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# Cells That Maintain Your Vocal Fold Tissues

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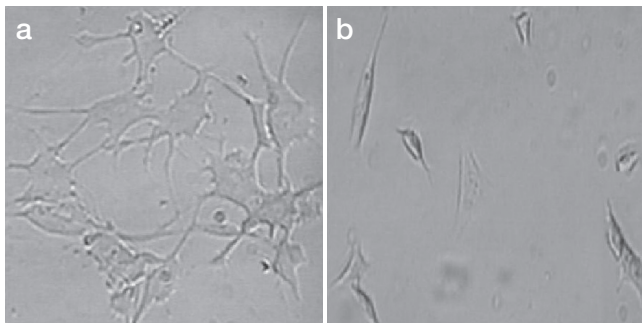
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**W**E ALL REMEMBER ENOUGH BIOLOGY from our high school or college days to know that cells are the carpenters of our body tissues. They make structural materials, deliver the material to specific locations, build or repair tissue fabric, remove waste products, and signal to each other when and where a job is needed. Some tissues, like skin and muscle, have so many cells side-by-side that they themselves are the structure. Like a group of acrobats stacked vertically and horizontally and holding on to each other's hands and feet, they become the fabric. Other tissues are constructed by tying together molecular strands, with lots of space between them for fluids and the cells themselves to occupy. The objective is to build a fabric that can be deformed (bent, elongated, squished), but will also snap back to its original shape when forces are removed. The "snapping back" cannot be too fast—otherwise our tissues would rattle. Hence, the fluids between the strands are viscous, meaning that they don't flow easily or quickly. The strands, on the other hand, are elastic, meaning that they force the tissue to return to its original shape. Scientists refer to tissues as being viscoelastic. A model for tissue would be a mattress filled with water (rather than air). Coiled springs and cotton threads provide the elastic component, while the water buffers the bounce.

The busiest of all the carpenter cells are the fibroblasts. They live in the lamina propria (the layers in motion) of the vocal folds, directly under the skin. Their population density is not nearly as large as that of skin cells or muscle cells (muscle fibers). They can migrate from place to place, depending on where they are needed. The greatest concentration of these cells is at the end points of the vocal ligament, where vibration is minimal. In shape, they appear star-like; hence, they are called stellate cells (Figure 1a). These cells can store vitamin A and lipid (fat-like) droplets, which are used to manufacture other products. The stellate cells appear to be brought into action when major repair is required. They lie in wait, so to speak. Another form of the fibroblast cell is spindle shaped rather than stellate (Figure 1b). It resides more in the middle of the vocal fold, where vibration takes place. It is believed to be in charge of the smaller maintenance jobs, and cell-to-cell signaling.

A number of proteins and protein-like molecules have been identified as being regulated by the fibroblasts. Collagen and elastin molecules provide

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**Figure 1.** (a) Star-like (stellate) fibroblast cells and (b) spindle-shaped fibroblast cells found in vocal folds.

the elastic properties. They can be uncoiled or stretched when tissue needs to be deformed, but they tend to restore shape when stresses are removed. Another group of molecules are known as glycosaminoglycans (GAGs). They are more fluid-like so that they can fill the spaces

between the structural proteins. These molecules are large and very complex, but at the core is a repeating disaccharide unit (two sugars, or glycoses) coupled with an amino group of atoms between them. One variation of the GAG is hyaluronic acid, a very friendly molecule that grabs all the water it can find and puffs itself up with it. It can slither and slide through small spaces when it is puffed up with water; hence, it becomes an excellent lubricant in places when much rubbing motion would otherwise occur, like in the vibrating portions of the vocal fold. Hyaluronic acid is found in great abundance in the vitreous humor of the eyeball, in the umbilical cord, between the surfaces of joints, or in the comb of a rooster. It is gel-like, clear and odorless.

Cells regulate the amount of material (solid or liquid) that is needed to make up an ideal extracellular matrix (a weave of solid strands filled with fluid). Scientists are currently investigating how vocal fold vibration influences the up-regulation or down-regulation of various molecules.

 A promotional poster for Belmont University's School of Music. At the top is the Belmont University logo. Below it, the text reads "Presents THE 17<sup>TH</sup> ANNUAL Summer Vocal Pedagogy & Performance Workshop". The central image is a stylized illustration of a jazz musician playing a piano, with musical notes and instruments like a saxophone and trumpet. Below the illustration, the text says "Jazzin' 't Up! with Rachel Cohen May 23-26, 2010". At the bottom, it provides contact information: "For more information, call 615.460.6408. www.BELMONT.EDU".

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