

Objective Muscular Fatigue Analysis in Minimally Invasive Surgeries

Rachel Harmon
harmon43@purdue.edu

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Significance

- Surgeries, such as laparoscopic surgeries, commonly result in musculoskeletal neuromuscular injuries, and arthritic injury and pain
- Impacts healthcare system by affecting operation schedules and the quality of surgeries
- Studies are limited as fatigue is subjective and difficult to quantify

Introduction

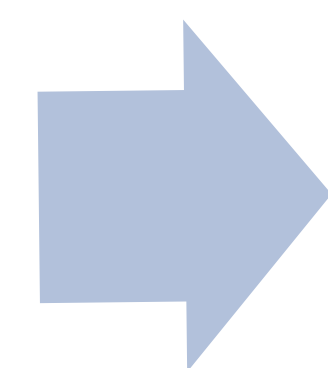
- Minimally invasive surgery allows for quicker patient recovery time, but poses a hard physical toll on surgeons
- Studies were geared towards reducing pain and discomfort through different surgeries and determining if those physical symptoms were associated with those operations (Plerhoples, 2012)
- The Subjective and muscular activity measurements (with EMG measurements) are collected from 51 subjects
- Robotic surgeries were studied and compared against open and laparoscopic surgeries
- Potential risk factors:
 - Musculoskeletal neuromuscular injuries
 - Arthritic injury
 - Muscular stress
 - Muscular fatigue
 - Pain and numbness in the neck or upper extremities
 - Chronic injury

Purpose

Analyze the risk factors of performing different surgeries that and the injuries that might result from them

Specific Aims (SA):

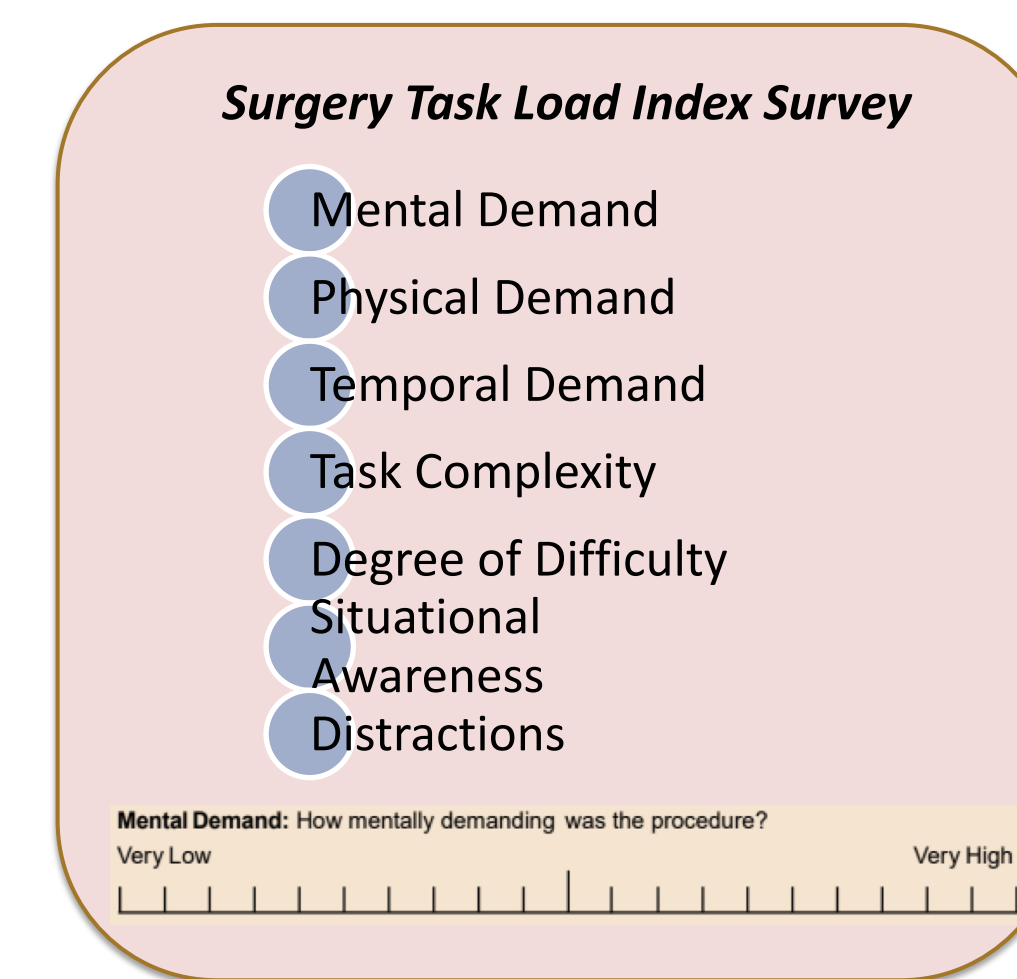
Specific Aim 1
Assessing the muscular workload in surgery tasks with EMG sensors



Specific Aim 2
Compare them with subjective surveys

Methods

Subjective Surveys



Discomfort Surveys (Pre and Post Surgery)

AREA/SUBJECT	NO		SLIGHT		SUBSTANTIAL	
	L	R	L	R	L	R
Numberness of the fingers and/or thumb						
Hand/wrist stiffness						
Hand/wrist pain						
Shoulder/arm stiffness						
Shoulder/arm pain						
Neck stiffness						
Neck pain						
Back stiffness						
Back pain						
Headache						
Thinking requires effort						
Trouble concentrating						
Irritability						
Wandering thoughts						

Objective Measurements

Maximum Voluntary Test Contraction

$$\%MVC = 100 * \frac{\{Force\ or\ Moment\}}{MVC_{\{Force\ or\ Moment\}}}$$

Percent Maximum Voluntary Contraction Formula

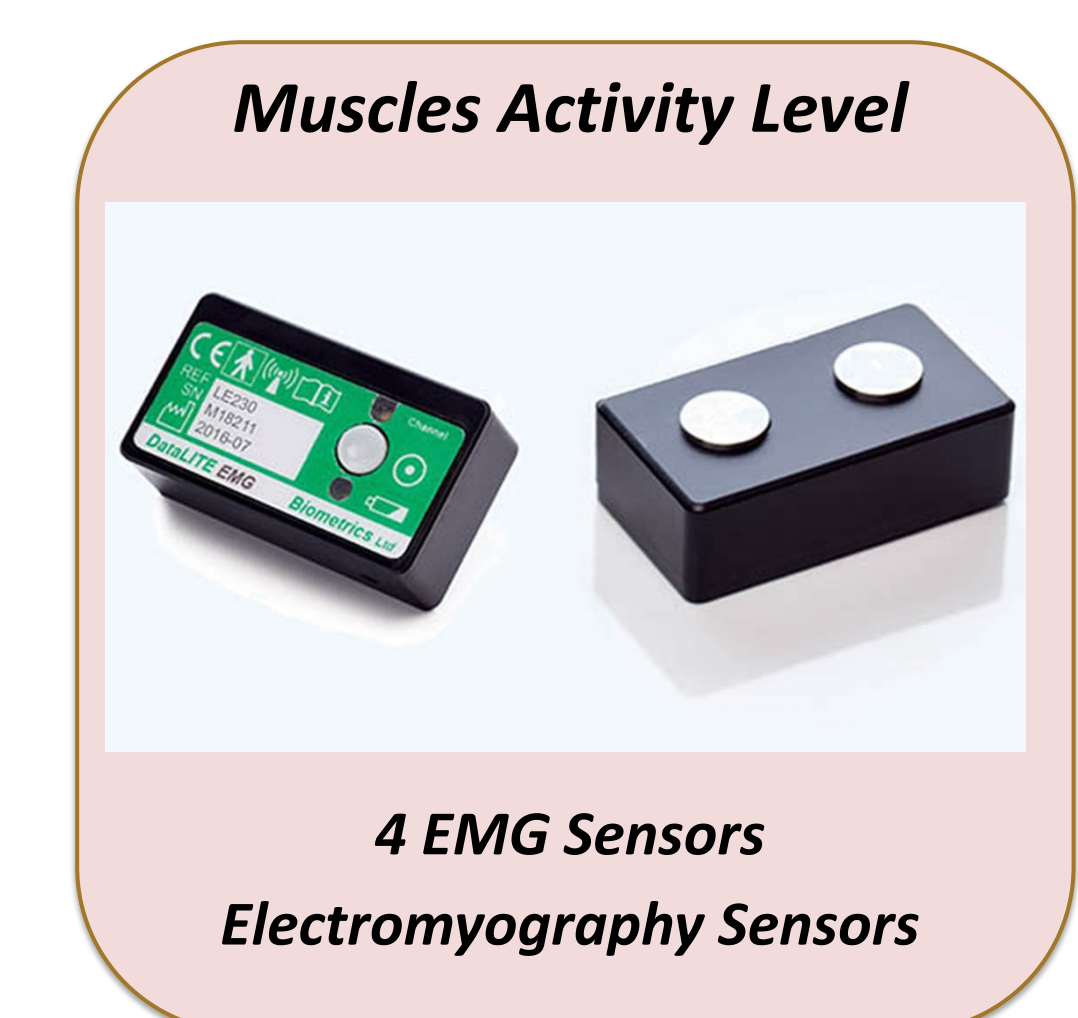
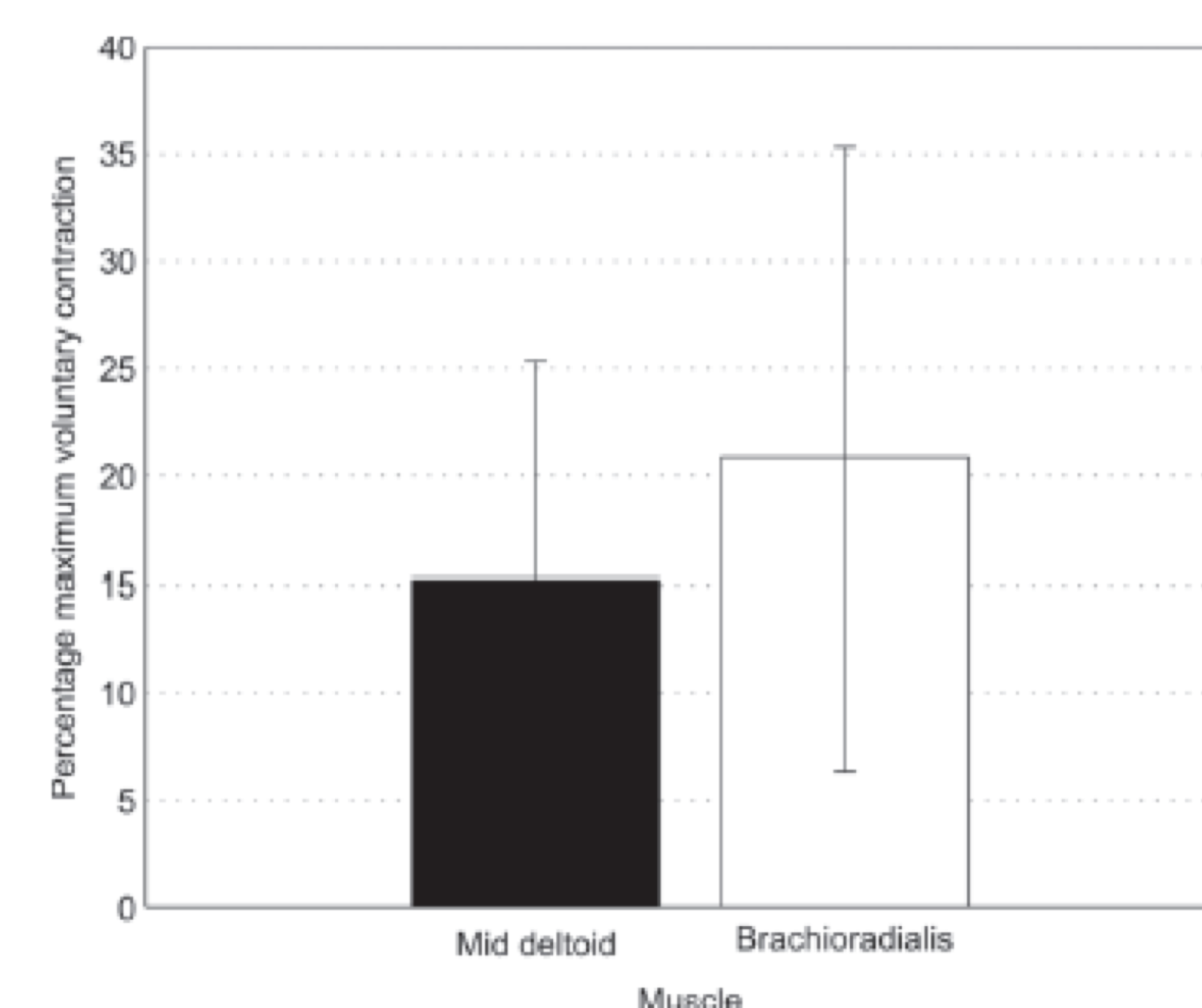
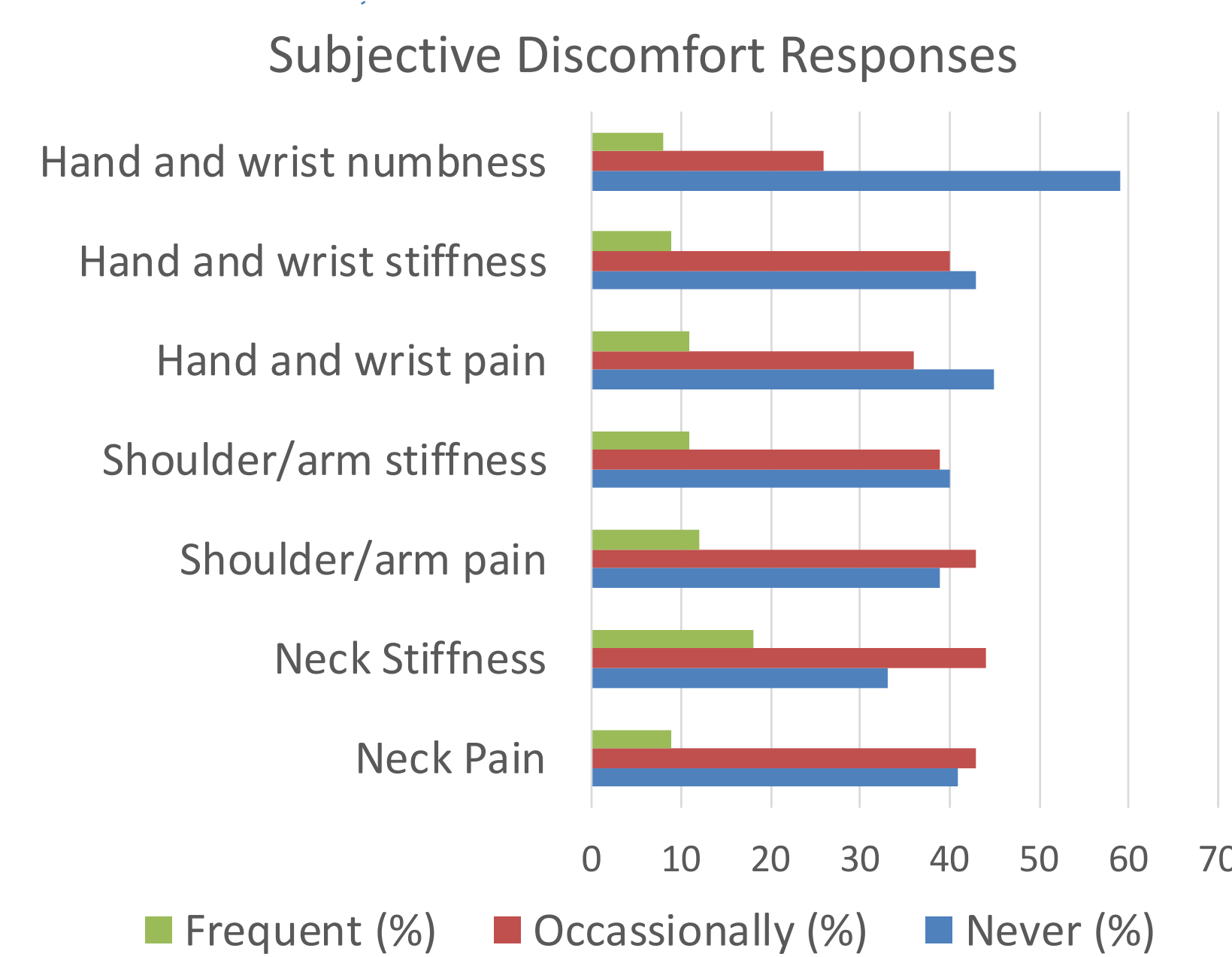


Fig. 1 Subjective and Objective measurements

Results



- EMG signals showed that certain muscles are used more frequently than others, therefore having a higher risk of fatiguing.
- Operations requiring a higher degree of precision should be performed earlier in a surgeon's schedule
- Laparoscopic surgeries have more taxing effects on surgeons due to the high physical muscular required
- The brachioradialis muscle fatigues more than 1.5 times as fast as the mid-deltoid muscle

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