

The fibrillar crimps of the sclera

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Crimps are a typical feature of tendons and of some ligaments where they are responsible for the non-linear behaviour of the tissue at low strain values. Previous studies (Raspanti et al., 2005) shown that in tendons these visible crimps always correspond to a distinctive buckling and/or left-handed torsion of the collagen fibrils, subsequently named “fibrillar crimp” (Franchi et al, 2007). These planar crimps are exclusive of the collagen fibrils of tendons and ligaments, whose subfibrils run straight and parallel and tend to behave like stiff rods; by contrast, the collagen fibrils of most tissues, which are sometimes defined as “reticular fibrils” of “type III fibrils” and whose subfibrils follow an helical course, are almost infinitely flexible and can withstand even sharp U-turns without buckling. In the present study we investigated the rat sclera, whose ultrastructure is closely related to that of tendons and ligaments (Raspanti et al., 1992). The tissue was observed by light microscopy, high-resolution scanning electron microscopy and atomic force microscopy. The sclera appears made of flattened fascicles of large and heterogeneous collagen fibrils, running in all directions and often following a wavy course. The individual fascicles are identical in structure and appearance to those of tendon, as are the numerous crimps which can be easily observed along their fibrils. The presence of crimps in the sclera cannot be taken for granted because at variance with tendon, which is subject to intermittent load/recoil cycles, this tissue is held under continuous tension by the intraocular pressure (IOP). A typical intra-ocular pressure of 20-30 mmHg would induce in the rat sclera a tension varying from 50 to 80 kN/m², and the elastic behaviour of the crimps may have a role in maintaining the shape of the eyeball. The crimps may therefore be fully functional, confirming this tissue as a sort of hemispherical tendon.

References

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