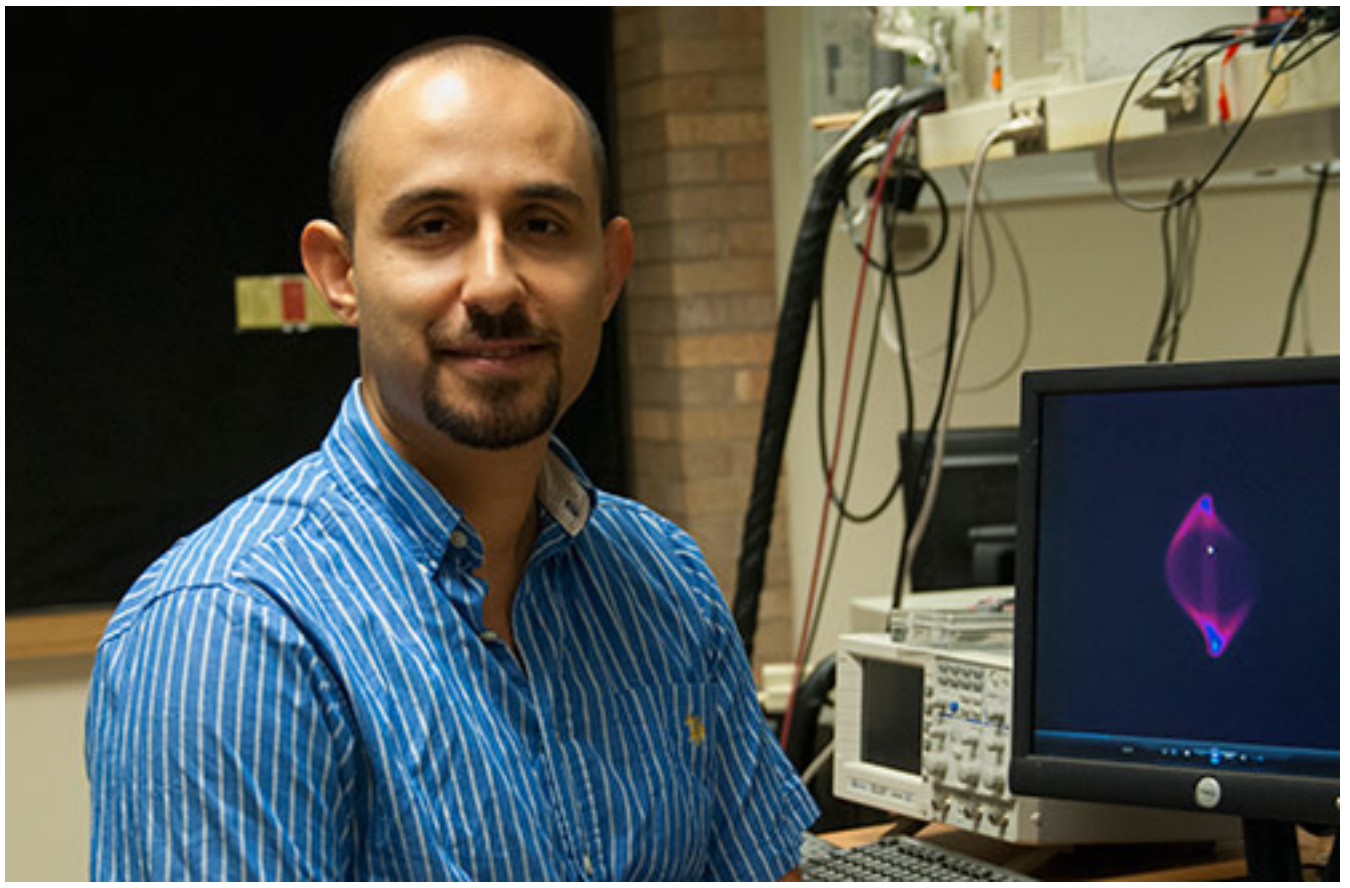
UT Teams with Harvard Doctors to Develop Laser Tools for Vocal Cord Repair

AUSTIN, TEXAS—June 18, 2014



Researcher Murat Yildirim in the lab.

Vocal Fold Scarring

Murat Yildirim, a University of Texas at Austin Mechanical Engineering Ph.D. student, and his advisor **Associate Professor Adela Ben-Yakar** have partnered with a leading medical team of physicians— **Steven Zeitels**, **James Kobler**, **Sandeep Karajanagi** and **Robert Langer**) at Harvard Medical School's Teaching Hospital, Massachusetts General Hospital (MGH) in Boston to develop a laser endoscope tool and technique that will allow doctors to restore damaged vocal cords. A condition known as **vocal fold scarring** results from years of wear and tear on the vocal cord, usually in people who use their voices extensively, such as singers, politicians and teachers.

A raspy or airy voice, lack of tonal range, or even no voice at all, can result from a lifetime of stress to the tiny organ. It is caused by abnormal scar tissue in the vibrating layer of the vocal fold, decreasing its ability to vibrate during singing or speaking.

The lab's biomedical research has potential to provide many new clinical solutions and enable creative future medical treatments in a number of areas, including vocal fold repair.

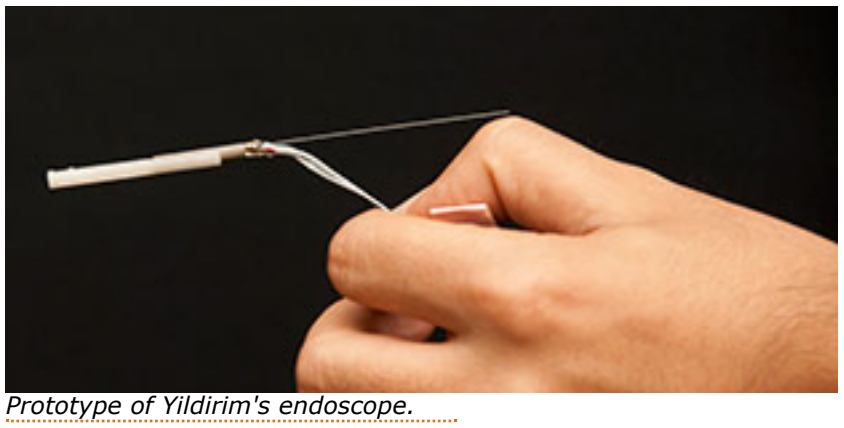
Ultrafast Laser Surgery for Vocal Fold Damage

Three well-known singers with vocal fold scarring are **Julie Andrews** (singer/actress in The Sound of Music, Mary Pop pins), **Adele** (Gram my award-winning female vocalist) and **Steven Tyler** (lead singer for Aero smith). All three singers, as well as many other performers, are patients of their collaborators at Massachusetts General Hospital under the direction of Dr. Steven Zeitels.

Related Links

- Murat Yildirim
- Adela Ben-Yakar Faculty Bio
- Ben-Yakar Group
- Vocal Fold Scarring
- Ablation
- Epithelium, a layer of animal tissue
- Ultrashort or ultrafast laser pulse
- Ultrafast/ultrashort lasers as explained in ME story on Yaguo Wang
- Massachusetts General Hospital (main site)
- Harvard Medical School Teaching Hospital
- Phonation
- Photons
- Ultrafast Laser Surgery

Murat Yildirim's Endoscope Prototype



Prototype of Yildirim's endoscope.

Steven Tyler and his Vocal Cord Surgery for National Geographic

*Singers **Julie Andrews**, **Adele** and **Steven Tyler** have all had problems with vocal fold scarring and turned to their collaborators for help. All are still performing, thanks to the team the team at Massachusetts General Hospital.*

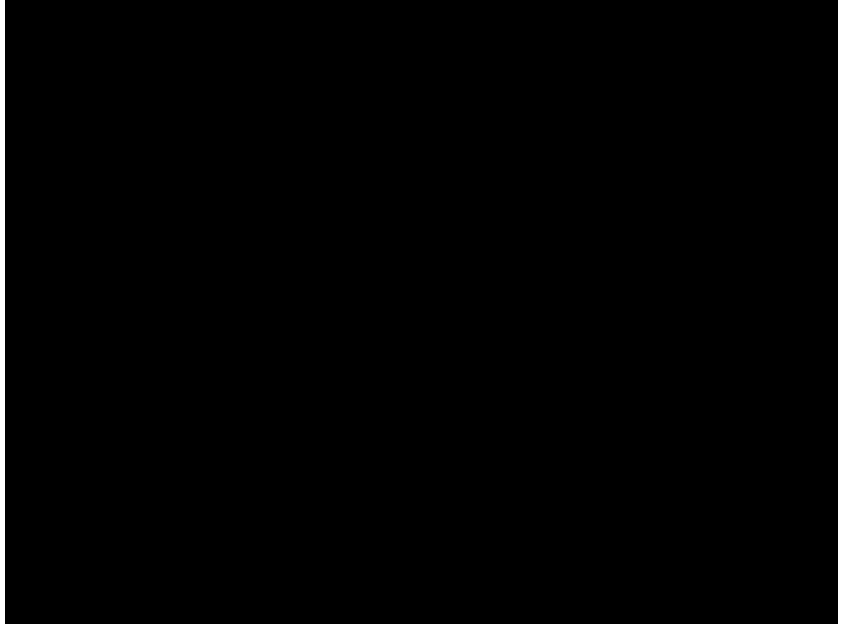
Yildirim's research focuses on ultrafast laser surgery, nonlinear imaging and development of clinical image-guided surgery endoscopes for the treatment of vocal fold scarring, a condition that affects about 4 million Americans.

Scar tissue in the vocal folds increases their stiffness, thus degrading or even eliminating voice function (phonation). However, there is no reliable treatment for restoring proper phonation to individuals with scarred vocal folds.

Recently, a variety of injected biomaterial for restoring the viscoelasticity of the vocal folds have been suggested by their collaborators. However, optimal localization of the material within the scarred tissue will likely be extremely difficult and unpredictable with injection alone because the injected material tends to follow the path of least resistance, ending up where it is least needed. To address this challenge, the research group has proposed a treatment in which an injection space is created through *sub-epithelial ablation* — the removal of material under the top layer of tissue by irradiation using a laser beam. The injection space is created in a vertical plane (see figure C below) in the vocal fold by using ultrashort laser pulses— an electromagnetic pulse whose time duration is of the order of a picosecond (10^{-12} second) or less.

Endoscope Development for Vocal Fold Scarring

Because there isn't a reliable treatment for the condition, the medical community is open to acceptance of ultrafast laser surgery to create precise cuts inside bulk tissue. Therefore, we are developing miniaturized, flexible, handheld endoscopes for the procedure. The graphic below illustrates three generations of endoscopes developed in Ben-Yakar's lab.



Steven Tyler, the lead singer of Aerosmith, had a documentary made by National Geographic detailing his problems and vocal fold scarring, as well as his treatment by our collaborators. The team was lead by Dr. Steven Zeitels, who is featured in this video clip.

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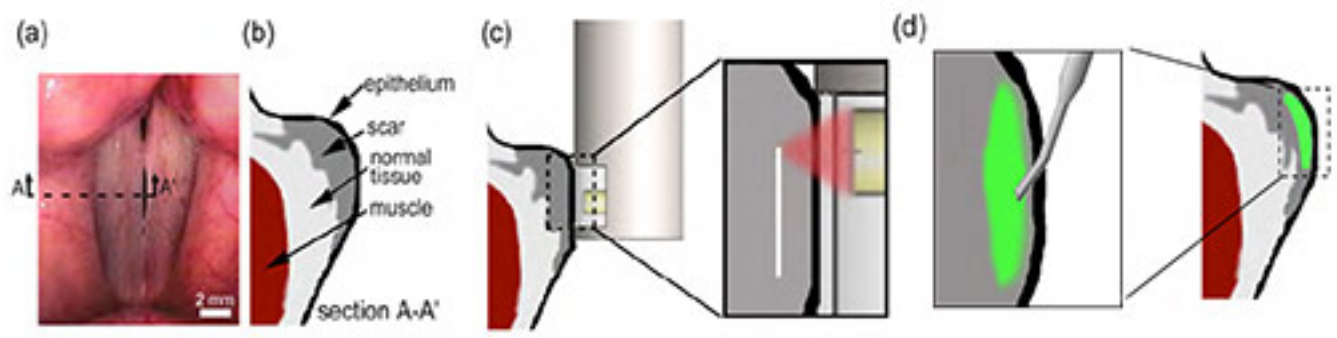
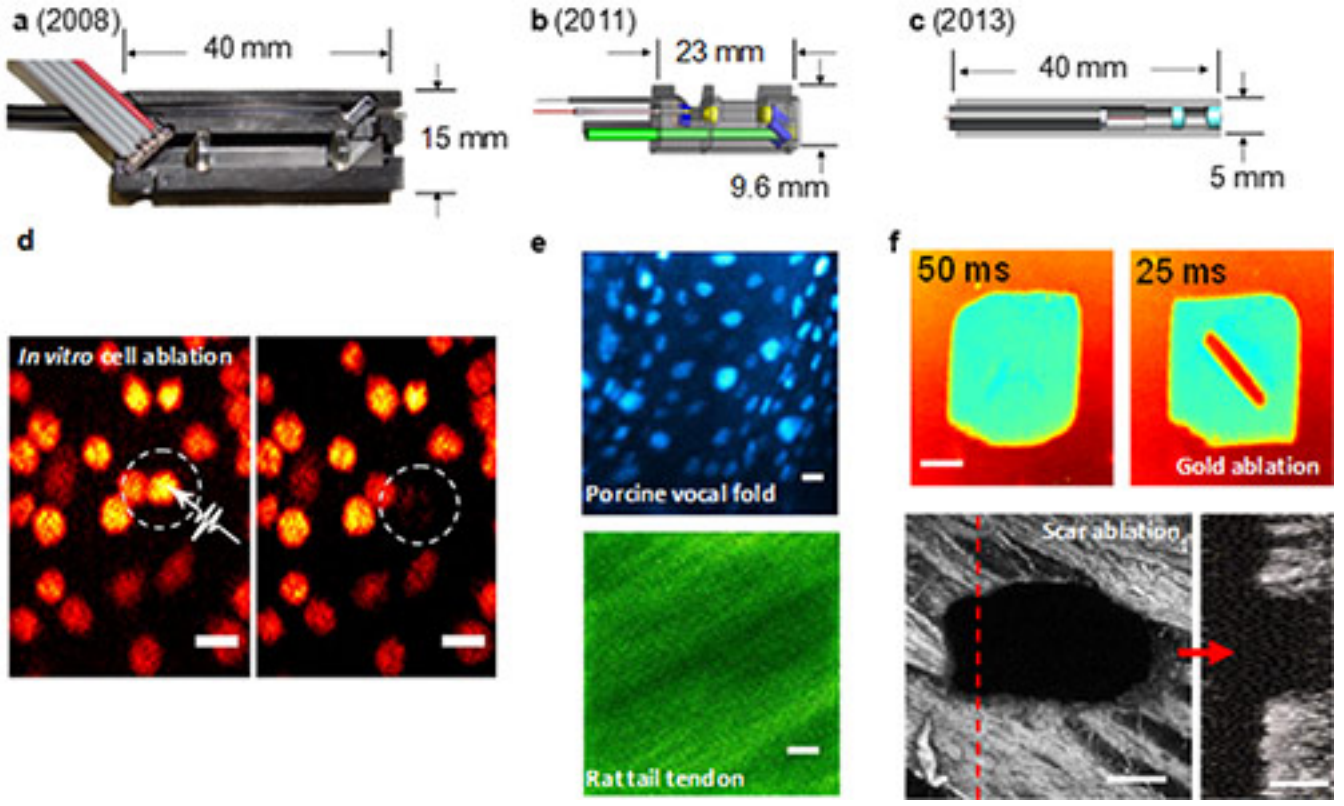


Proposed Treatment Plan: *(a) Video image of human vocal folds. (b) Schematic of vocal fold histology (coronal section) corresponding to the A-A' reference line in (a) showing the site for typical scar formation. (c) The surgery probe is positioned against the compliant vocal tissue, deforming it around the optical window of the probe and allowing for both imaging of the superficial lamina propria (SLP)/scar and ablation of a planar void within the scar. (d) Following laser surgery, we use a specialized phonographer needle to inject biomaterial into the new surgical plane and fill the void selectively. We hypothesize that a void filled with soft biomaterial will recover the mechanical functionality of the vocal fold.*



Three generations of endoscopic ultrafast laser surgery probes developed in Dr. Ben-Yakar's lab. *Photograph of the (a) 18-mm probe and schematics of the (b) 9.6-mm probe and the (c) 5-mm probe. (d) Imaging of breast carcinoma cells (left) and ablation of a single cell without giving any damage to its neighborhood (right) using the 18-mm probe. Scale bars are 20 μm.(e) (Top) Imaging of freshly excised porcine vocal fold and (Bottom) Imaging of rat tail tendon acquired with the 9.6-mm probe, showing highly aligned collagen fibers. Scale bars are 10 μm and 5 μm, respectively. (f) (Top) Ablation of a 30-nm gold coated glass slide scanned for 50 ms (left) and 25 ms (right) durations using with 5-mm diameter probe. (Bottom) Ultrafast laser drilling through an ex vivo 70-μm thick scarred hamster cheek pouch using 200 nJ pulse energy. Scale bars are 100 μm.*

Last modified on June 30th, 2014