

The Voice

The Voice

VOICE OF THE EDITOR

Mary Sandage, PhD

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IN SUPPORT OF VOICE CARE

BY MARY SANDAGE, PHD

In times of uncertainty, it is gratifying to know that there is basic research upon which we can draw for insight into hypothesis development and treatment planning. In this issue, three exemplary researchers discuss a range of relevant topics that will support voice care. It is my hope that all three of these contributions will inspire your work in the clinic or studio.

Nathan Welham has provided a cogent description of the lamina propria

which will be required reading in my graduate voice course. Cari Tellis reminds us how important it is to understand the motor learning aspects of habilitation and rehabilitation, an often overlooked aspect of the “how” of what we do in behavior management. Finally, Aaron Johnson delineates the importance of balancing bedside-to-bench with bench-to-bedside.

Wishing you a wonderful summer!



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*Voice
of the
Editor*

46TH ANNUAL SYMPOSIUM

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WHAT MAKES THE LAMINA PROPRIA SO SPECIAL?

BY NATHAN WELHAM, PhD, CCC-SLP

Since pioneering descriptive work by Minoru Hirano in the 1970s, the lamina propria has been considered an important – perhaps even sacred – part of the vocal fold anatomy. Its biologic makeup is fundamental to the capacity of the vocal fold to vibrate, continue in self-sustained vibration, and show certain physiologic features such as a traveling surface (mucosal) wave. Many of the parameters that clini-

“...the lamina propria has been considered an important – perhaps even sacred – part of the vocal fold anatomy”

cians evaluate during a videostroboscopic or high-speed videoendoscopic evaluation (amplitude of vibration, mucosal wave travel, etc.) are conferred by the mechanical properties of this lamina propria region, which in turn are conferred by its biologic makeup. Disruption of the lamina propria’s native biology, due to injury or disease for example, can

have serious consequences for voice. A skilled phonosurgeon is well aware of this and treats the lamina propria with extreme care.

The lamina propria is a type of stromal tissue, with a mesenchymal origin. **The function of stroma is to provide structural support to the primary functional region (parenchyma) of an organ or tissue region** [e.g., the relationship between the dermis (stroma) and epidermis (parenchyma) in skin]. The lamina propria’s exquisite role in creating voice is, in this sense, a secondary function; its primary function is to support the vocal fold epithelium. Described simply, the lamina propria contains cells (mostly fibroblasts) and a cell-supporting matrix. We often call this matrix the

“extracellular matrix” or ECM. It is this ECM (synthesized by the cells) that makes the lamina propria so special.

What do we know about the makeup of the ECM of the lamina

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LAMINA PROPRIA...CONTINUED

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propria? The ECM is comprised of proteins, glycans (sometimes simply referred to as carbohydrates or sugars), and lipids, as well as conjugates of these three primary molecular types (e.g., glycoproteins—proteins with a smaller glycan component; proteoglycans—glycans with a smaller protein component; glycolipids; etc.). All three major molecule types are probably important to function; however, our knowledge of the ECM is highly biased towards proteins, followed by glycans, and then lipids. The reason for this bias is technical. Proteins (and conjugates with a protein component) can be roughly predicted from gene expression, and they are more amenable to detection using antibodies

and other technologies such as mass spectrometry combined with protein database searching. Glycan and lipid identification, on the other hand, is more complicated because these molecules are synthesized via various (and often multiple) enzymes and are typically comprised of long chains of repeated motifs, which are not antigenic and not necessarily predicted from an enzyme's gene expression. Thus, their measurement is more complex (although certainly not impossible). For this reason, with the exception of some fundamentally important and highly-studied glycans (e.g., hyaluronic acid), most of our understanding of the ECM is limited to its proteins and protein conjugates. This imbalance in biological perspective will undoubtedly diminish

with time and additional scientific study.

Just as important as understanding the molecules present in the ECM is understanding the way in which they are arranged within the tissue. This organization of matrix components can be thought of both in terms of the local arrangement of molecules with respect to each other, and the overall change in distribution as a function of lamina propria depth. Locally, molecules are arranged based on structure and function. Certain structural proteins (e.g., the fibrous proteins collagen and elastin) are arranged as semi-directional fibers, within an overall three-dimensional lattice pattern. These fibrous proteins confer shape, strength, and elasticity. Other proteins, glycans, and conjugates are interstitial, which means they bind to, and occupy space between, the fibrous proteins. These interstitial molecules are particularly important for lamina propria viscosity.

The arrangement of fibrous proteins and interstitial molecules changes in a meaningful way as we move from the superficial towards the deep region of the lamina propria. *The superficial aspect of the lamina propria (functionally considered the vocal fold cover)* is rich in low viscosity glycans and has a relatively

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LAM-I-N-A PRO-PRI-A

[TA]

the layer of connective tissue underlying the epithelium of a mucous membrane.

Synonym(s): [lamina propria mucosae](#)

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LAMINA PROPRIA

(prō' prē-ə)

n. pl. laminae propriae (-prē-ē')

A thin vascular layer of connective tissue beneath the epithelium of a mucous membrane.

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LAMINA PROPRIA, CONTINUED

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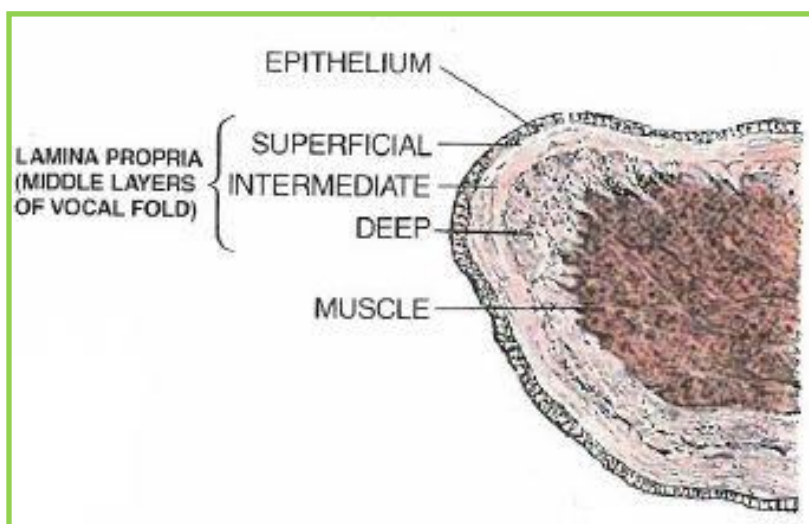
sparse fibrous protein matrix. In contrast, *the deeper aspect of the lamina propria (functionally considered the body)* contains fewer glycans and has a relatively denser fibrous protein matrix. This transition in ECM composition is gradual, but sufficient to account for the physiologic differences in

vibration of the body and cover.

In summary, the lamina propria is a highly complex tissue that is comprised of an array of important structural ECM biomolecules, each of which contributes different facets of tissue function. We still have much to learn about the lamina propria's proteins, glycans, lipids, and conjugates; however, it is very clear that

the function of these constituents is conferred by their abundance, interconnectedness within the matrix, and localization within the overall lamina propria tissue. This complexity is important to remember when thinking about vocal fold biology, treating patients, and performing phonosurgery.

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Associate Professor Welham is a speech-language pathologist and scientist focused on the study of vocal fold mucosal biology. He is specifically interested in tissue regeneration, matrix and matrisome, vitamin A transport and function, and immunology. His clinical practice and laboratory are in Madison, WI, USA. His work has been funded by the United States National Institutes of Health since 2006.

THE IMPORTANCE OF MOTOR LEARNING IN HABILITATION AND REHABILITATION

BY CARI TELLIS, PHD

Despite having vocal surgery to resolve a recurring vocal fold injury, Adele recently canceled yet another string of tour dates. In a conversation with Ellen Degeneres, Megan Trainor described her recent experience with vocal fold surgery, thanking the surgeon "who made her better."

Countless other singers and performers experience vocal fold injury on a daily basis. Most of these individuals, however, do not have immediate access to voice care teams that can evaluate and treat the injury; they do not have the luxury to take time off after surgery to heal and get better. Their careers and their paychecks depend on the next gig, or at least their ability to continue to sing night after night, day after day in their current gig. "The show must go on," as they say in the theater. But, really, the show doesn't go on if the singer has no voice. Chronic injury; constant singing and speaking on that injury; and lack of time for rest and rehabilitation set the stage for *no* stage. Reality sets in, dreams fade, and the singer is forced to deal with the harsh truth – a sometimes career-ending, crushing truth.

Vocal injury is like a broken instrument, an instrument that needs fixing. While I have a great respect for the surgeons in the field of voice

science and medicine, I believe that the greatest surgeons believe that a surgical "fix" is not always ideal for every patient, especially the professional voice user.

These are the medical doctors who value that a course of rehabilitation and subsequent training take a great deal of time and effort. Voice therapists and vocal coaches aren't off the hook either. The greatest voice trainers know that to be a strong, versatile, dynamic singer and performer, individuals have to train like athletes. This type of training requires a specific type of focus, attention, time, effort, and practice. The vocal demands on singers and performers require that these performers see themselves and their trade in a particular way. If you are going to sing and perform for your career, you have to train and practice like it's your job. And, when you get injured, you have to take the time to rehabilitate and train, train, and train.

Current and emerging motor learning literature from the fields of exer-

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"Training for the singer, then, is not just about scale work, breathing deeply, or singing a song over and over again."

IMPORTANCE OF MOTOR LEARNING, CONTINUED

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cise science and sports psychology support athletic training, which includes certain key components:

- An integration of implicit (*subconscious*) and explicit (*conscious*) learning strategies that train the athlete to monitor, adjust, and alter body movements, even highly skilled movements
- Building of internal mind schemes and constructs about these movements, learned through a combination of action observation (*learning by watching others perform the task, or a representation of the task*) and motor imagery (*mental practice that relies on an individual's awareness and conceptualization of the visual and kinesthetic components of the motor task*)
- Deliberate and focused practice involving repetition of even the smallest component of the mo-

tor task and the athlete's ability to switch from optimal, automatic processing to optimal, controlled processing even during on-line performance.

Training for the singer, then, is not just about scale work, breathing deeply, or singing a song over and over again. To be able reach the most proficient realization of a task, training must include

- a) **learning how to control as many components of the vocal mechanism that can be trained;**
- b) **monitoring, controlling, and practicing**

those movements throughout a scale, a speech, a song; and then

- c) **having the ability to monitor, adjust, and alter those skilled movements in the midst of performing**

While this type of training certainly applies to the skilled, elite performer, it also relates to the lay speaker who acquires a voice-related issue from an injury, disease, or disorder. The training and the rehabilitation for these individuals is the same; the functional application to their particular speaking or singing context is their stage. This type of training maximizes what the human brain is able to learn and achieve and puts voice users in the arena of athletes, elite and skilled, as well as amateur and hobbyists. Athletes also need great trainers, and to be a great

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Vocal Master Class with Kammersängerin Reri Grist



IMPORTANCE OF MOTAR LEARNING, CONTINUED

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trainer you need to know what you are training. For trainers to affect the most substantive change in the largest number of people, trainers need to adjust their teaching approach to the learning styles of their students. So, learn all you can and never stop learning. Train in the most effective ways to maximize learning for your students. Don't underestimate the learning capacity of the human brain. Rest and rehabilitate. And train like an athlete – get to the voice gym, think about what you're doing, and do the work.

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Cari Tellis, PhD is a certified speech-language pathologist and a full professor in the Speech-Language Pathology Department at Misericordia University in Dallas, Pennsylvania. Her areas of specialization include the treatment of voice disorders, laryngeal anatomy, physiology and biochemistry, voice and speech science, and counseling. She completed her training as a voice specialist at the University of Pittsburgh Medical Center Voice Center in Pittsburgh, Pennsylvania. She has professional certification as a master teacher and certified, course instructor in the Estill Voice Training™ System.

Dr. Tellis has authored and coauthored numerous presentations in the fields of voice science and fluency at international, national, and state conferences, and she has published her research in the "Annals of Otology, Rhinology, and Laryngology", "Journal of Voice", and "Perspectives on Voice and Voice Disorders". Dr. Tellis has worked with both professional and aspiring speakers and singers for more than 15 years and currently serves as a voice consultant for several professional voice groups. She founded the Performing Arts Training Academy, a program in which school-age and adolescent performers receive training in all aspects of the performing arts, including the mechanics, care, and health of the voice.

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Linda Carroll, PhD, Edrie Means Weekly, Gwen Korovin, MD, Joan Lader



THE INHERENT NEED FOR TRANSLATIONAL SCIENCE IN A MULTIDISCIPLINARY VOICE WORLD

BY AARON M. JOHNSON, MM, PHD, CCC-SLP

Each year the Voice Foundation Symposium brings together a myriad of professionals, from scientists and engineers to laryngologists and singing teachers, all of whom share a passion for the care, training, and understanding of the voice. This multidisciplinary approach has been at the core of The Voice Foundation since its formation in 1969. Multidisciplinarianism commonly applies not only across members of The Voice Foundation, but also within individual members. My own career journey has taken me from professional singer and singing voice teacher to speech-language pathologist and translational voice scientist. I often hesitate when filling out forms that ask for my occupation! With this wide range of disciplines within the voice world comes different jargon and vocabulary to discuss the voice, different ways of thinking about how the voice works, a variety of technical and human skill sets, and different questions (and sometimes answers) about the care and training of the voice. Communicating and sharing ideas between disciplines can sometimes be challenging. Within the scientific community, a need for communication and translation be-

tween different types of scientific inquiry and disciplines spawned a new scientific approach, aptly dubbed, translational science.

A little over a decade ago, then NIH Director Dr. Elias Zerhouni wrote an article in the *New England Journal of Medicine* outlining a new initiative, the Clinical and Translational Science Awards (CTSAs), to address the "need for a robust, bidirectional information flow between basic and translational scientists" ¹. The goal was to encourage scientists to translate basic biological discoveries into medical practice to make widespread impact on human health. This concept is embodied by the commonly-used phrase "**bench-to-bedside**". However, the "bidirectional information flow", as articulated by Dr. Zerhouni, demonstrates that "**bedside-to-bench**" is just as important. **Not only should scientific discoveries inform clinical practice, but the real-life problems clinicians face should drive the questions being pursued by scientists.** In the voice world the "bench" could be the traditional wet lab where new understandings of vocal fold biology



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THE INHERENT NEED FOR TRANSLATIONAL SCIENCE ... CONTINUED

are being investigated, but it could also be a computer-based simulation helping us understand laryngeal muscle control of vocal registers. The real-world "bedside" questions in the voice world typically come from clinicians in an outpatient clinic or singing voice teachers in the studio. Voice science is inherently translational and voice scientists have always crossed disciplines, from Manuel García to Ingo Titze.

There are many clinical voice questions that are ripe for translational study and are currently being pursued. For example, how do we keep our vocal folds hydrated? You may be familiar with the conventional voice studio wisdom advising us to "pee pale" to determine if our hydration is adequate (although perhaps we sometimes take hydration a bit too seriously; I recall my freshman vocal performance class being collectively ad-

monished by the program coordinator, a native Texan, for "walking around like a bunch of baby calves" with our water bottles all the time). What evidence do we have to support hydration recommendations other than tradi-

hydration.² This work in and of itself does not provide specific recommendations for how many glasses of water we should be drinking each day. It does, however, provide a basis on which to build future inves-

tigations and will ultimately lead us to an answer for the original clinical question. Answering complex questions about the care and training of the voice takes

time, many studies using different approaches, multiple disciplines and investigators, and a translational approach spanning from bedside to bench and back again.

As a singer-turned-scientist my own research program is motivated by a desire to know if vocal exercise is really exercise - can we train people to increase laryngeal muscles endurance and strength? The laryngeal muscles are difficult to study in humans. Luckily, I was introduced to basic science techniques when I worked with Dr. Nadine Connor (a fellow Voice Foundation member) at the University of Wisconsin-



tion and witty phrases? Researchers investigating this important "bedside" question using basic science "bench" approaches have discovered the mechanisms of how the vocal epithelium regulates surface

THE INHERENT NEED FOR TRANSLATIONAL SCIENCE ... CONTINUED

Madison. I learned how behavioral animal models can be used to ask questions about the effects of aging and exercise on muscles of the upper airway, including the tongue and laryngeal muscles.^{3,4} My lab, now at the New York University School of Medicine, is continuing this work using translational methods spanning from animal models to human clinical trials. We are currently investigating how vocal exercise dose affects the muscles and neuromuscular junctions of the larynx by training rats to increase their production of ultrasonic vocalizations. My doctoral student, Charles Lenell, is using the rat model to look at how estrogen affects laryngeal muscles. We are also attempting to translate our basic science findings into practice by investigating the health ben-

efits of singing training for older adults and patients with Parkinson's Disease. By using translational research methods - incorporating both basic and clinical methodologies - we hope to add to the understanding of how vocal exercise and vocal training affect the muscles of the larynx.

Whether we work at the bench, bedside, studio, or clinic, advancing our individual and collective understanding of the voice requires us to reach beyond our own silos and communicate and collaborate with our fellow voice professionals. **If you don't already attend sessions outside of your expertise at our annual symposium, I encourage you to do so.** They may require some translation, but that is the name of the game!



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Aaron M. Johnson, MM, PhD, CCC-SLP, began his career in voice as a professional singer and teacher of singing in the Chicago area for over a decade. He then shifted his focus to the health and science of the voice and earned a master's in speech-language pathology from Rush University and a research doctorate from the University of Wisconsin-Madison. After four years on faculty at the University of Illinois at Urbana-Champaign, he joined the New York University (NYU) Voice Center as an Assistant Professor of Otolaryngology in the NYU School of Medicine. At NYU he draws upon his multidisciplinary background as a clinician, researcher, and educator, working clinically to evaluate and treat voice disorders in performers and directing an NIH-funded research laboratory investigating the neuromuscular mechanisms underlying vocal exercise.

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Top: Nancy P. Solomon, PhD, Ron Scherer, PhD, **Middle:** Young Laryngologists, **Bottom:** Brian Gill, PhD, Walt Fritz

46TH ANNUAL SYMPOSIUM AWARDS



Top: Sataloff Award-Maryam Naghibolhosseini, PhD; International Presentation Award-Claudio Storck, MD; G. Paul Moore Lecture-Sten Ternström, PhD; Quintana Award-Dimitar Deliyski, PhD.
Bottom: Van Lawrence Fellowship-Matthew Schloneger, PhD and Matthew Edwards, DMA

46TH ANNUAL SYMPOSIUM AWARDS



Top: JOV Best Papers-Shaheen Awan, PhD (SLP); Wenli Chen, MD (Clinical Medicine); Mami Kaneko, SLP & Shigeru Hirano, MD (Basic Science) **Middle:** Best Student Honorable Mention- Marina Englert, SLP, Livia Lima Krohling, MD. **Bottom:** Best Poster Award-1st Lynn Maxfield (Titze, Palaparathi); Poster 2nd Megan K. MacPherson, PhD (Shembel, Stepp); Best Student Award: Jeong Min Lee

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VOICE FOUNDATION NEWS

47TH ANNUAL SYMPOSIUM: CARE OF THE PROFESSIONAL VOICE

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MAY 30—JUNE 3, 2018 PHILADELPHIA PENNSYLVANIA

Wednesday, May 31

Basic Science Tutorials
Presentation Coaching
Accent Reduction Coaching

Thursday, June 1

Science Sessions
Quintana Awardee: Luc Mongeau, PhD
Keynote Speech

Friday, June 2

Special Session:

Nancy P. Solomon, PhD

Young Laryngologists Study Group
Vocal Workshops

Voices of Summer Gala

Saturday, June 3

Medical, SLP Session
Panels

Vocal Master Class

*Sing Along with
Grant Uhle*



Sunday, June 4

Medical Session

Panels

Voice Pedagogy Session

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Sten Ternström, PhD, Charles Larson, PhD





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46TH ANNUAL SYMPOSIUM VOLUNTEERS!

