**Supplementary File**

*Etiology of corneal innervation defects*

To investigate the etiology of the corneal innervation defects in the *Pax6*+/- mouse we tracked neurites with β-tubulin III in corneas between E12.5 and P25 and compared wild-type to *Pax6*+/- littermates. At E12.5 minimal β-tubulin III staining was observed in wild-type corneas (Supplementary Fig. S2A) however in *Pax6*+/- littermates trigeminal neurones have already projected to the circumference of the cornea and start to form the limbal nerve ring (n = 9) (Supplementary Fig. S2B). It was also possible at this age to see some *Pax6*+/- neurites branching away from the nerve ring towards the cornea. By E14.5 the entire periphery of the cornea was innervated in both genotypes with branched neurites around the circumference projecting toward the centre (data not shown). The most striking differences occur at E16.5 in which the wild-type cornea takes on the appearance of a clock face with stromal neurites projecting in a regular pattern towards the centre (Supplementary Fig. S2C). In *Pax6*+/- corneas the pattern of neurite projection within the corneal stroma appears much more random and disorganised (Supplementary Fig. S2D). Innervation of the *Pax6*+/- corneal epithelium was associated with feathery neurites branching towards the corneal surface from the large stromal bundles from E14.5 (n = 12). At P10, both wild-type and *Pax6*+/- corneal epithelia were fully innervated, but without any radial direction in the peripheral cornea (Supplementary Figs. S2E, F). The radial swirling pattern of projections characteristic of adult corneas was visible from about P25 (Supplementary Fig. S2G), in contrast to epithelial cell centripetal migration patterns which are not clearly observed until at least P40 (Collinson et al., 2004). In *Pax6*+/- corneas the central nerve knot and attraction of nerves radial towards the lens-corneal plug was visible from P2 (Supplementary Fig. S2H).

These data showed that corneal innervation is accelerated in the *Pax6*+/- cornea and that, in wild-types, maturation of the adult pattern of innervation precedes that of adult patterns of epithelial cell migration.
Supplementary Figure S2. Embryonic and neonatal development of neurite growth. β-tubulin III expression in wholemount Pax6+/+ and Pax6−/− corneas. (A,B) Increased expression at corneal circumference in Pax6−/− (B) compared to Pax6+/+ (A) E12.5 corneas. (C,D) E16.5 corneas show radial, clock-face projection of stromal nerve bundles in Pax6+/+ (C) that are more profuse and less regular in Pax6−/− (D). (E,F) P10, fully innervated corneas showing no directionality of epithelial neurites in either genotype. (G) Evidence of swirling patterns in P25 Pax6+/+ cornea. (H) Radial projection of neurones towards central plug, P25 Pax6−/− cornea. Scale bars, (C) 100 μm; (E, G) 50 μm.