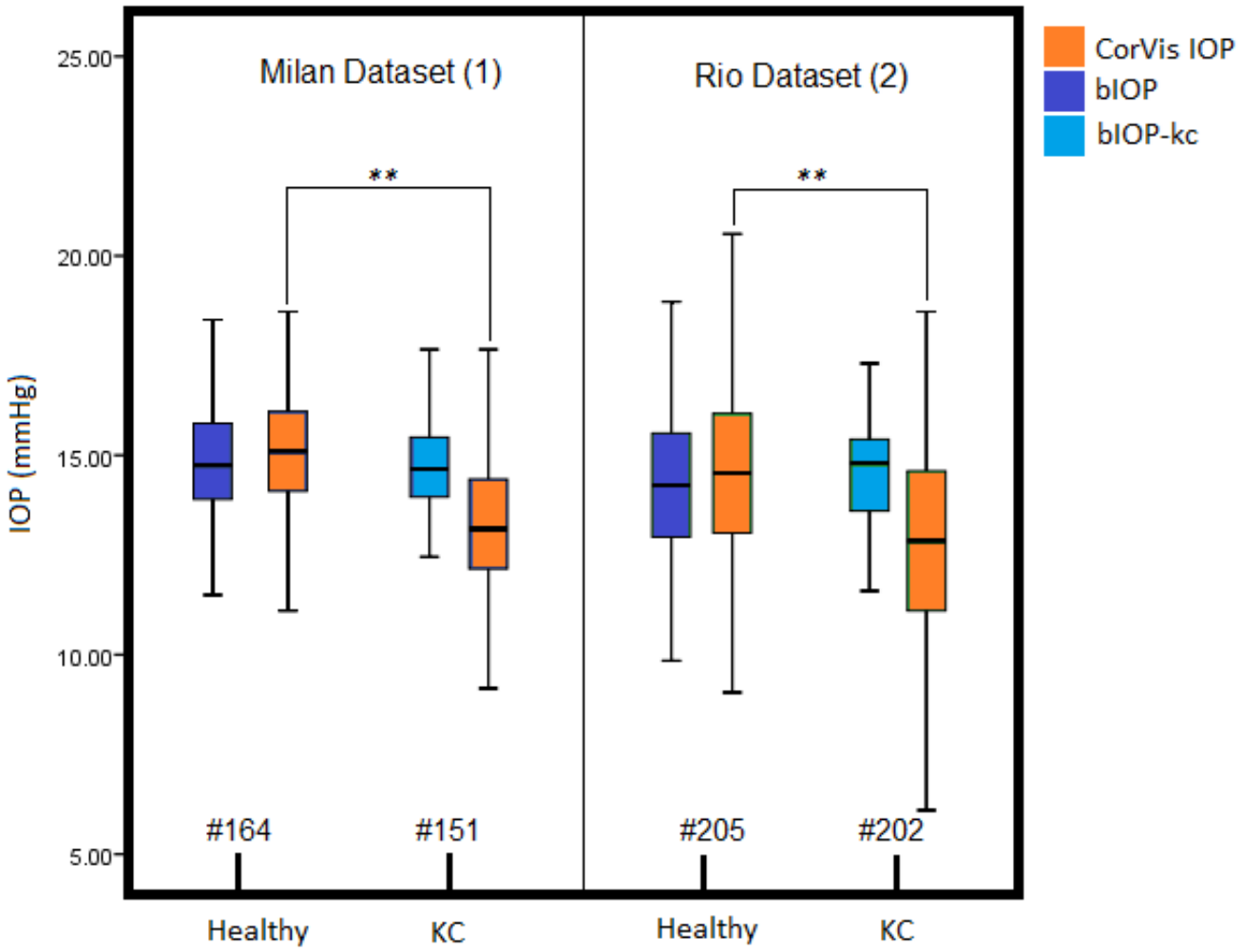

Figure 1 CorVis IOP, bIOP (biomechanically corrected IOP for Healthy patients) and bIOPkc are presented in the graph. ** significant differences in means (p<0.05).

Conclusions: The absence of significant differences between bIOP (for healthy eyes) and bIOPkc (for KC patients), and the absence of dependence of bIOPkc on corneal stiffness parameters are evidence of the effectiveness and reliability of the new IOP algorithm. The routine use in clinical practice of this algorithm may help take into account the well-known systematic errors that affect other tonometers

References

1. Shah S, et al. Invest Ophthalmol Vis Sci 2007;48(7):3026-31.

2. Goldich Y, et al. Cornea 2010;29(9):1011-5.

3. Joda AA, et al. Comput Methods Biomech Biomed Engin 2016;19(9):943-53