



# Tablet Computing Ergonomic Study

Presented by:

Don Becker, Verizon Wireless

Carl Patrizio, AIG

Kevin Costello, United States Ergonomics

# Tablet Computing Ergonomic Study

- Introduction to Study
- Risk Management Process
- Verizon Wireless Introduction
- Ergonomic Study
- Best Practices
- Conclusions and Next Steps

# Tablet Computing Ergonomic Study

- Introduction
  - Tablet use is more prevalent in today's retail industry providing portability and a powerful point-of-service (POS) tool.
  - Tablet implementation would affect thousands of employees and involve significant capital investment.
  - Prior to integrating tablet computers into their stores, Verizon Wireless wanted to analyze the ergonomic risks and the proper use of tablets by users.

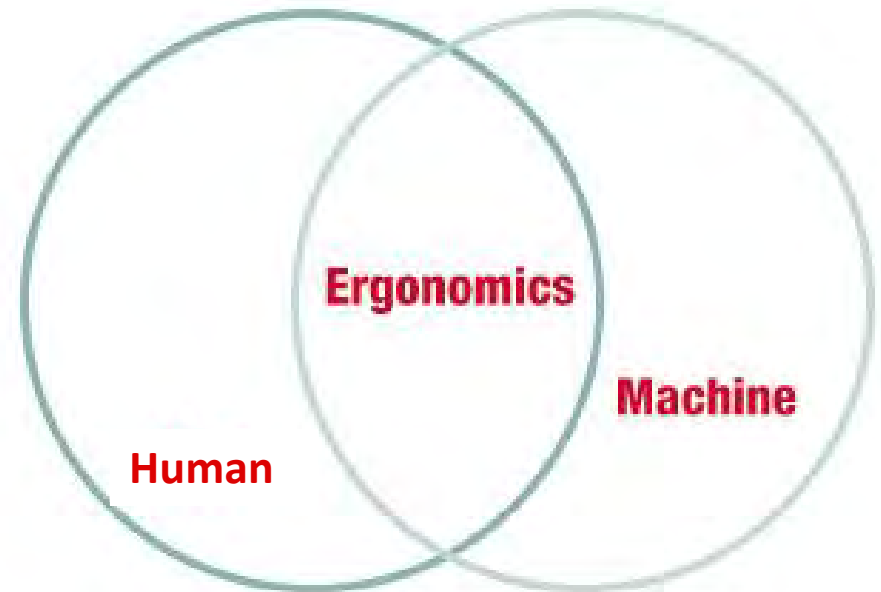
# Tablet Computing Ergonomic Study

- Introduction by Carl Patrizio
  - AIG partnership with VZW and US Ergonomics
  - Teaming to provide customers with answers
  - Results married improved job performance and safety



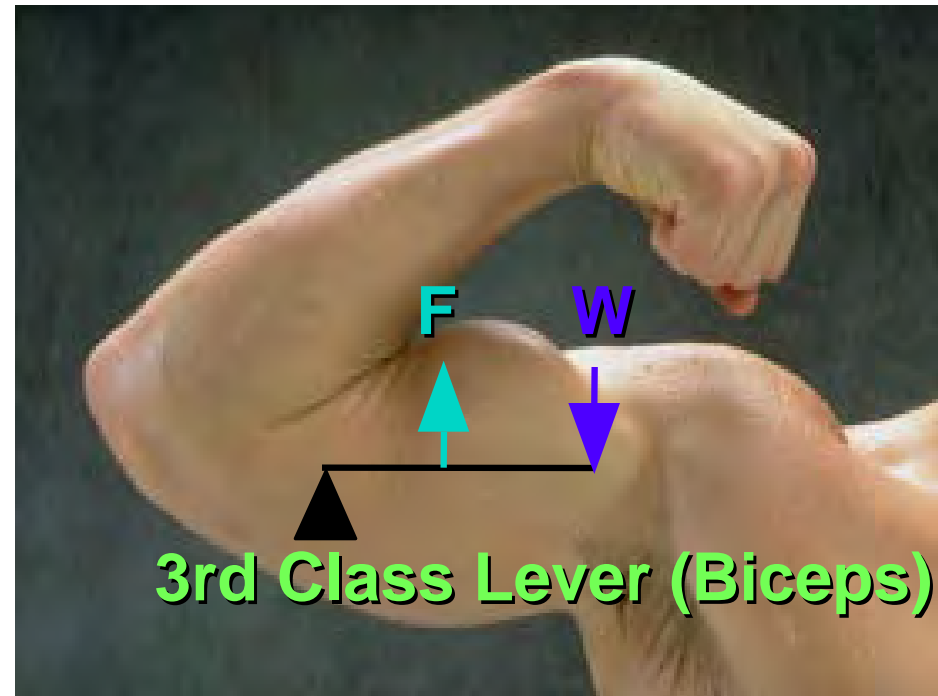
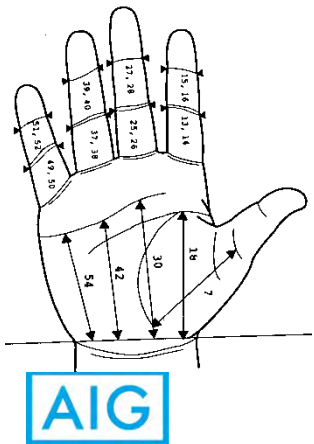
# Ergonomics

“The design of work in relation to the capabilities of people”



# The Sciences of Ergonomics

- Anthropometry
  - Biomechanics
  - Physiology
  - Psychology
- Engineering



# Study Objectives

- To assess tablet use in retail sales operations with regard to ergonomic exposures
- Analyze the ergonomic risks and determine proper use of tablets



# Study Approach

- In-Store Investigation
- Measurement & Testing of Professional Users
- Best Practice Guideline Development



# Ergonomic Risks

Primary ergonomic concerns include:

- Holding for extended periods statically loading the upper extremities and neck.
- Potential for poor postural technique:
  - Excessive hand/wrist bending,
  - Abduction of the elbow (when scanning items or swiping credit cards)
  - Excessive neck flexion (while viewing).
- Improperly adjusted or poorly fitting hand straps and grips resulting in increased effort and contact stress.
- Likely increase in the duration of standing work.
- A lack of support surfaces (tables) to rest the devices.
- Potential for glare from the screen of the device.

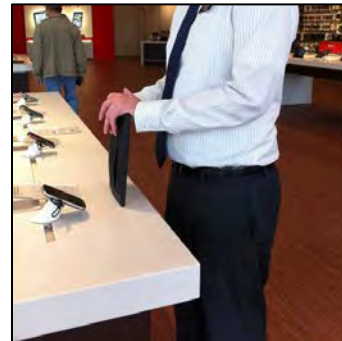
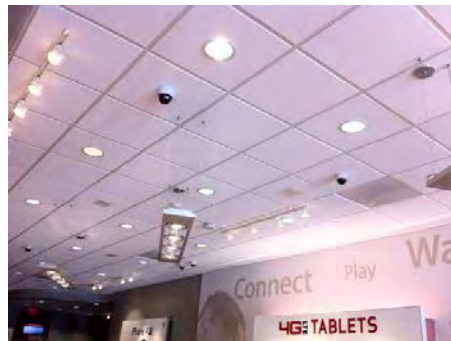
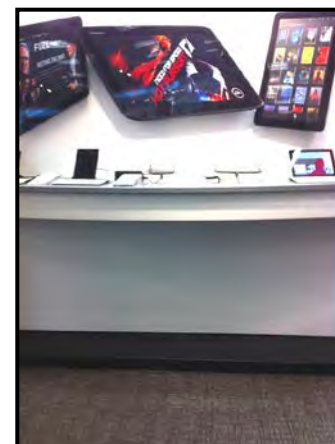
# In-Store Investigation

- Evaluation of customer interactions and actual transaction techniques
- Observations of store configurations represented the range of designs existing throughout the country



# In-Store Investigation

- Variables assessed:
  - Total time the device is held in the hand
  - Average transaction time
  - Percent of self-use versus showing the display to the customer
  - Techniques for supporting the device
  - User posture with and without customer interactions
  - Changes in hand orientation while holding device
  - Variations in user technique given size of hands and fingers
- Observations included configuration and style of support surfaces (tables), table accessibility, congestion characteristics, lighting, and general user and customer interaction.



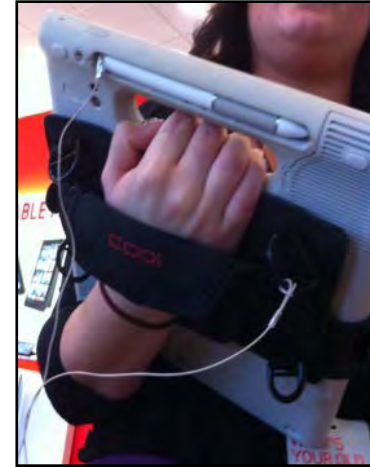
# Measurement & Testing of Users

- Eight (8) Verizon Wireless sales team members participated
- Controlled testing completed in a mock-up store
- Simulated greeting, sales scenarios and transactions
- Muscle effort testing using Electromyography (EMG)
- Subjective survey including product performance ratings and body part comfort ratings
- Background surveys and hand anthropometry



# Tablet Configurations Tested

*Device A:* D-style grip incorporated into the case design and an adjustable fabric strap. Total weight = 3.87lbs



*Device B:* An elastic band on rear of the unit for securing the grip. Total weight = 2.68lbs



# Tablet Configurations Tested

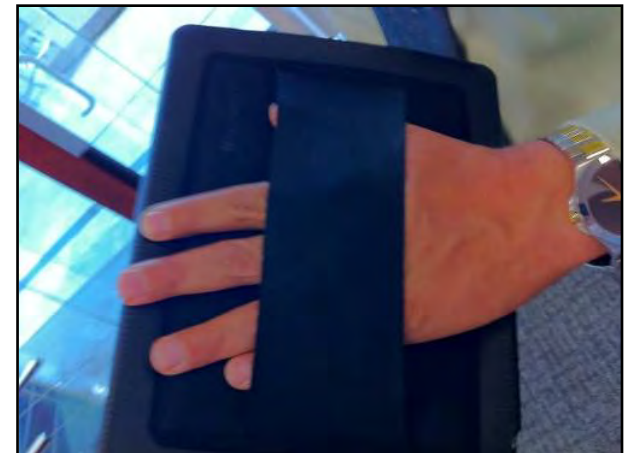
*Device C:* A puck type palm grasp with an adjustable strap for the back of the hand.

Total weight = 2.14lbs



*Device D:* A soft sided protective tablet case with a simple, non-adjustable, elastic grip primarily used by greeters. NOT a POS device

Total weight = 1.55lbs.





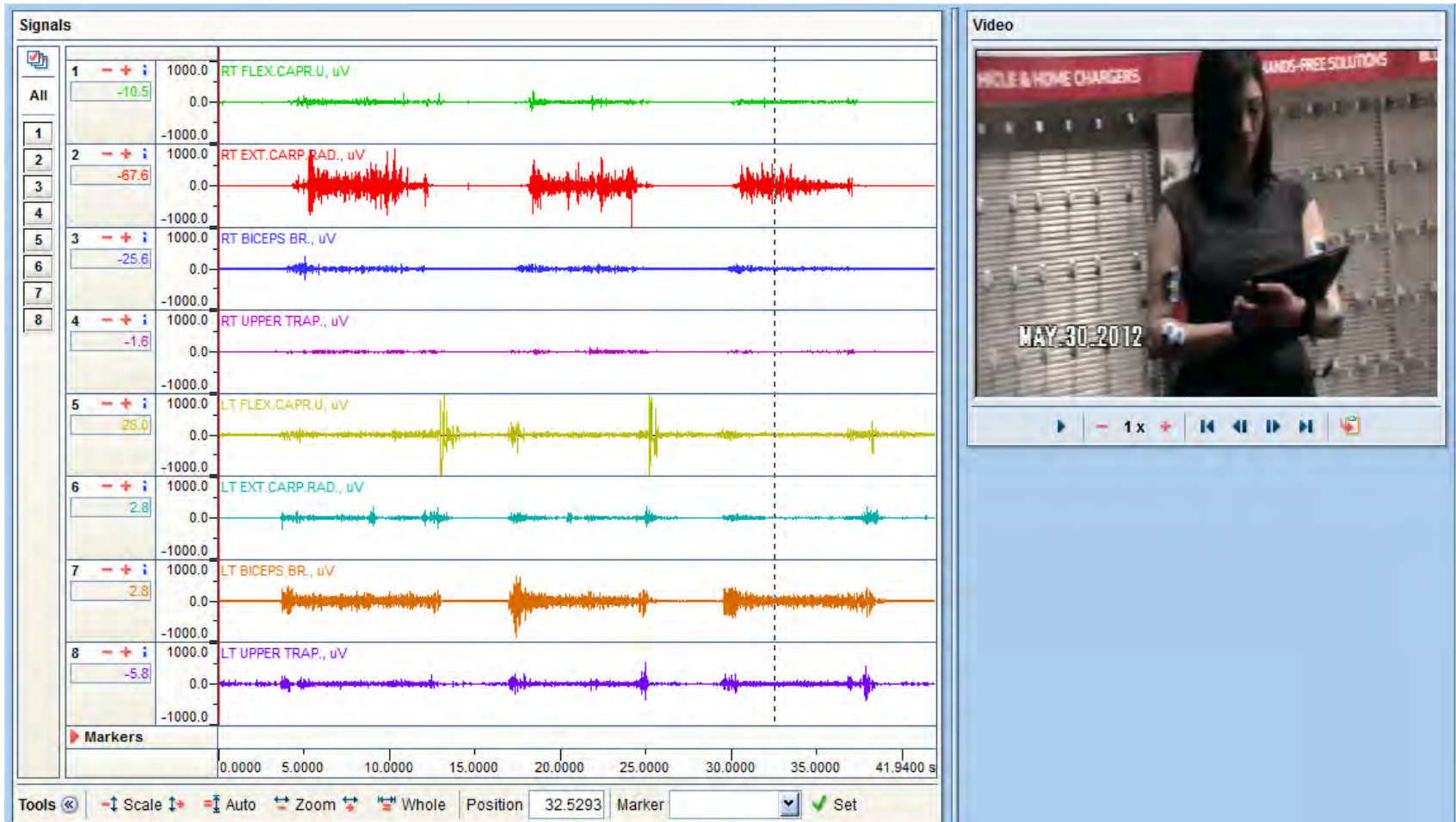
# Scenarios Tested

Simulation of common device applications and transactions

- Dynamic Activities:
  - Accessory sale
  - New Line sale
  - Carrying tablet with accessories
  - Walk & carry
  - Lifting up and down
- Static Activities:
  - Viewing
  - Sharing display with customer
  - Cradle the device
  - Hold at side
  - Support on a table top



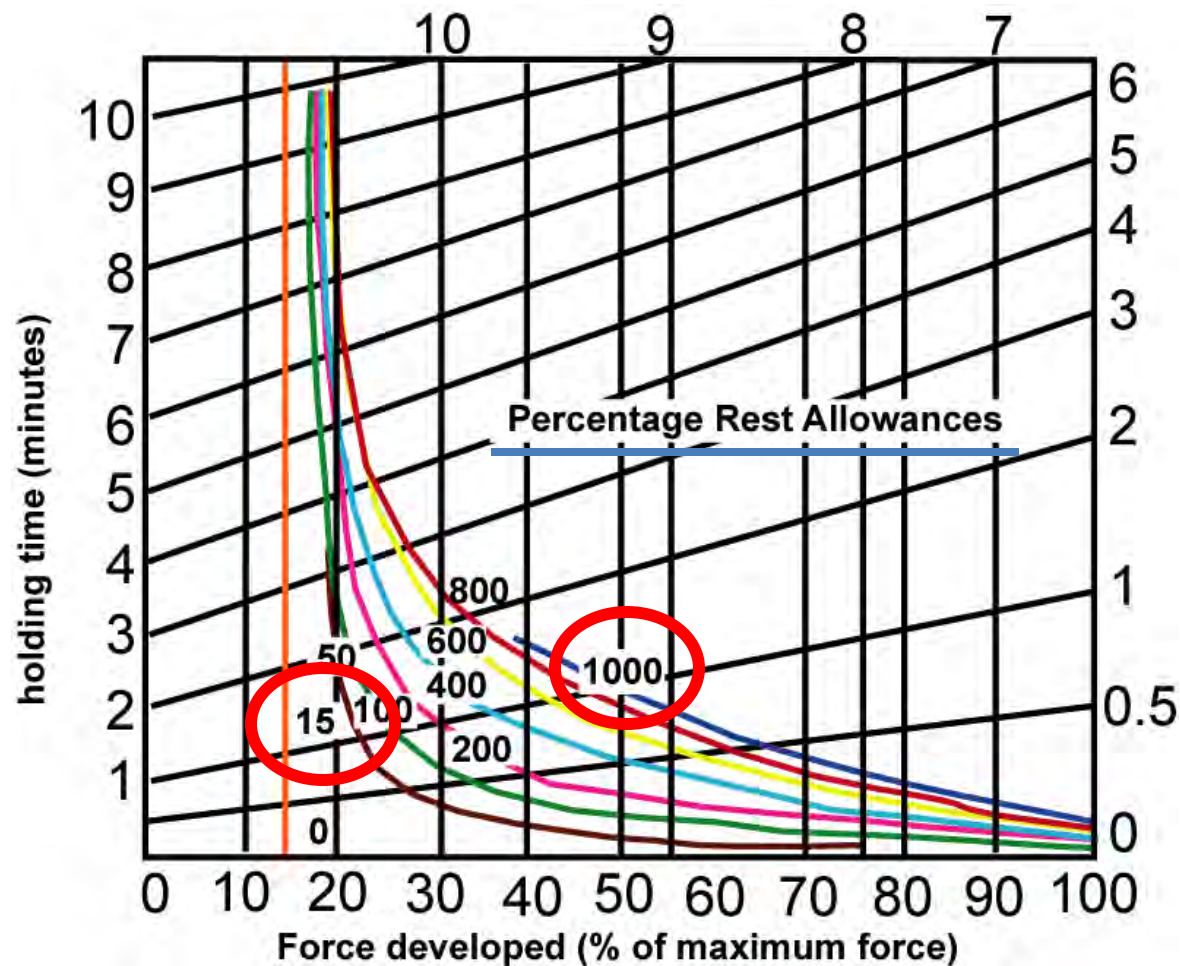
# Muscle Effort Measurement



EMG signal scaled to individuals Maximum Voluntary Contraction (MVC)



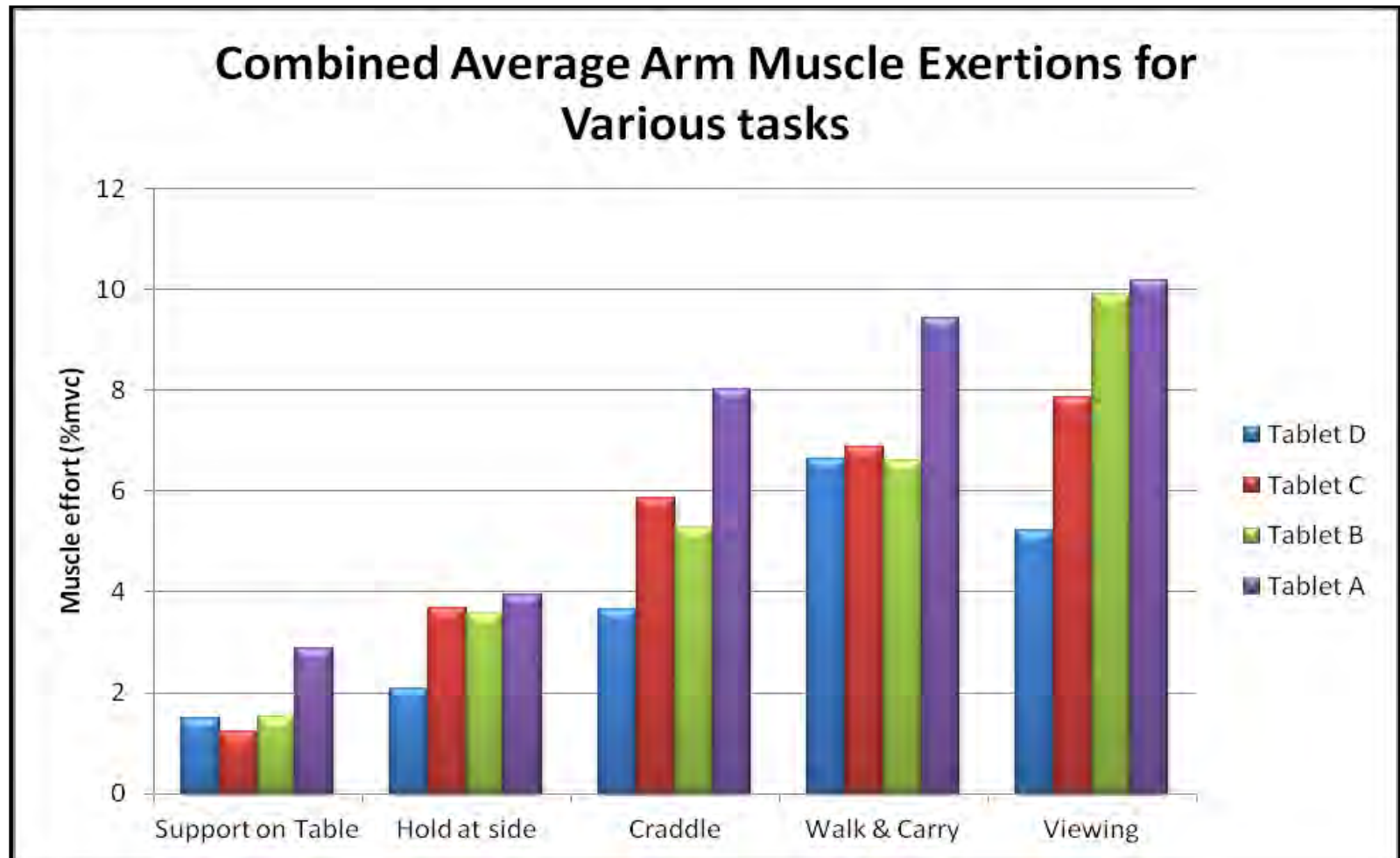
# Work:Rest Periods for Static Work



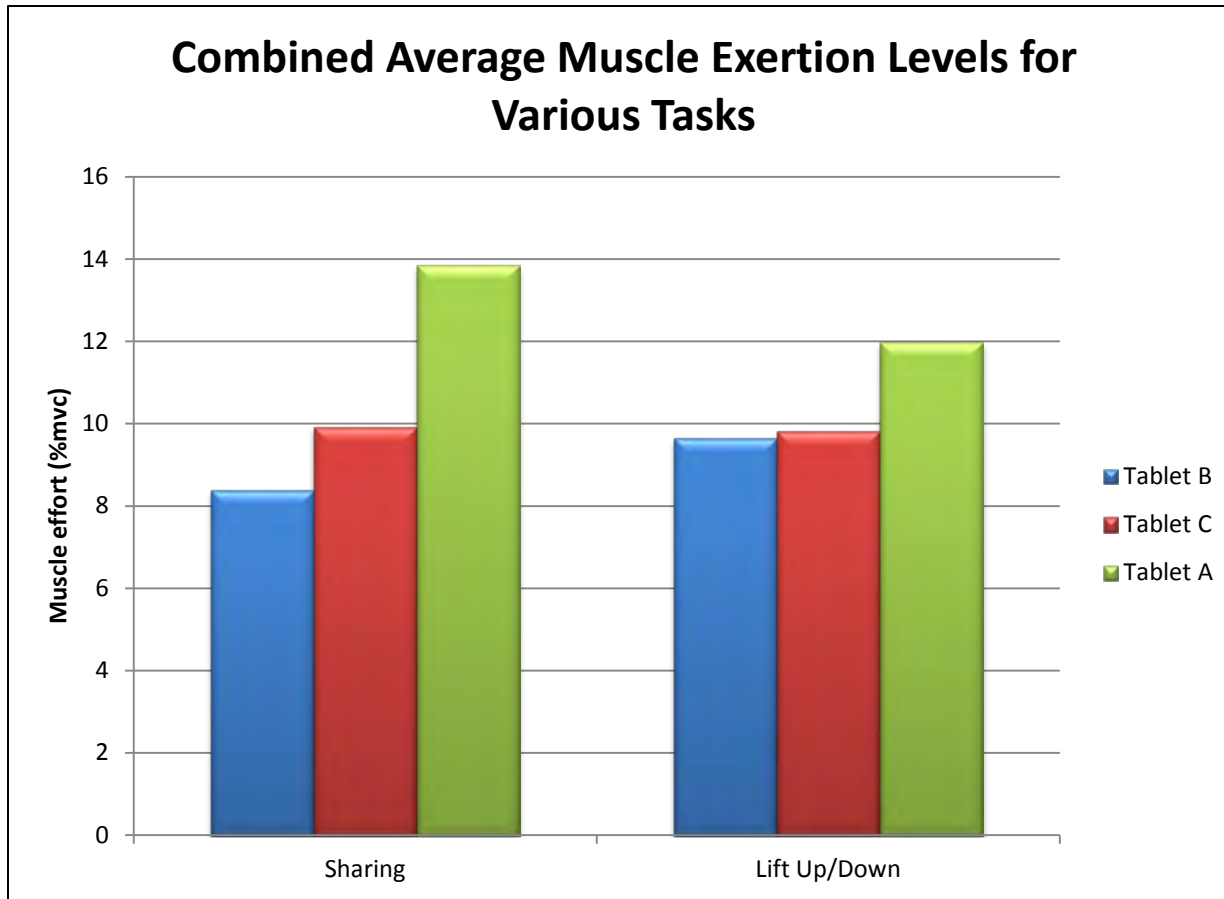
# Results

- Measurable differences in devices tested:
  - Exertion levels (muscle effort)
  - Perceptions of performance
  - User comfort

# Sample Muscle Effort Levels



# Sample Muscle Effort Levels

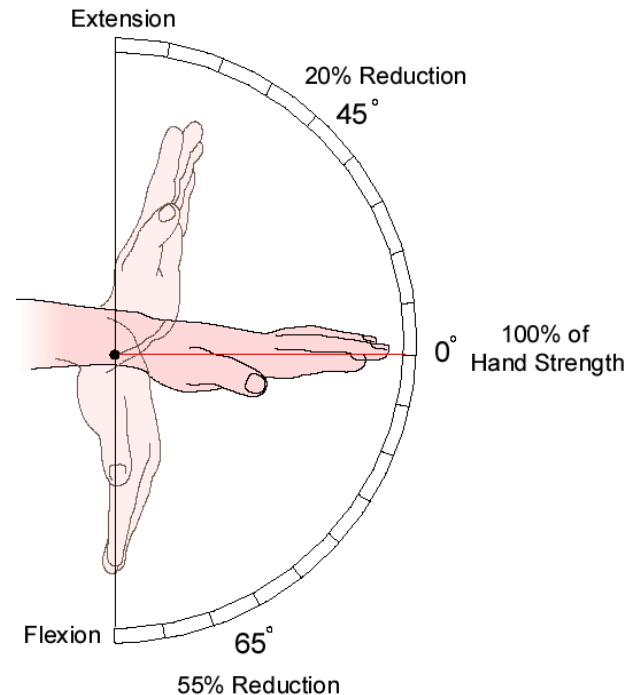
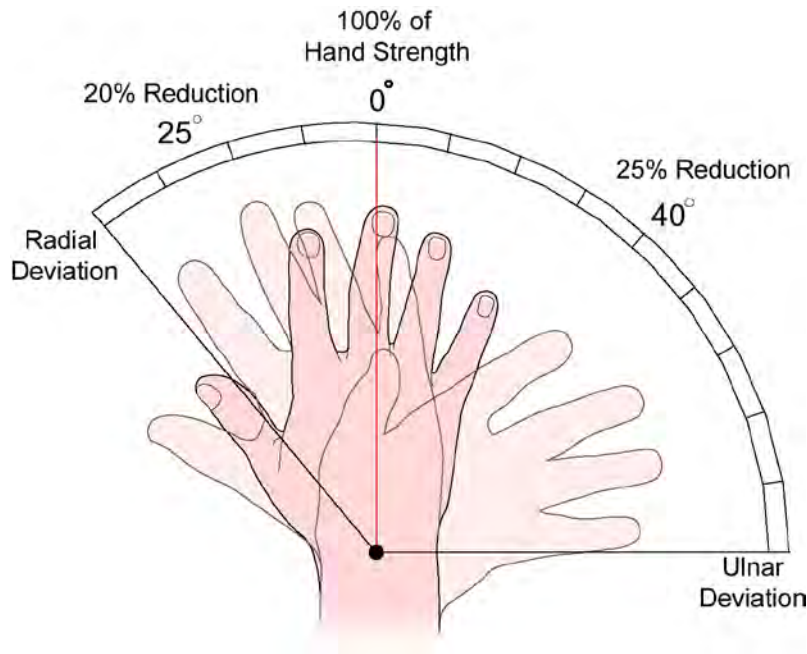


# Results

- All devices < 20% MVC for all of the use scenarios tested.
- The grip design, device weight and adjustability affected effort levels
- The tasks with higher levels of exertion included:
  - Processing a sales transaction
  - Using the device as a tray to carry accessories.
- The arm holding the device exerted more effort than the “free arm”, indicating an ergonomic opportunity
- Tablet D configuration, as used by the Greeter, also < 20% MVC for the use scenarios tested.

# Results

- User technique had a measureable impact on exertion levels.
- If the devices are used with poor postural technique, exertion levels and the potential for fatigue will increase.



# Sample Survey Results

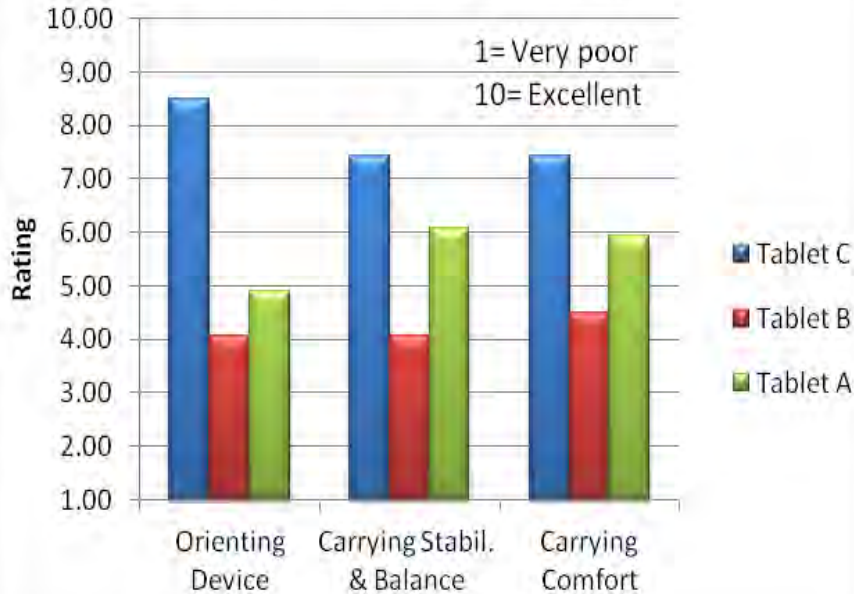


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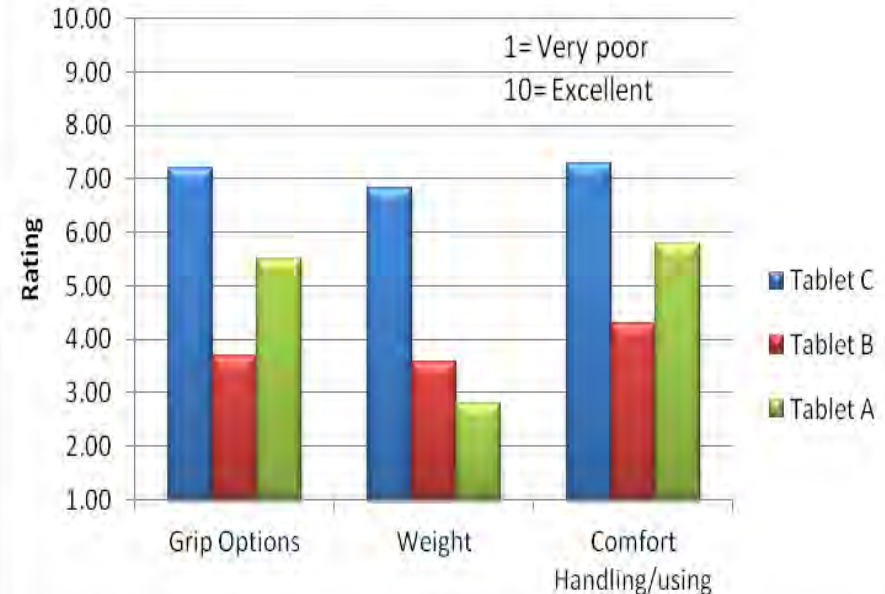


# Sample Survey Results

## User Product Ratings



## User Product Ratings



- Survey results indicated considerable differences in the perceived performance
- The POS Tablet C significantly outperformed other POS configurations



# Best Practice Guideline Development

- The tablet must be usable for the range of tasks performed over a full shift duration.
- The goal is to ensure comfortable, fatigue free use, reduce risk of repetitive motion injuries while providing for effective operations.
- Keys to success include weight, grip features, and display characteristics.

# Device Selection Criteria

## ***1. Minimizing the total weight of tablet and accessories is essential***

- Slight variations in weight can result in measureable increases in user effort and fatigue
- Forces and torques on the user are amplified when display information is shared (two or more people looking at one display)

# Device Selection Criteria

## 2. *Ensure proper grip design*

- A better fitting grip results in significantly less effort
- Allow the user to vary their grip technique for fatigue free use.
- Avoid grips that lock the users hand or fingers into fixed postures.
- The grip must be adjustable to accommodate the range of hand sizes.

## 3. *Device must be secure in the hand*

- The user should be able to carry the device at their sides in a natural posture with little concern of the device slipping from their hand.
- A grip adjusted to fit comfortably and securely on the hand will reduce the holding effort.

## 4. *Avoid contact stress*

- Contact stress is defined as an aggressive point of physical contact between the device and the user's body.
- Ensure grip and contours do not produce contact stress points on the hands or forearms.

# Device Selection Criteria

## **5. *Display Features***

- A clear display is essential for a positive user and customer experience.
- The ability to rotate the display can provide postural ergonomic benefits.
- The illumination, resolution, and reflective properties of the display will impact visual requirements of the user.
- Display brightness should be easily adjustable to accommodate variations in ambient lighting.
- Zoom features assist in meeting the visual need of the user and the customer.

# Best Practices: User Techniques

- Proper user technique is critical to ergonomic success.
- A variety of techniques may be employed to ensure comfort throughout the day.
- Orientation and training are essential to the effective implementation of tablet use.

# Best Practices: User Techniques

1. Frequently alter hand position. Movement promotes blood circulation and minimizes fatigue risks
2. Don't lock the fingers or wrist position. Keep grip flexible and light
3. When possible, use two hands to support the weight. Particularly when sharing information on the display
4. When carrying a tablet, hold device with arm relaxed alongside the torso. Reduces torque and strain on the shoulder and neck
5. Support arms against the torso or chest while holding the tablet. When sitting, support the device in the lap

# Best Practices: User Techniques

6. Alternate the hand holding the device (left versus right)
7. When possible, use device while it is supported on a surface (e.g., a table top or counter)
8. When possible, put device down. Consider gentle stretches to promote circulation
9. Keep wrists straight. Adopt a neutral, low effort wrist position when using the device
10. Avoid static postures. Don't hold device or your body in one posture for extended periods. Avoid a "bent neck" posture

# Conclusions

- Tablet use in the workplace is increasing
- An ergonomic design is essential to reduce employee effort and risk
- Proper technique and user training are keys to success





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