Innervation of the feline and canine cornea in correlation to corneal sensitivity

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Introduction
The purpose of our study was to determine the basic architecture of the corneal neural network, the relative nerve density and the corneal touch threshold (CTT) in healthy dogs and cats. The obtained data were screened for correlation between the nerve density and corneal touch threshold.

Material and Methods
For microscopic and morphometric investigations 40 corneas of adult mesaticephalic dogs and 26 corneas of domestic shorthair cats were examined, which had been obtained from animals euthanised by pentobarbital overdose for reason unrelated to this project. The CTT were determined in a second group of 22 healthy, adult, mesaticephalic dogs (Fig. 1) and 24 domestic shorthair cats. The corneal nerves were stained using a modified silver/imregnation technique. The morphometric evaluation was focused on the quantification of the subepithelial and basalepithelial nerve plexus. In total 360 images of corneal sections were analysed morphometrically. The points of intersections of nerve fibers with a square grid (hits) were counted as morphometric primary parameter of relative nerve density and afterwards converted into square millimeter.

Morphometric and aesthesiometric results
The relative nerve density of the subepithelial nerve plexus was 5943 ± 939 hits/mm² in the central (Fig. 2), 6447 ± 877 hits/mm² in the dorsal, 6351 ± 1228 hits/mm² in the ventral region in dogs, 5432 ± 1229 hits/mm² in the central, 5538 ± 659 hits/mm² in the dorsal and 5200 ± 576 hits/mm² in the ventral region in cats. There were no statistically significant differences when comparing the regional values of the subepithelial nerve plexus.

Microscopic results
The periphery was innervated by a conjunctival nerve plexus (Fig. 4) entering at the superficial level, branching in a disorganized pattern and ending after a short distance. Corneal stromal nerve trunks (Fig. 5) entered the anterior third of stroma from various perilimbal sites, continued centrally and gave off collaterals in horizontal and vertical plane. Most of the smaller nerve fibers extended in anterior direction forming the subepithelial (Fig. 6) and basalepithelial nerve plexus (Fig. 7), expanded into the wing cell layer and ended there as free nerve endings.

Peripheral Cornea

Central Cornea

Conclusion
The higher relative nerve density of the cats basalepithelial nerve plexus and the higher corneal sensitivity indicated a functional connection. No correlation was found between the subepithelial relative nerve density and the CTT values.

Support: promotional program of the Fazit-Stiftung, gemeinnützige Verlagsgesellschaft mbH, Frankfurt am Main, Germany