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Introduction

- Surgeon's operating posture can contribute to chronic pain
- Goal:** Accurately measure the surgeon's neck flexion angle while performing ear surgery, comparing the postural ergonomics of traditional "heads down" surgery and "heads up" endoscopic surgery.



Microscopic



Open Surgery

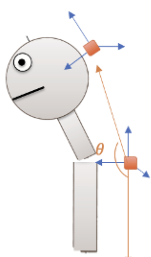


Endoscopic

Problem

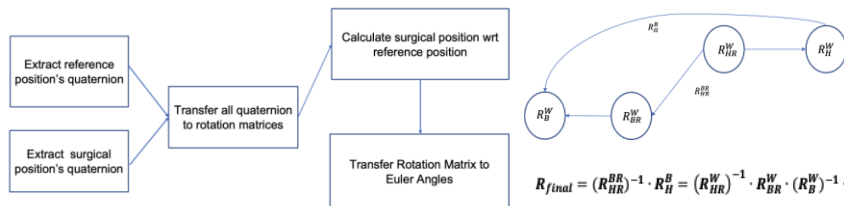
- Persistent neck flexion, extended periods of static posture, and the long-time use of microscopes/magnifiers increase risk of discomfort, cervical musculoskeletal strain, and chronic pain
- Can also be a root cause of middle and lower back pain
- 87% of survey laparoscopic, ophthalmic, and general surgeons reported prevalence of musculoskeletal symptoms in the neck and shoulders

Method



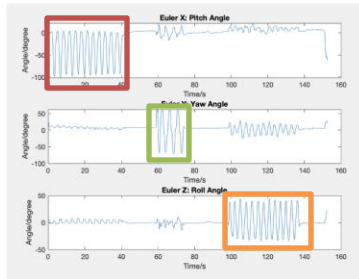
Two Inertial Measurement Units (IMUs) were utilized, with one banded to the forehead and the other attached to the back.

Neck flexion angle was indicated by the pitch angle between the two IMUs, and the mathematical model is derived as followed



Outcomes and Results

(i) Base Test



Pitch: "shaking yes"

Yaw: "shaking no"

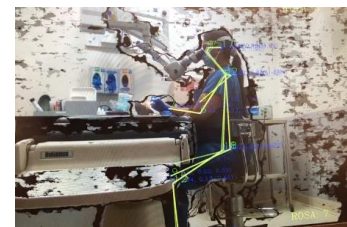
Roll: "shoulder to shoulder"



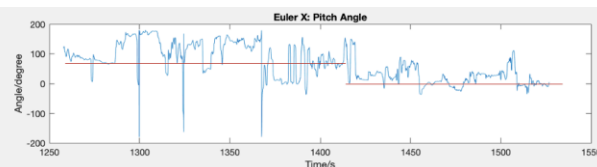
(ii) Eggshell drilling experiment



Bad Ergonomic Position

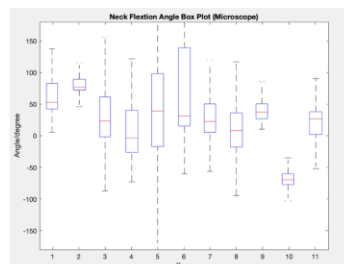


Good Ergonomic Position

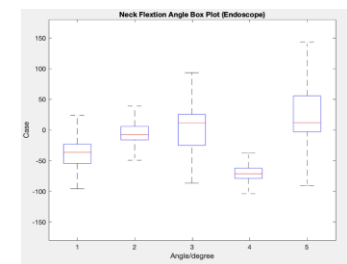


Neck Flexion Angles:
Bad Position: 50-100°
Good Position: 0-30°

(iii) Real Surgical Data

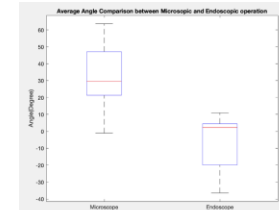


Microscopic Operation



Endoscopic Operation

Conclusion

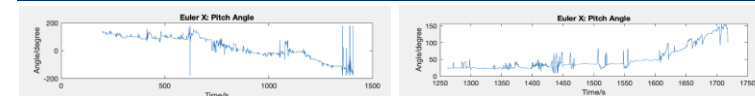


Scenario Comparison

Average Neck Flexion Angle in
Microscope Scenario: 33.3744°
Endoscope Scenario: -7.0667°

Endoscopic surgery yields smaller neck angles compared to microscopic surgery.

Future Work



1. Prevent the gradual drift in the average pitch angle as the surgery progressed. (physical sliding/innate bias)

2. Sample a larger pool to make better comparisons between physicians at varying points in their careers.

3. More testing and better methods are expected to filter out noise

4. Interested in surgery phase which has largest neck flexion angles and the according actions taken by surgeons.

Lessons Learned

- Matrix transformation and applying quaternion to calculate Euler angle.
- Time management
- Presenting research updates

Citations

Wong K, Grundfast KM, Levi JR. Assessing work-related musculoskeletal symptoms among otolaryngology residents. *Am J Otolaryngology*. 2017;38(2):213–217.
Wang R, Liang Z, Zihni AM, Ray S, Awad MM. Which causes more ergonomic stress: Laparoscopic or open surgery?. *Surg Endosc*. 2017;31(8):3286–3290.

Credits and Acknowledgements

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