# Group 21: Robotic Soft Tissue Manipulation Assessment

## Seminar Presentation

"Quantitative Evaluation of Phonomicrosurgical Manipulations Using a Magnetic Motion Tracking System"

Chen et al. 2014

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# Overview

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- Why I selected the paper
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# Project Summary

- Assess and prove through subjective expert analysis that robotic assisted laryngeal surgery is more effective than mere manual surgery

- Use GALEN robot to assist in the laryngeal cyst removal surgery in animal larynx to mimic real surgery

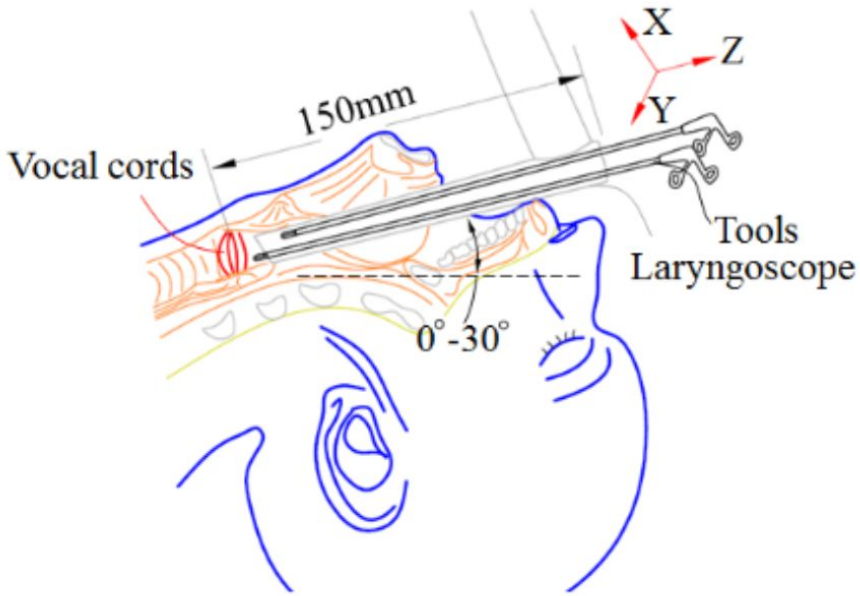



Figure 1: Microlaryngeal Phonosurgery

# Introduction

- Laryngeal diseases affect millions of people
- Vocal cords are extremely delicate as they define mucosal wave propagation and normal vibratory function in humans
  - Requires delicate and accurate surgical approach
- Traditionally surgeons are trained in an apprentice style where they observe and perform procedures under supervision
- Ability to objectively evaluate and provide feedback to surgeons would enhance consistency of surgical education
- Simulative training provides benefit for public health

# Why I selected this paper

- Our analyses currently consist only of subjective parameters

- Very insightful look at how to objectively set up analyses parameters
  - Maintenance of motion smoothness
  - Minimization of Tremor
  - Compact and continuous spatial motion of the tip of an instrument
  - Coordination of two hands

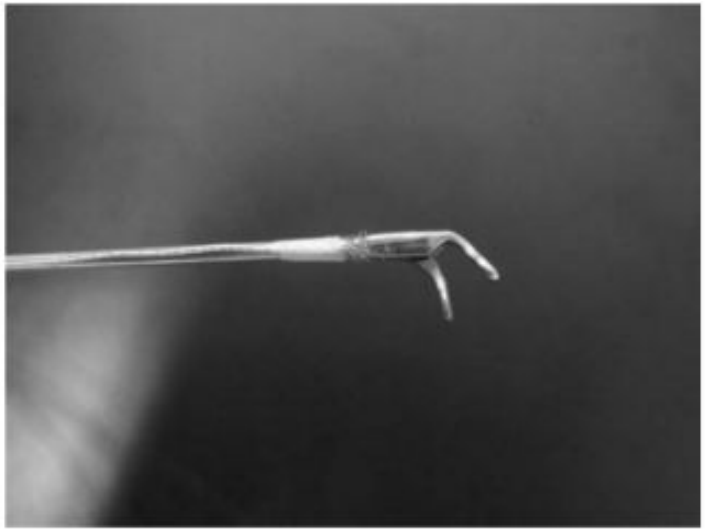
# Benefit of this study

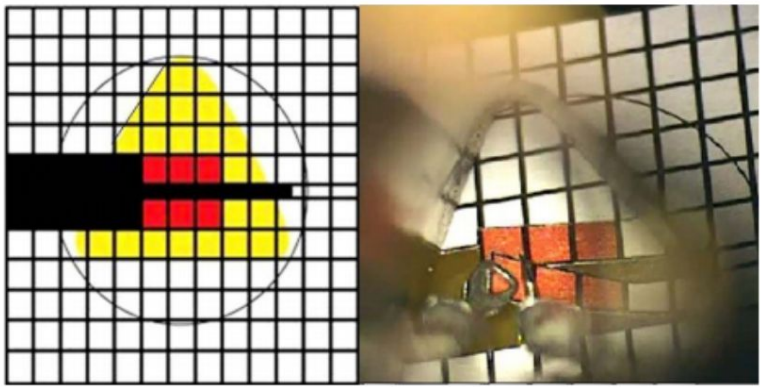
- Using the objective metrics, simulation training systems could be put in place which would help surgeons in training develop better skills.

# Experimental Design

-Magnetic Motion Tracking System called microBIRD

-Simulative Task included cutting out small squares using laryngeal microscissors





# Parameters Developed

Motion Smoothness $$S = \frac{1}{T}\sqrt{\frac{1}{2}\int_0^T j^2 dt}$$

Path Length $$p = \sum_0^T \sqrt{(dx)^2 + (dy)^2 + (dz)^2}$$

Depth Perception $$D = |(x_1 - x_2) \cdot \cos(42^\circ) - (Z_1 - Z_2) \cdot \sin(42^\circ)|$$

Quality $$Q = \sum_{k=1}^{n} (A - A_k)/n * A$$

# Results

TABLE I.
Comparison of Dominant-Hand Parameters.

| | *S* | | | *P* | *D* |
|---|---|---|---|---|---|
| | x-axis | y-axis | z-axis | | |
| Novices | 0.294 ± 0.1870 | 0.366 ± 0.1918* | 0.381 ± 0.2256 | 40.080 ± 22.4007 | 15.600 ± 9.1191 |
| Experts | 0.261 ± 0.1391 | 0.146 ± 0.0377* | 0.373 ± 0.1628 | 38.020 ± 16.2938 | 13.490 ± 5.9172 |

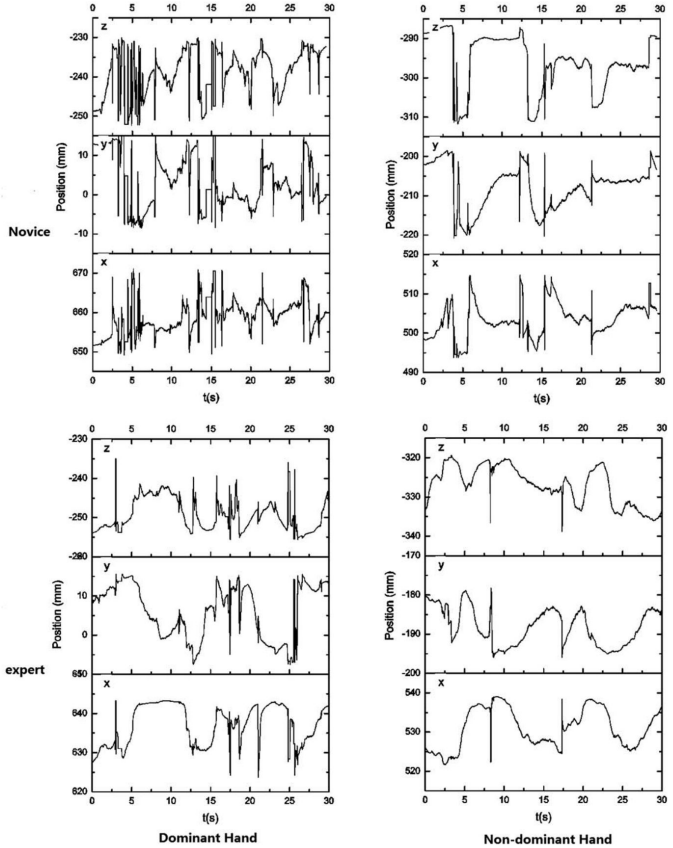
*Statistically significant differences in a one-tailed *t* test ($P < .05$).
*D* = depth perception; *P* = path length; *S* = smoothness.

TABLE II.
Comparisons of Nondominant-Hand Parameters.

| | *S* | | | *P* | *D* |
|---|---|---|---|---|---|
| | x-axis | y-axis | z-axis | | |
| Novices | 0.188 ± 0.0870* | 0.211 ± 0.0907* | 0.220 ± 0.0952* | 21.536 ± 6.8449* | 9.109 ± 3.2757* |
| Experts | 0.101 ± 0.0696* | 0.116 ± 0.0596* | 0.098 ± 0.0519* | 14.747 ± 3.0808* | 6.057 ± 1.5502* |

*Statistically significant differences in a one-tailed *t* test ($P < .05$).
*D* = depth perception; *P* = path length; *S* = smoothness.

# Results


Novice
expert
Position (mm)
t(s)
z
y
x
Dominant Hand
Non-dominant Hand

# Results

➔ Found differences in kinematic parameters between experts (trained 5 trials) and novices (trained 4 trials)

➔ Experts had significantly better motion smoothness along the y-axis for the dominant hand and all 3 axes for non-dominant hand

# Relevance to our study

- Team developed a novel approach to use magnetic fields to measure the movement of the tip of an instrument during a surgical procedure and provide quantitative feedback
- Possible next step would be to actually do a simulated surgery on soft tissue (what we are trying to accomplish)
- If we could integrate an objective measure in our study, it would make our final deliverable much more crisp.

# References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# Questions