­Table 1: Cells in LP

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Cells | Average cell/image field (men)2 | % of total cells in LP (men) | Average cell/image field (women)2 | % of total cells in LP (women) | % of total cells in LP (average)2 |
| LP Fibroblast | 4.28 | 78.94 | 4.24 | 78.78 | 78.86 |
| LP Macrophage | 0.30 | 5.53 | 0.38 | 7.06 | 6.29 |
| LP Myofibroblast | 0.842 | 15.53 | 0.762 | 14.16 | 14.85 |

[2] Catten, Michael, Steven D. Gray, Thomas H. Hammond, Ruixia Zhou, and Elizabeth Hammond. "Analysis of cellular location and concentration in vocal fold lamina propria." *Otolaryngology--Head and Neck Surgery* 118, no. 5 (1998): 663-667.

Table 2: Cells in LP and epithelium

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Cells | % of total cells | | | Million cells per g ww | | |
| Total (LP and epithl) | 100 |  |  | 57 ± 91 |  |  |
| Epithelium |  | 60 1 |  |  | 34.2 |  |
| Blood Vessel (Neutrophil) |  | 4\* |  |  | 2.3 |  |
| LP |  | 36 |  |  | 20.5 |  |
| LP Fibroblast |  |  | 28.82 |  |  | 16.4 (181, 21 ± 4  2) |
| LP Macrophage |  |  | 2.22 |  |  | 1.3 |
| LP Myofibroblast |  |  | 5.42 |  |  | 3.1 |

\* estimated approximate 10% non-epithelial cells in LP are neutrophil

[1] Muñoz-Pinto, Dany, Peter Whittaker, and Mariah S. Hahn. "Lamina propria cellularity and collagen composition: an integrated assessment of structure in humans." *Annals of Otology, Rhinology & Laryngology* 118, no. 4 (2009): 299-306.

[2] Catten, Michael, Steven D. Gray, Thomas H. Hammond, Ruixia Zhou, and Elizabeth Hammond. "Analysis of cellular location and concentration in vocal fold lamina propria." *Otolaryngology--Head and Neck Surgery* 118, no. 5 (1998): 663-667.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| VF Layers | Depth (% of LP) | | Fibroblast3 | | | |
|  | According to collagen organization 1, 2 | Uniform | Cell/ image field | Std Dev | Max | Min |
| Superficial LP | 13% of LP2 | 20% | 4.51 | 3.02 | 14.50 | 0.5 |
| Intermediate LP | 51% of LP2 |
| 20% | 4.08 | 3.19 | 12.67 | 0.67 |
| 20% | 3.60 | 3.00 | 13.67 | 0.17 |
| 20% | 3.77 | 2.32 | 10.33 | 0.67 |
| Deep LP | 36% of LP2 |
| 20% | 5.33 | 3.01 | 15.75 | 2.20 |

Table 3: Fibroblast in LP

[1] Kaiser, M. L., M. Rubinstein, D. E. Vokes, J. M. Ridgway, S. Guo, M. Gu, R. L. Crumley, W. B. Armstrong, Z. Chen, and B. J. F. Wong. "Laryngeal epithelial thickness: a comparison between optical coherence tomography and histology." *Clinical Otolaryngology* 34, no. 5 (2009): 460-466.

[2] Prades, Jean-Michel, Jean Marc Dumollard, Sébastien Duband, Andrei Timoshenko, Céline Richard, Marie Dominique Dubois, Christian Martin, and Michel Peoc’h. "Lamina propria of the human vocal fold: histomorphometric study of collagen fibers." *Surgical and radiologic anatomy* 32, no. 4 (2010): 377-382.

[3] Catten, Michael, Steven D. Gray, Thomas H. Hammond, Ruixia Zhou, and Elizabeth Hammond. "Analysis of cellular location and concentration in vocal fold lamina propria." *Otolaryngology--Head and Neck Surgery* 118, no. 5 (1998): 663-667.

Table 4: Macrophage in LP

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| VF Layers | Depth (% of LP) | | Macrophage3 | | | |
|  | According to collagen organization 1, 2 | Uniform | Cell/ image field | Std Dev | Max | Min |
| Superficial LP | 13% 2 | 20% | 1.01 | 0.37 | 1.5 | 0.5 |
| Intermediate LP | 51% 2 |
| 20% | 0.30 | 0.4 | 1.0 | 0.0 |
| 20% | 0.16 | 0.2 | 0.5 | 0.0 |
| 20% | 0.04 | 0.12 | 0.33 | 0.0 |
| Deep LP | 36% 2 |
| 20% | 0.14 | 0.26 | 0.6 | 0.0 |

[1] Kaiser, M. L., M. Rubinstein, D. E. Vokes, J. M. Ridgway, S. Guo, M. Gu, R. L. Crumley, W. B. Armstrong, Z. Chen, and B. J. F. Wong. "Laryngeal epithelial thickness: a comparison between optical coherence tomography and histology." *Clinical Otolaryngology* 34, no. 5 (2009): 460-466.

[2] Prades, Jean-Michel, Jean Marc Dumollard, Sébastien Duband, Andrei Timoshenko, Céline Richard, Marie Dominique Dubois, Christian Martin, and Michel Peoc’h. "Lamina propria of the human vocal fold: histomorphometric study of collagen fibers." *Surgical and radiologic anatomy* 32, no. 4 (2010): 377-382.

[3] Catten, Michael, Steven D. Gray, Thomas H. Hammond, Ruixia Zhou, and Elizabeth Hammond. "Analysis of cellular location and concentration in vocal fold lamina propria." *Otolaryngology--Head and Neck Surgery* 118, no. 5 (1998): 663-667.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| VF Layers | Depth (% of LP) | | Myofibroblast3 | | | |
|  | According to collagen organization 1, 2 | Uniform | Cell/ image field | Std Dev | Max | Min |
| Superficial LP | 13% 2 | 20% | 1.39 | 1.52 | 5.80 | 0.0 |
| Intermediate LP | 51% 2 |
| 20% | 0.91 | 0.35 | 5.00 | 0.0 |
| 20% | 0.93 | 1.28 | 4.25 | 0.0 |
| 20% | 0.53 | 1.05 | 4.33 | 0.0 |
| Deep LP | 36% 2 |
| 20% | 0.25 | 0.50 | 1.75 | 0.0 |

Table 5: Myofibroblast in LP

[1] Kaiser, M. L., M. Rubinstein, D. E. Vokes, J. M. Ridgway, S. Guo, M. Gu, R. L. Crumley, W. B. Armstrong, Z. Chen, and B. J. F. Wong. "Laryngeal epithelial thickness: a comparison between optical coherence tomography and histology." *Clinical Otolaryngology* 34, no. 5 (2009): 460-466.

[2] Prades, Jean-Michel, Jean Marc Dumollard, Sébastien Duband, Andrei Timoshenko, Céline Richard, Marie Dominique Dubois, Christian Martin, and Michel Peoc’h. "Lamina propria of the human vocal fold: histomorphometric study of collagen fibers." *Surgical and radiologic anatomy* 32, no. 4 (2010): 377-382.

[3] Catten, Michael, Steven D. Gray, Thomas H. Hammond, Ruixia Zhou, and Elizabeth Hammond. "Analysis of cellular location and concentration in vocal fold lamina propria." *Otolaryngology--Head and Neck Surgery* 118, no. 5 (1998): 663-667.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Depth (% of LP) | Fibroblast | Macrophage | Myofibroblast |  |
|  |  | Cell/ image field ^ | Cell/ image field ^ | Cell/ image field ^ | Total |
| Superficial  Deep | 20% | 4.51 | 1.01 | 1.39 | 6.91 |
| 20% | 4.08 | 0.30 | 0.91 | 5.29 |
| 20% | 3.60 | 0.16 | 0.93 | 4.69 |
| 20% | 3.77 | 0.04 | 0.53 | 4.34 |
| 20% | 5.33 | 0.14 | 0.25 | 5.72 |
| Total |  | 21.29 | 1.65 | **4.01** | 26.95 |

Table 6: Cells in LP layers

Table 7a: Cells in LP layers (as % of each cell type )

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Depth (% of LP) | Fibroblast | Macrophage | Myofibroblast |
|  |  | % of fibroblast | % of macrophage | % of myofibroblast |
| Superficial  Deep | 20% | 21.2 | 61.2 | 34.7 |
| 20% | 19.2 | 18.2 | 22.7 |
| 20% | 16.9 | 9.7 | 23.2 |
| 20% | 17.7 | 2.4 | 13.2 |
| 20% | 25.0 | 8.5 | 6.2 |

Table 7b: Cells in LP layers (as % of total LP cells)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Depth (% of LP) | Fibroblast | Macrophage | Myofibroblast |
|  |  | % of LP cells | % of LP cells | % of LP cells |
| Superficial  Deep | 20% | 16.7 | 3.7 | 5.2 |
| 20% | 15.1 | 1.1 | 3.4 |
| 20% | 13.4 | 0.6 | 3.5 |
| 20% | 14.0 | 0.1 | 2.0 |
| 20% | 19.8 | 0.5 | 0.9 |

^ref Table 3-5

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| VF Layers | Depth1, 2  (% of total LP depth) | | % of Total  Cells^^ | Fibroblast  (% of Total Cells) ^^^ | Macrophage  (% of Total Cells) ^^^ | Myofibroblast  (% of Total Cells ) ^^^ | Neutrophil  (% of Total Cells) |
| Epithelium |  |  | 60 1 |  |  |  |  |
| Superficial LP | 13% 2 | 20% | 36 | 6.0 | 1.3 | 1.9 |  |
| Intermediate LP | 51% 2 |
| 20% | 5.5 | 0.4 | 1.2 |  |
| 20% | 4.8 | 0.2 | 1.2 |  |
| 20% | 5.0 | 0.1 | 0.7 |  |
| Deep LP | 36% 2 |
| 20% | 7.2 | 0.2 | 0.3 |  |
| Blood Vessels |  |  | 4\*\*\*\* |  |  |  | 4 |

Table 8: Cells in VF layers (as % of total VF cells)

Table 9: Cells in VF layers

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| VF Layers | Depth1, 2  (% of total LP depth) | | Million Cells per g ww\*,\*\* | Fibroblast  (million cells) | Macrophage  (million cells) | Myofibroblast\*\*\*  (million cells) | Neutrophil  (million cells) |
| Epithelium |  |  | 34.2 |  |  |  |  |
| Superficial LP | 13% of LP2 | 20% | 20.52 | 3.43 | 0.77 | 1.06 |  |
| Intermediate LP | 51% of LP2 |
| 20% | 3.11 | 0.23 | 0.69 |  |
| 20% | 2.74 | 0.12 | 0.71 |  |
| 20% | 2.87 | 0.03 | 0.40 |  |
| Deep LP | 36% of LP2 |
| 20% | 4.06 | 0.11 | 0.19 |  |
| Blood Vessels |  |  | 2.28 |  |  |  | 2.28 |

^^ Total cells refer to cells in LP and epithelium

^^^Table 7

\*convert from million cells per mg of tissue total protein. 100 μg protein/mg tissue wet weight (<http://www.ncbi.nlm.nih.gov/pubmed/20949398>), assume LP have similar protein levels by wet weight (approx. 10%) as other loose connective tissues

\*\* approximate human LP weight (one of left or right): 1 g ww

\*\*\* myofibroblast are differentiated fibroblast. In VF ABM, we consider them ‘activated fibroblasts’

\*\*\*\* estimated approximate 10% non-epithelial cells in LP are neutrophil

[1] Muñoz-Pinto, Dany, Peter Whittaker, and Mariah S. Hahn. "Lamina propria cellularity and collagen composition: an integrated assessment of structure in humans." *Annals of Otology, Rhinology & Laryngology* 118, no. 4 (2009): 299-306.

[2] Catten, Michael, Steven D. Gray, Thomas H. Hammond, Ruixia Zhou, and Elizabeth Hammond. "Analysis of cellular location and concentration in vocal fold lamina propria." *Otolaryngology--Head and Neck Surgery* 118, no. 5 (1998): 663-667.