The role of stem cells in renewing the cornea

2 October 2008

A group of researchers in Switzerland has published a study appearing in the Oct 1 advance online edition of the Journal *Nature* that shows how the cornea uses stem cells to repair itself.

Using mouse models they demonstrate that everyday wear and tear on the cornea is repaired from stem cells residing in the corneal epithelium, and that more serious repair jobs require the involvement of other stem cells that migrate from the limbus, a region between the cornea and the conjunctiva, the white part of the eye.

The integrity of the cornea, the transparent outer layer of the eye, is critical for vision. Millions of people around the world suffer from partial or complete blindness when their corneas lose transparency. Treatment options involve corneal transplants and, more recently, stem cell therapy. The surface of the cornea is naturally in a state of constant renewal; its upper layer, or epithelium, is completely turned over once every 7-14 days. Because slow-cycling stem cells have been found in the mouse limbus, researchers have assumed that these stem cells are the ones responsible for corneal renewal.

The research led by Professor Yann Barrandon, who holds a joint appointment at EPFL and the Lausanne University Hospitals (CHUV), challenges this prevailing opinion that the limbus is the only place where corneal stem cells reside. The researchers demonstrated that the epithelium of the cornea also contains stem cells, and that these cells have the capacity to generate two different epithelial tissues: corneal (covering the transparent part of the eye) and conjunctival (covering the white part of the eye). They demonstrated experimentally that these are the cells activated in everyday corneal renewal. The stem cells residing in the limbus have a different role; they are only activated when the cornea is seriously wounded.

To explain this distribution of stem cells and the different roles played by stem cells in different zones of the eye, the researchers propose that the expanding epithelia of the cornea and the conjunctiva act like tectonic plates, squeezing the limbus between them into a kind of equilibrium zone. Due to the constant expansion, stem cells accumulate in this zone. In the event of a rupture in the equilibrium, such as a large corneal injury, these limbal stem cells migrate into the cornea and conjunctiva and differentiate into the appropriate cell type to make repairs.

The limbus is already recognized as a source of cells for corneal stem cell therapy in humans, and this new research indicates that the cornea itself can also be explored as a potential source of these cells. And because cancer has been associated with the presence of adult stem cells, the model also helps explain why transitional zones like the limbus, where stem cells accumulate, are sites where cancer tends to occur more frequently.

Source: Ecole Polytechnique Fédérale de Lausanne