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Corneal Swelling

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Dear Sir,

A recent study of corneal swelling by Aakre and Doughty [1] found two regimes in the time course of tissue fluid imbibition. We are pleased to note that this confirms our discovery made over 10 years ago at the University of New South Wales, Sydney [2, 3]. We first reported these results in 1986–1988 to meetings of the International Society of Contact Lens Research, the American Academy of Optometry and the Association for Research in Vision and Ophthalmology.

Stromal oedema of the living cornea is an important clinical concern, and valuable insights can be gained by studying isolated pieces under laboratory conditions. We studied the free swelling behaviour of corneal stromas from cats, rabbits and the ox. Buttons and whole corneas were immersed in physiological saline at room temperature. We were surprised to find that the time course of stromal mass gain showed two distinct regions rather than a single smooth curve as previously reported. The results of Aakre and Doughty [1] confirm that this biphasicity is only evident

if measurements are undertaken at short time intervals. Predried corneal stroma shows altered swelling kinetics, but the biphasicity is still present [4]. The biphasicity appeared to be a general feature of isolated mammalian corneal stroma and was subsequently confirmed in human cornea [4].

Biphasicity of corneal swelling is not predicted by the Gibbs-Donnan osmotic model which explains much of the corneal swelling pressure [5, 6]. The kinetics of corneal swelling is governed by the minimization of free energy [7]. A free-energy analysis of this phenomenon suggests the existence of two thermodynamic domains for corneal swelling [4]. The exact nature of this biphasicity remains to be elucidated but probably implicates an intrastromal cohesive force, possibly due to a structural effect of the corneal proteoglycans or interstitial collagen fibrils.

References

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