

2011 Military Health System Conference

Advances in Prosthetics and Orthotics

The Quadruple Aim: Working Together, Achieving Success

Jason M. Wilken, PhD, MPT

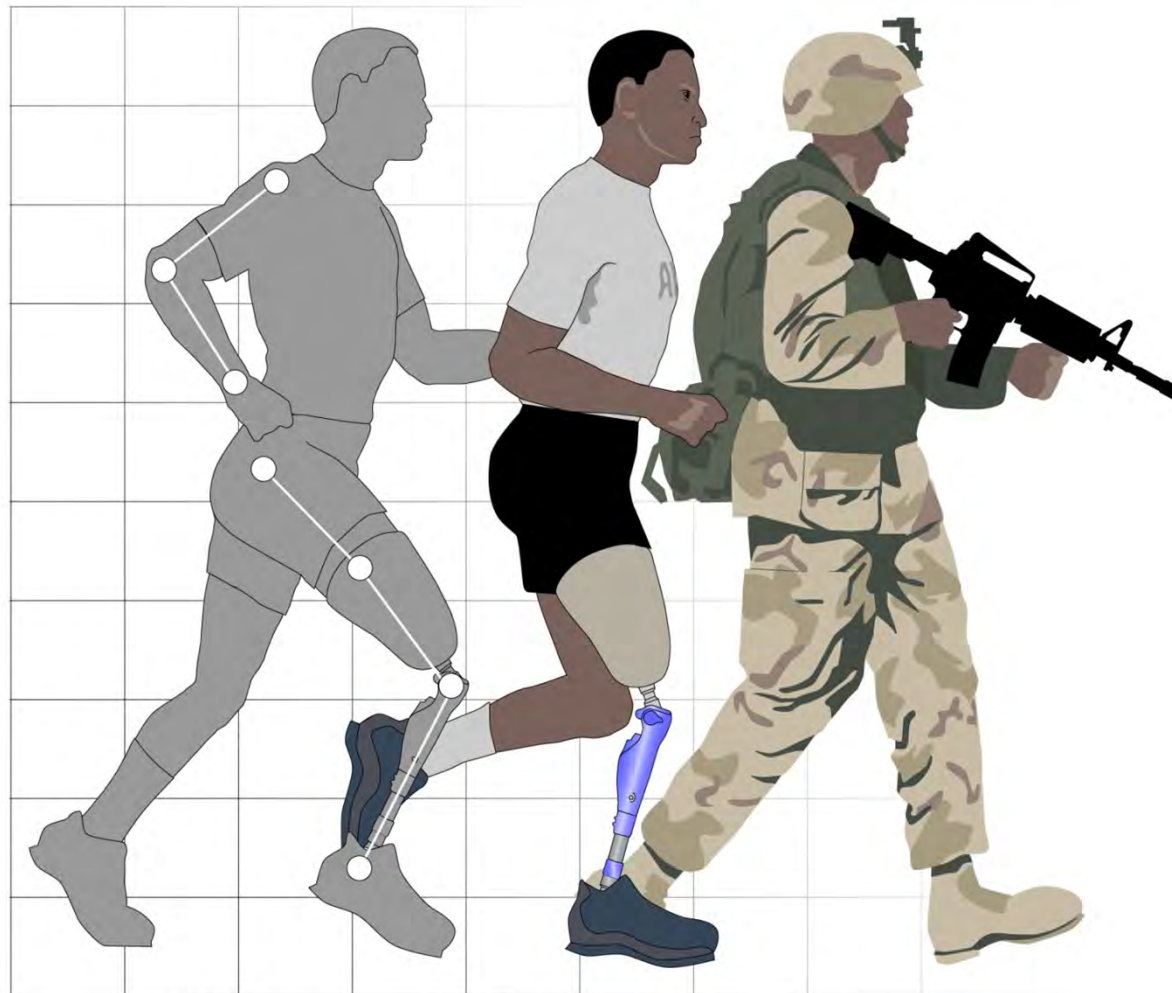
26 January 2011



Center For the Intrepid
Brooke Army Medical Center

Report Documentation Page				Form Approved OMB No. 0704-0188	
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE 26 JAN 2011		2. REPORT TYPE		3. DATES COVERED 00-00-2011 to 00-00-2011	
4. TITLE AND SUBTITLE Advances in Prosthetics and Orthotics				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Brooke Army Medical Center,Center For the Intrepid,Fort Sam Houston,TX,78234				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES presented at the 2011 Military Health System Conference, January 24-27, National Harbor, Maryland					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT Same as Report (SAR)	18. NUMBER OF PAGES 36	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

Military Performance Laboratory



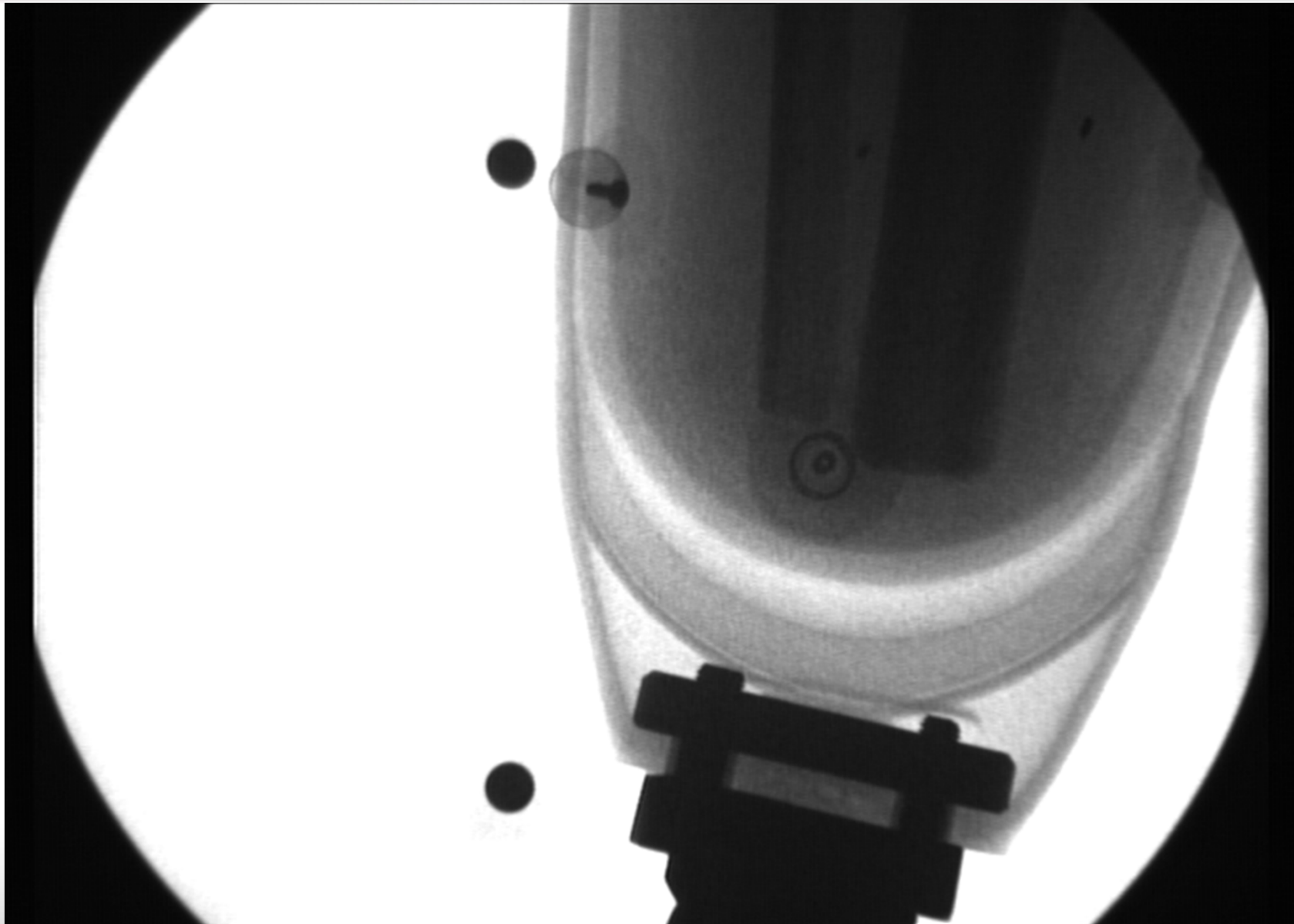
Measuring Motion to Enhance Function

Factors Limiting Performance



- **Injury Severity**
- Socket Fit - Limb-Socket Dynamics
- Prosthetic Functionality
- Orthotic Function
- Walking Stability – Fall risk
- Training – Type, Timing, Dosage
- Energy Consumption
- Comorbidities

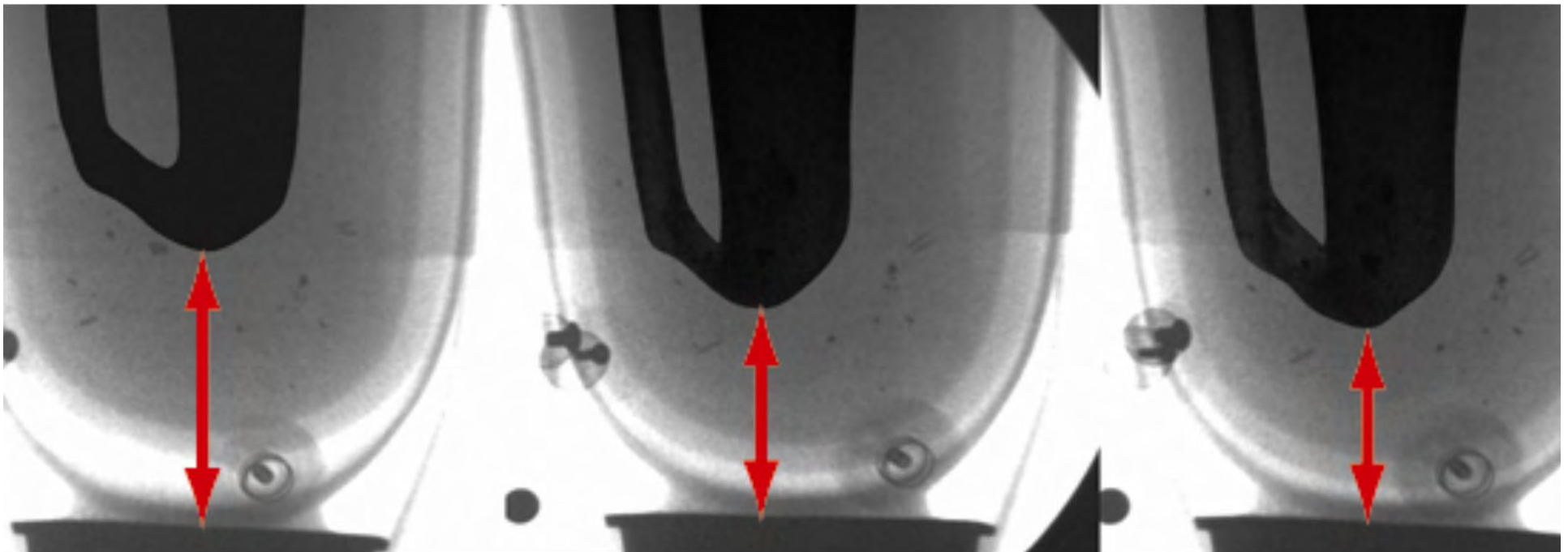
Limb-Socket Interface



Limb-Socket Interface



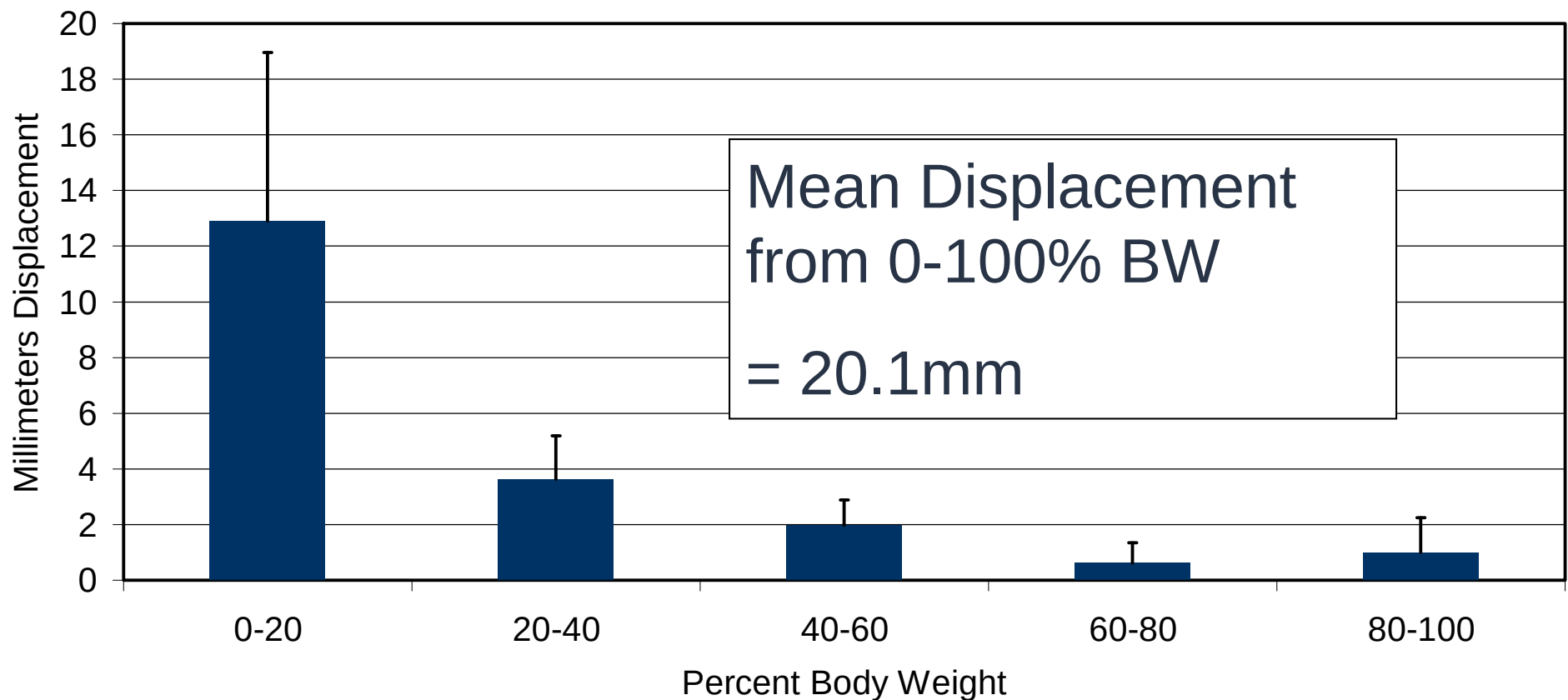
- **Trans-tibial Amputations: Reliability of Kinetic and Videofluoroscopic assessment in Global War on Terrorism Veterans** (Tucker, Wilken, Teyhen, Granville)



Limb-Socket Interface



Limb-Socket Displacement



Limb-Socket Interface



The Effect of Vacuum Assisted Suction Suspension on Limb-Socket Dynamics, Physical Performance and Perception

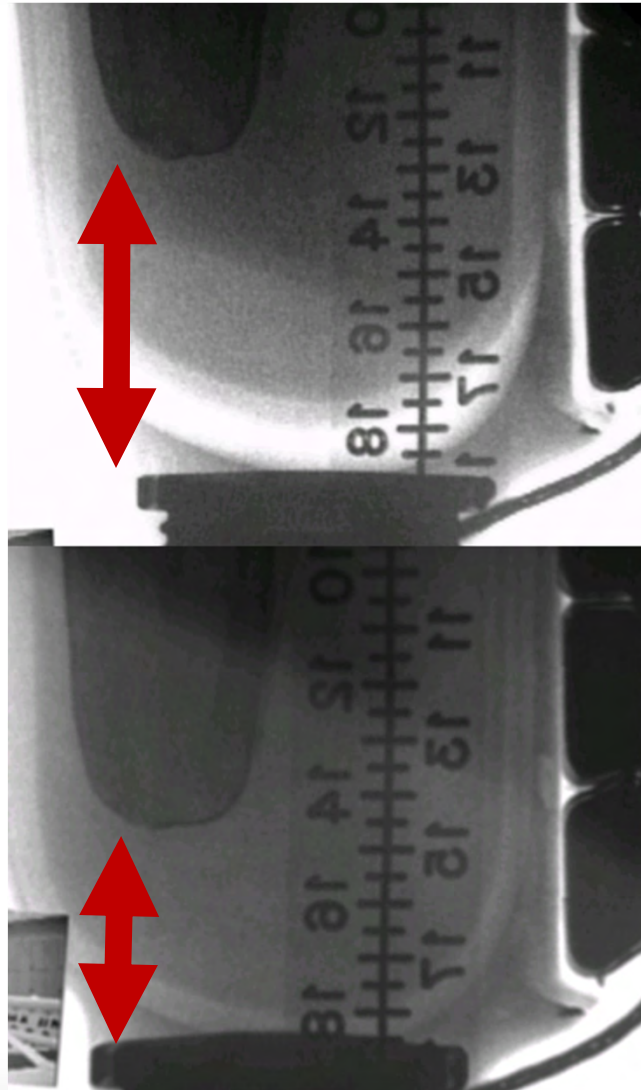
(Wilken, Darter, Dingwell)





Limb-Socket Interface

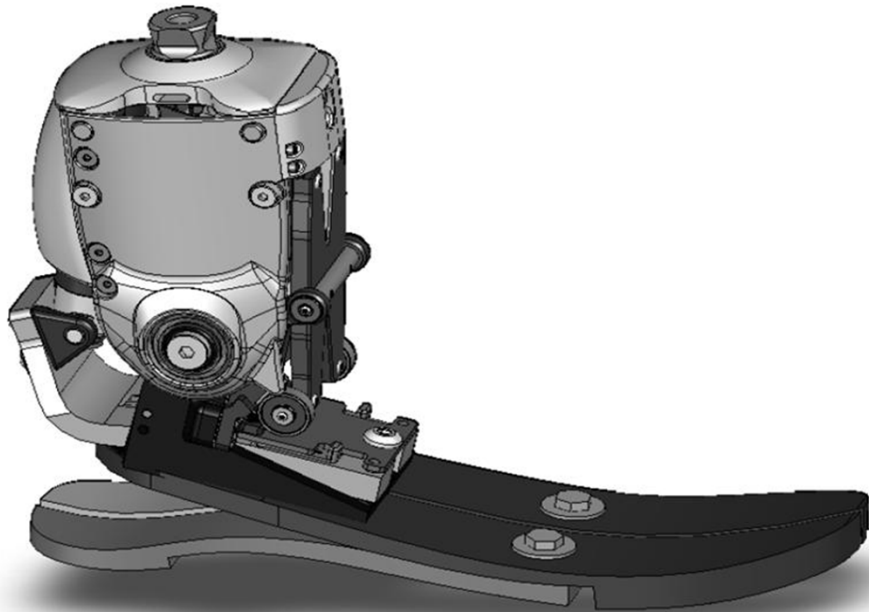
18.4
mm



Prosthetic Functionality



- Initial Clinical Implementation of a New Microprocessor Controlled Powered Prosthetic Foot/Ankle System (Wilken)

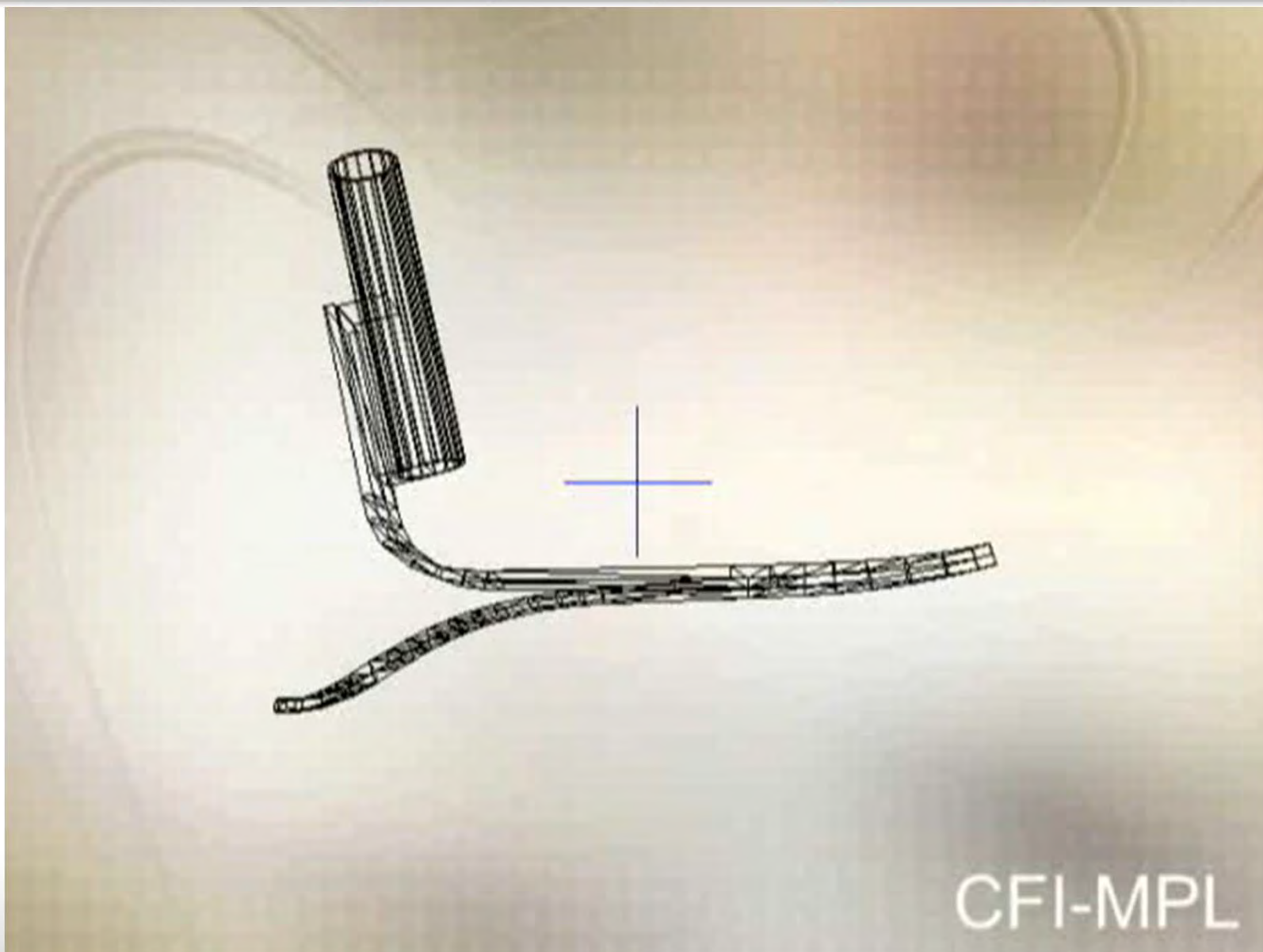


Prosthetic Functionality



- Prosthetic feet are unable to fully replicate the function of the intact ankle
- Act as a spring returning stored energy
- Persistent gait deviations
 - Asymmetry
 - Decreased efficiency
 - Low back pain
 - Osteoarthritis

Prosthetic Functionality

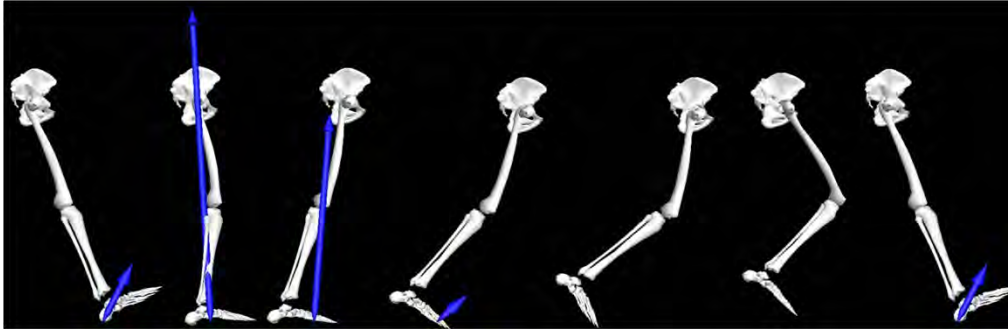


CFI-MPL

Prosthetic Functionality

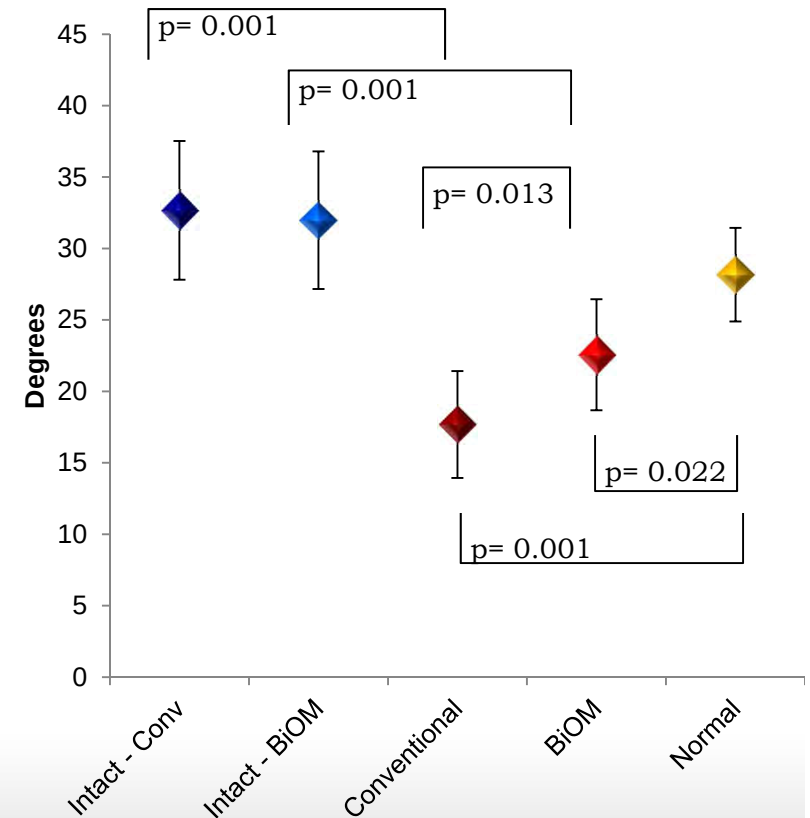
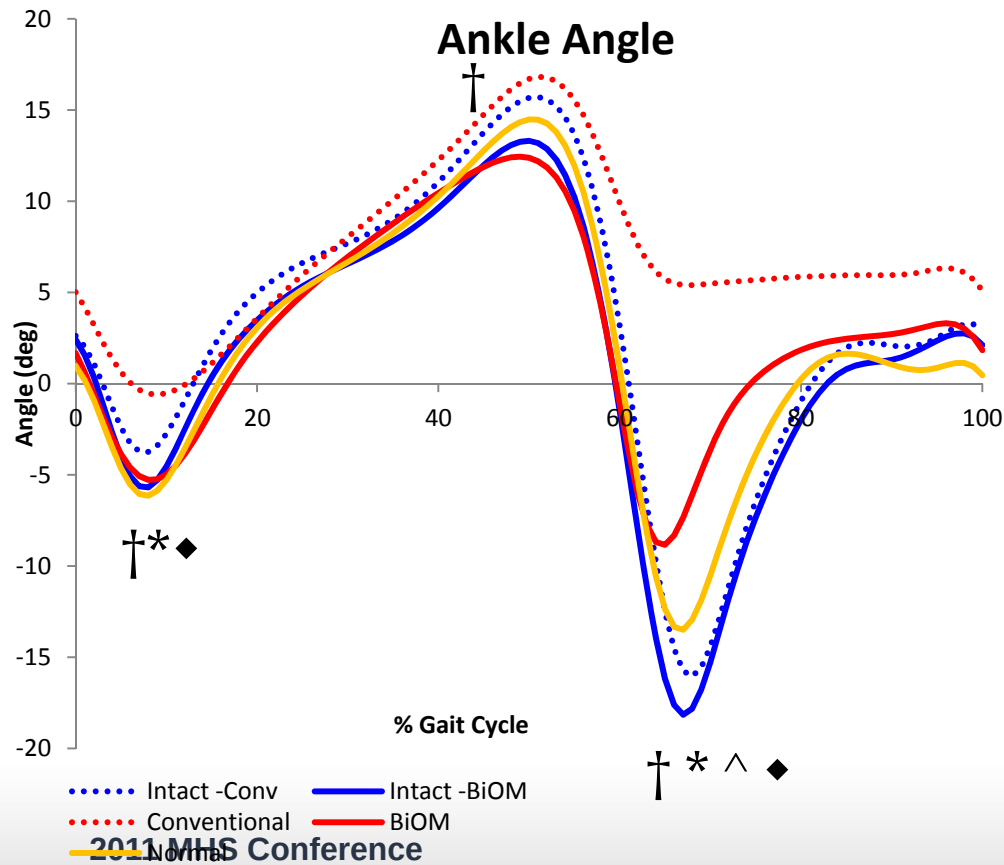


Ankle Angle

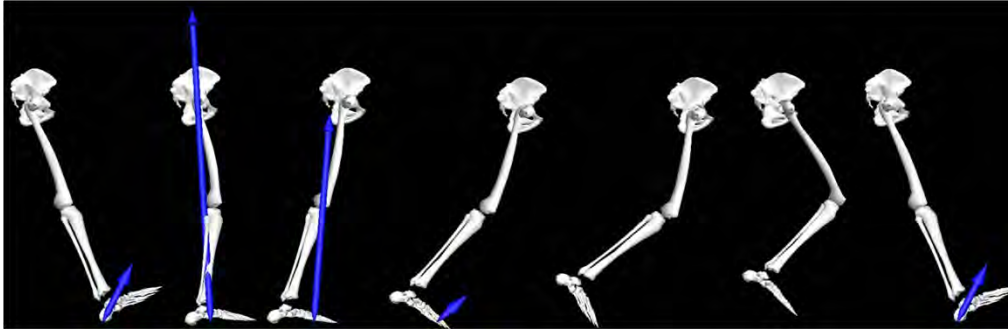


Symbol	Significance Between
†	Conventional and PF
*	Conventional and Intact
^	BiOM and Intact
◆	Normal and Conventional

Ankle Range of Motion

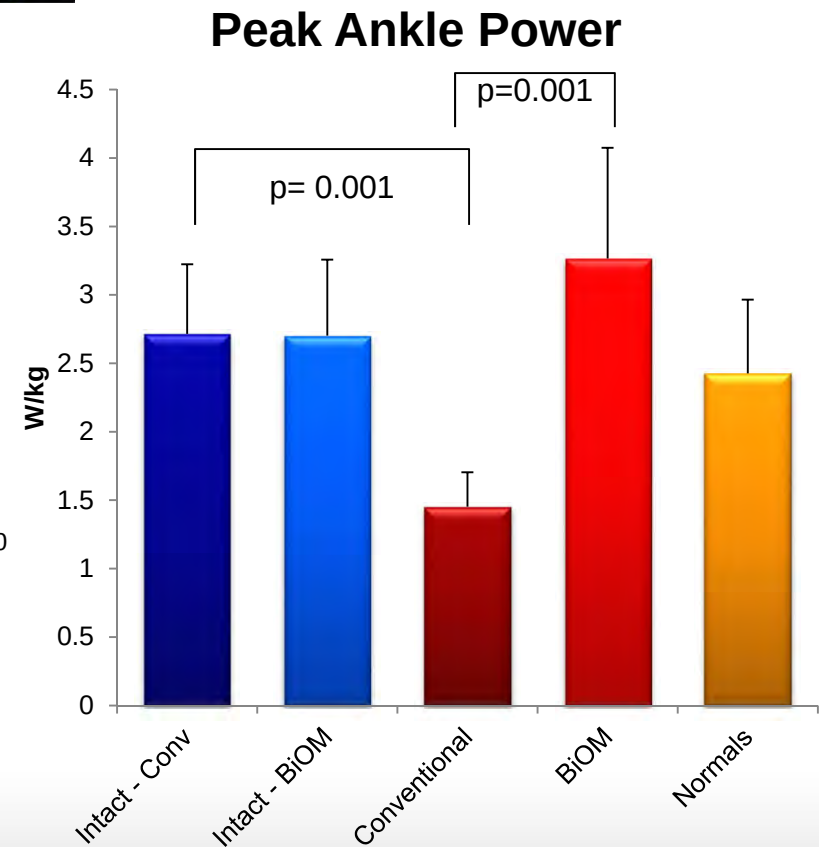
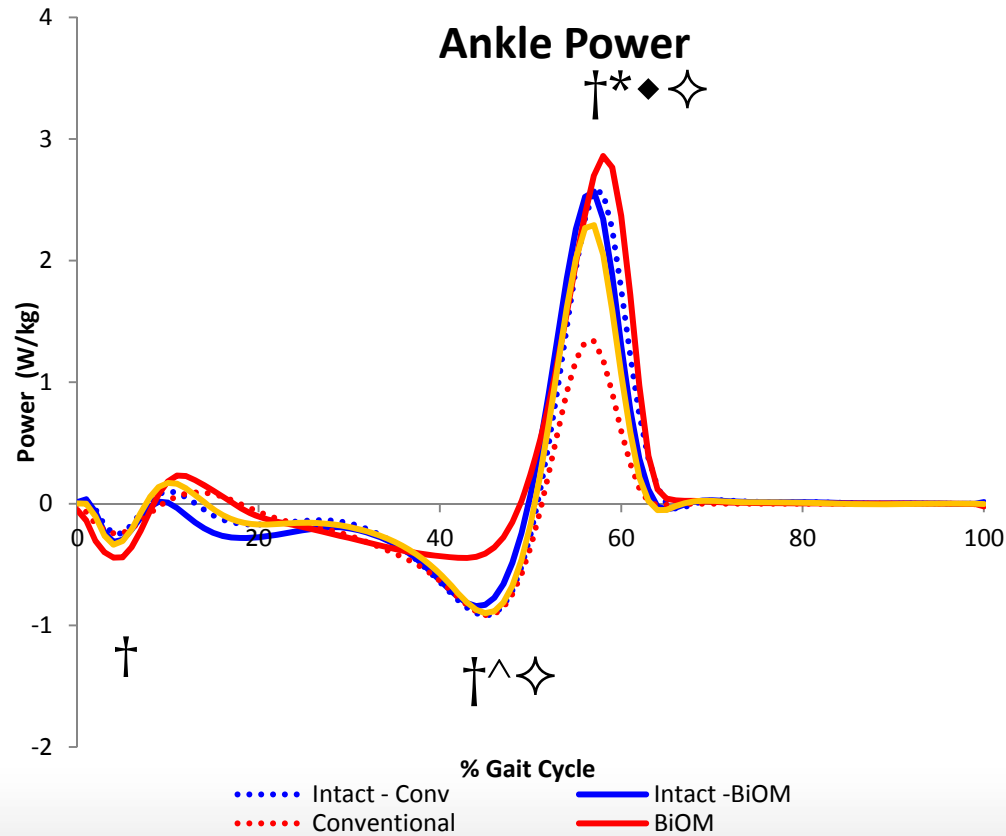


Prosthetic Functionality



Symbol Significance Between

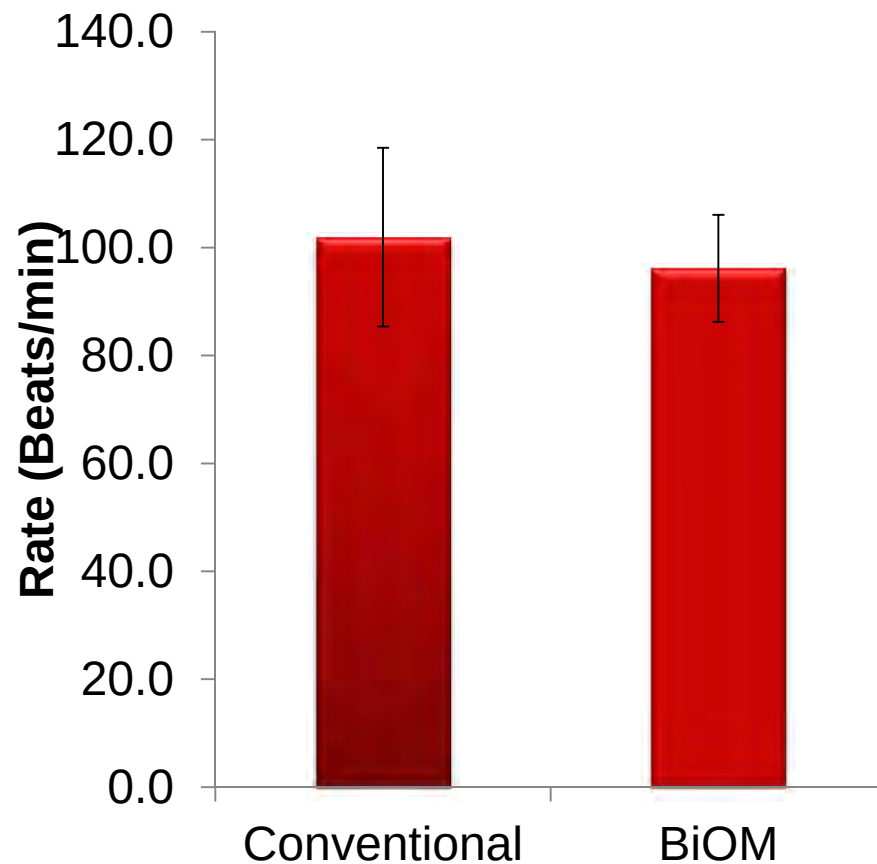
- † Conventional and PF
- * Conventional and Intact
- ^ BiOM and Intact
- ◆ Normal and Conventional
- ◇ Normal and BiOM



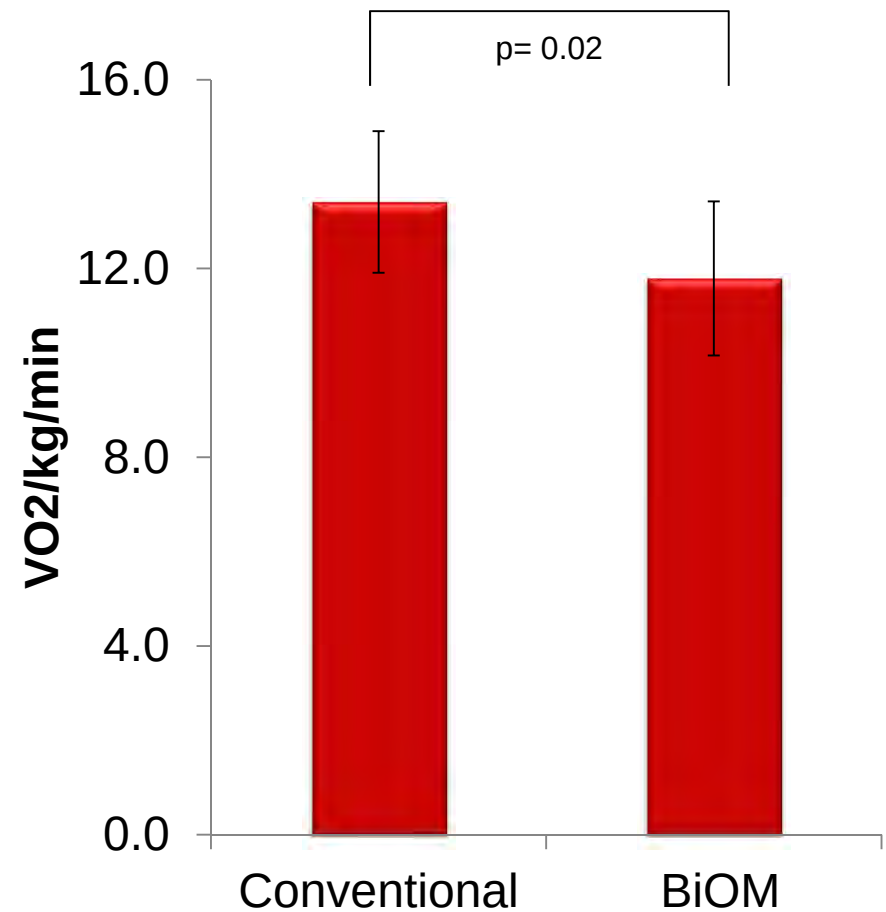
Metabolic Cost



Heart Rate



Metabolic Cost



Orthotic Functionality



- **The Effect of Ankle-Foot Orthosis Type on Agility, Power and Running Performance in Patients Undergoing Limb Salvage after Severe Lower Extremity Trauma**



Orthotic Functionality



- Available orthoses are unable to meet the demands of many injured service members
- Provide inadequate support and energy return
- Problem: Functional limitations
(Consider amputation to improve function)
- Solution:
Intrepid Dynamic Exoskeletal Orthosis (IDEO)

Intrepid Dynamic Exoskeletal Orthosis



- Reinforced Carbon lamination
- Proximal supportive bi-valve or monolithic cuff
- Low profile supramalleolar foot section
- Modular Trulife Littig dynamic carbon strut



CFI Dynamic Strut AFO



Ossur Cheetah Sprint foot

Orthotic Functionality



Orthotic Functionality



- Hypothesis: Use of the IDEO leads to improved performance on functional measures of speed, power and agility as compared to commercial off the shelf orthoses and no brace.

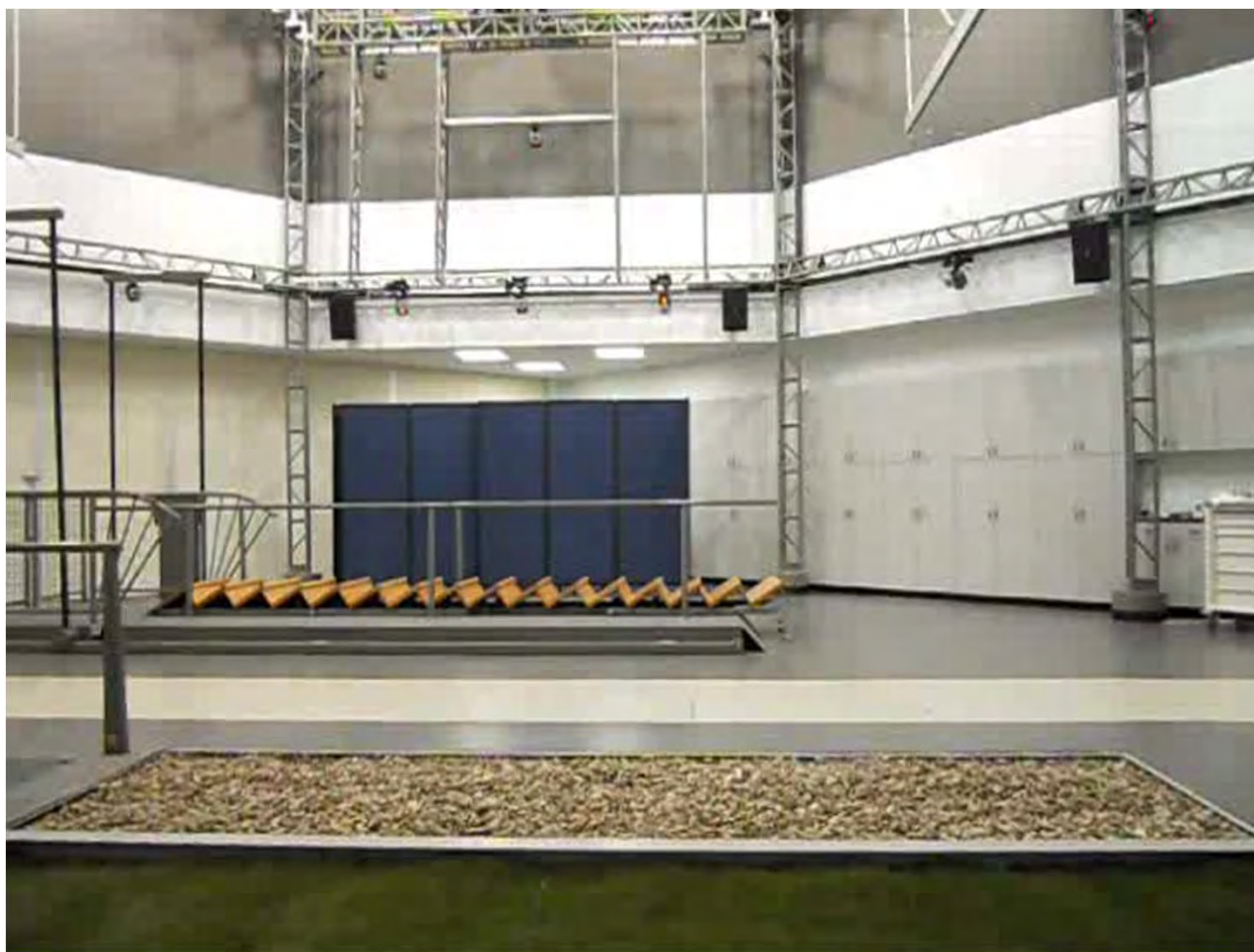
Orthotic Functionality



- Eighteen Patients
 - IDEO
 - Allard Blue Rocker (BR)
 - Posterior Leaf Spring (PLS)
 - No brace (NONE)
- One testing session
- Brace order randomized



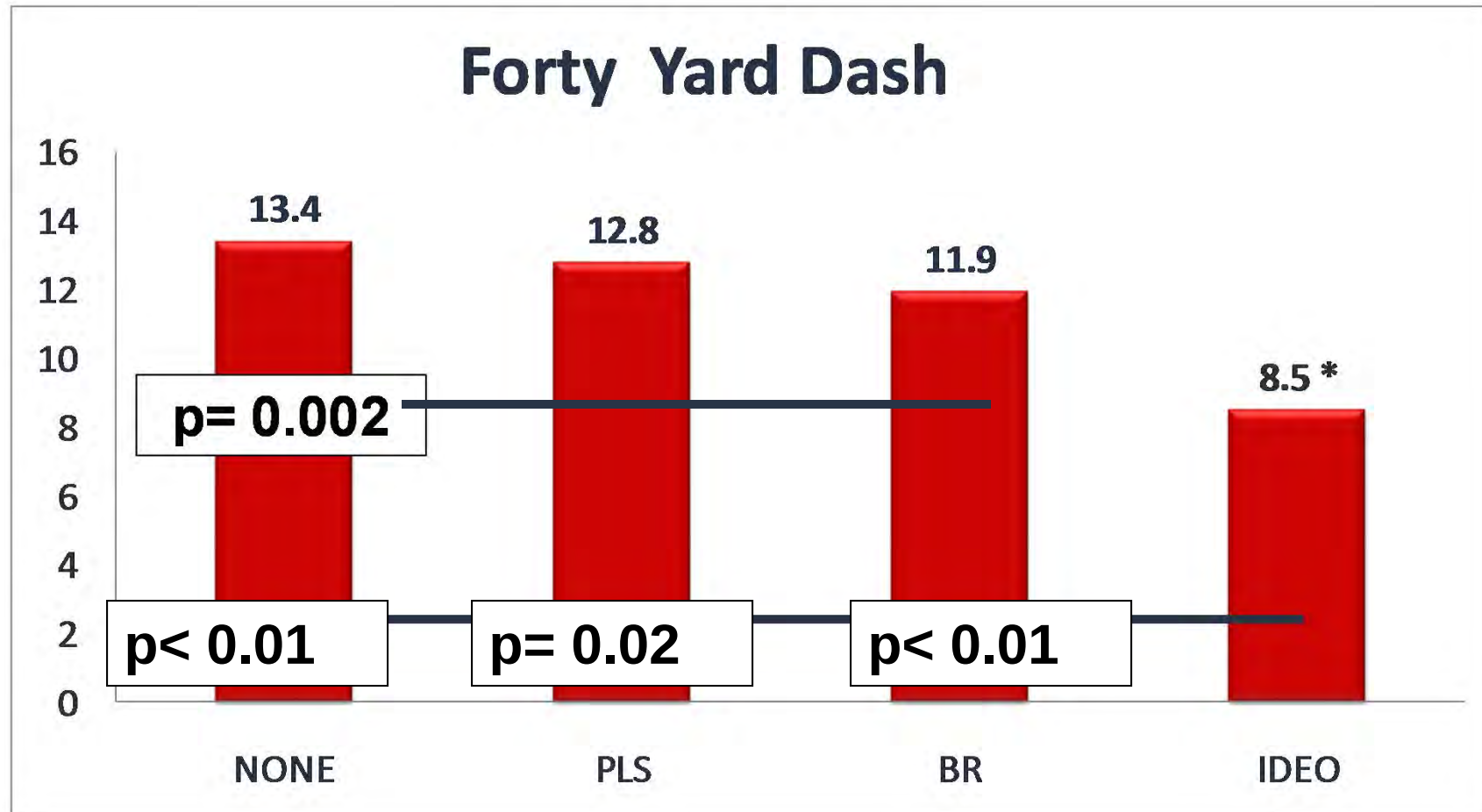
Running – Without AFO



Running – With IDEO



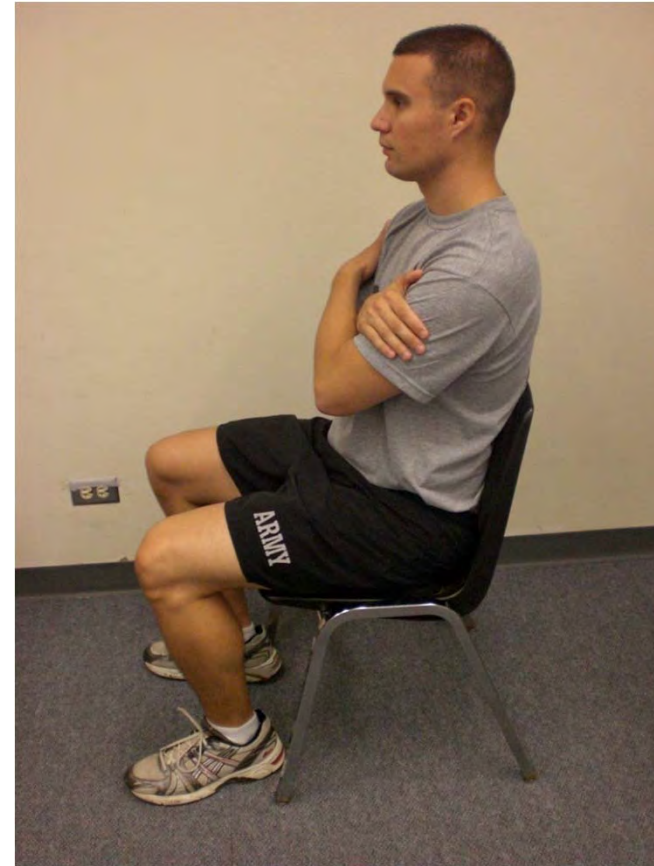
Forty Yard Dash



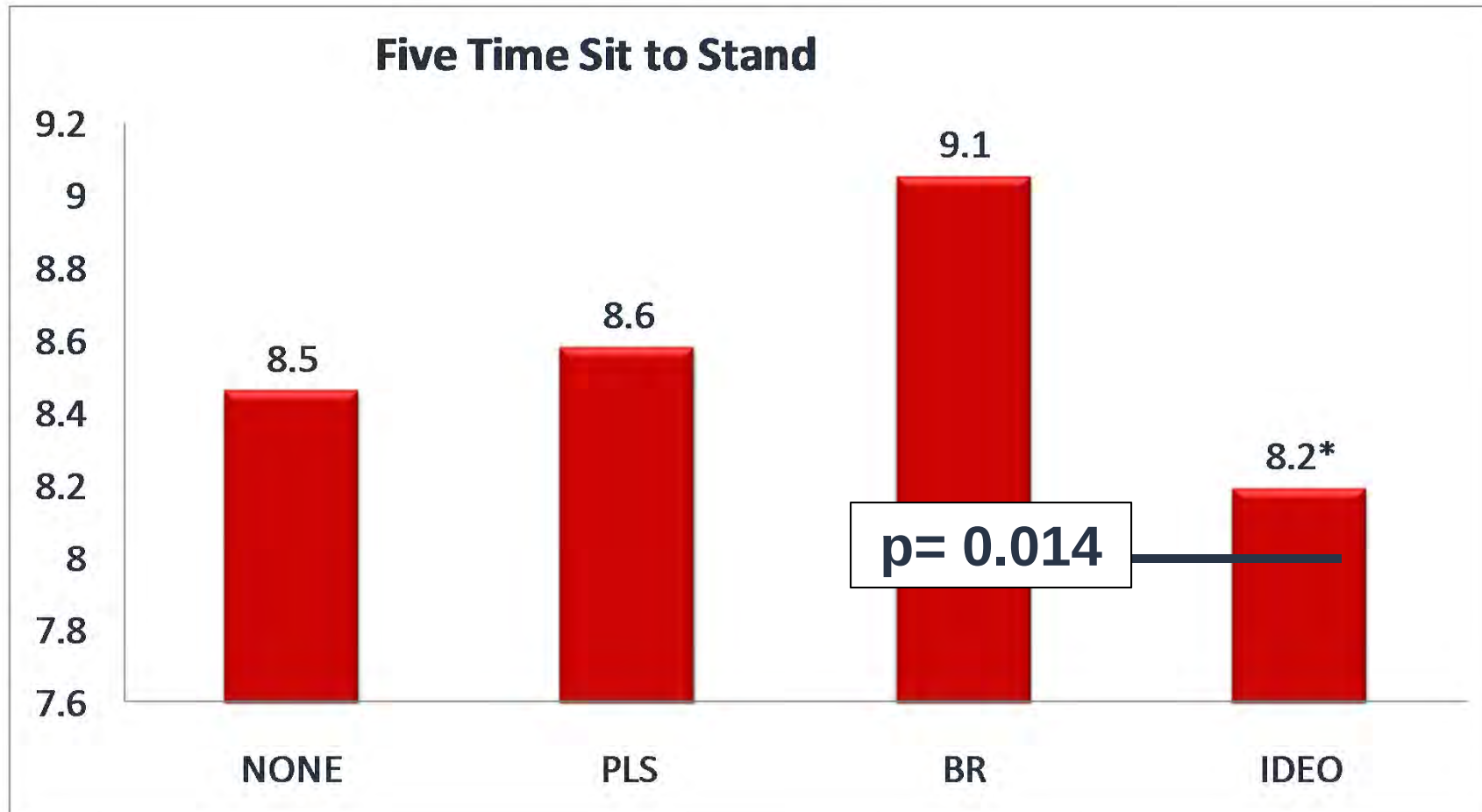
Five Time Sit to Stand



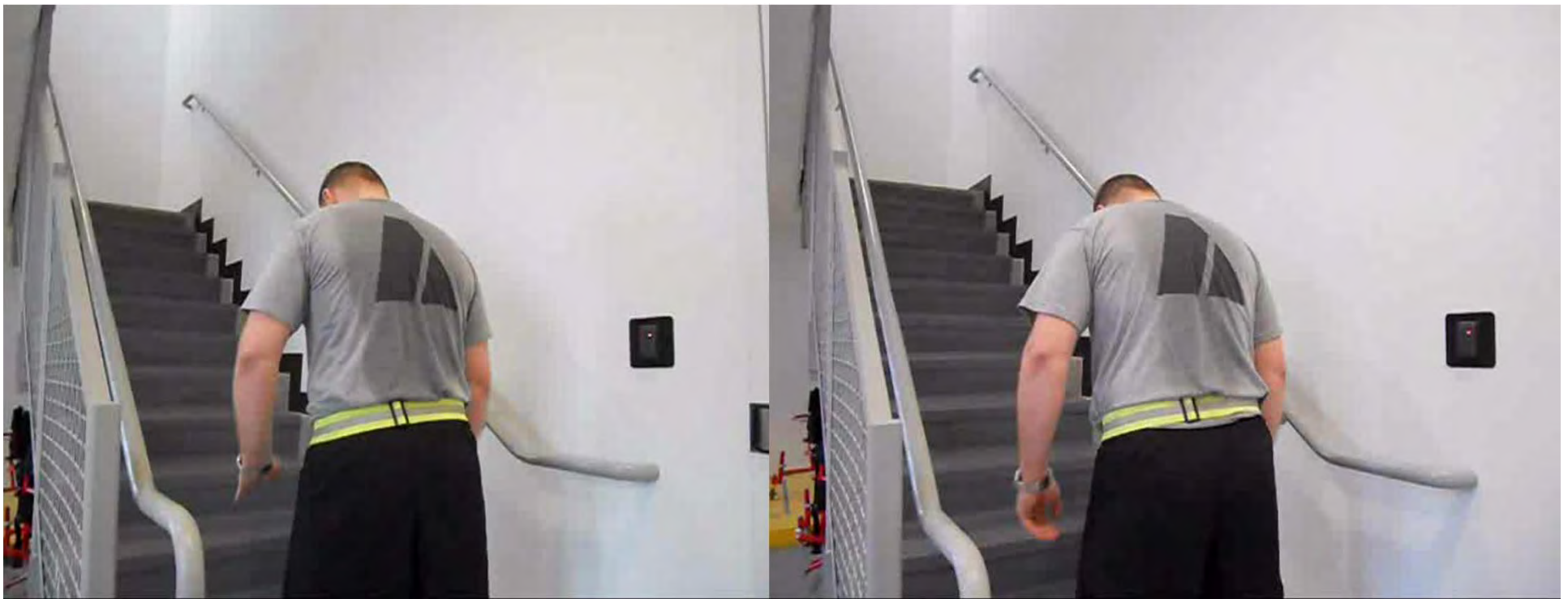
- Five Time Sit to Stand (5STS)
 - Commonly performed to assess lower extremity strength, endurance, and mobility (Whitney, 2005)
 - Tests ability to rise from a chair and sit back down five times in quick succession
 - 3 trials



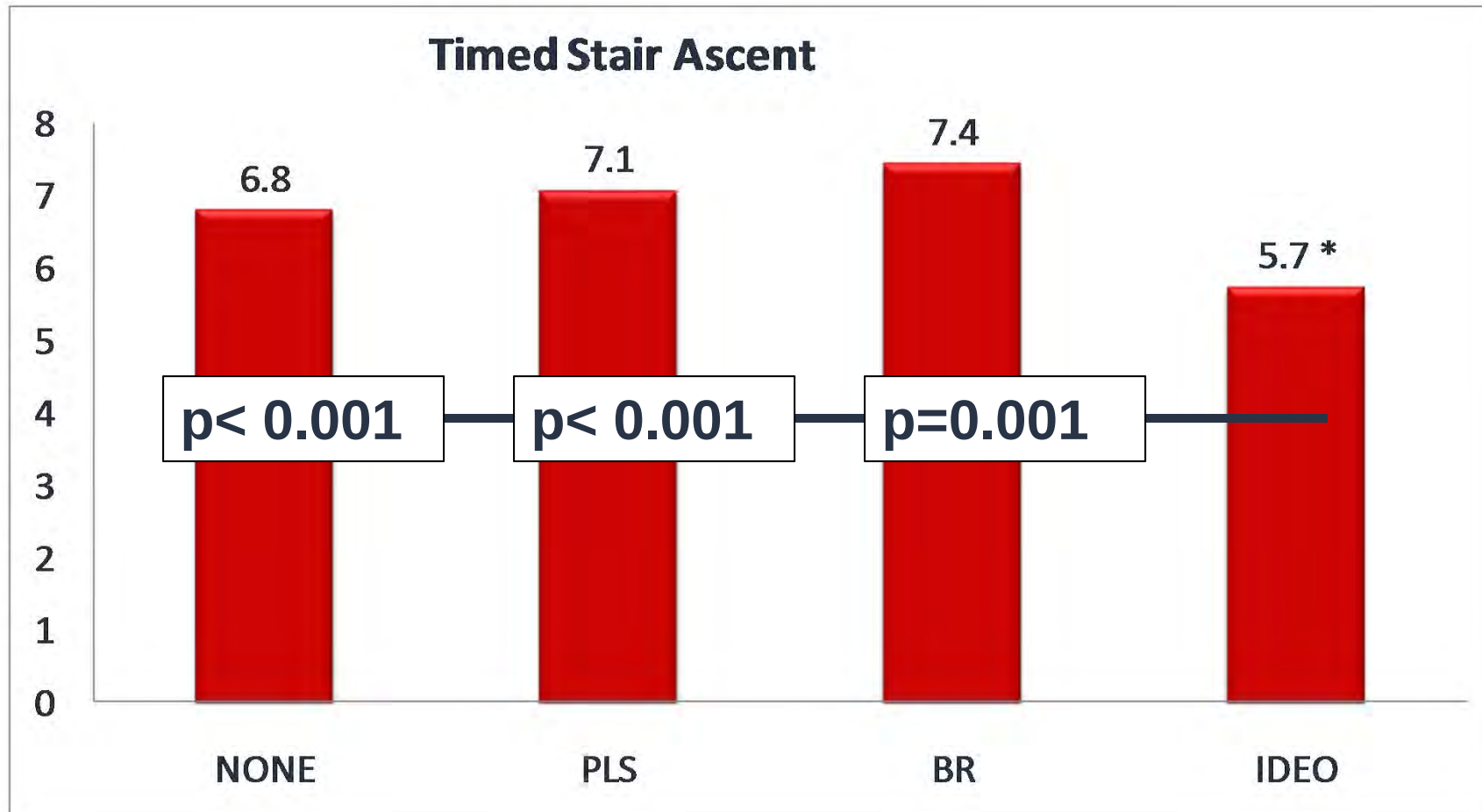
Five Time Sit to Stand



Timed Stair Ascent



Timed Stair Ascent

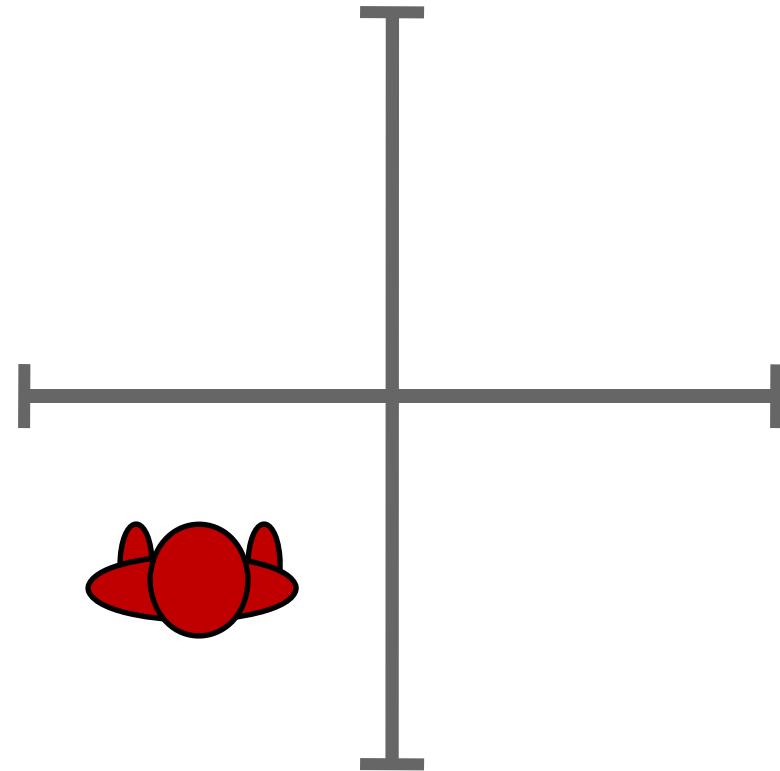


Four Square Step Test

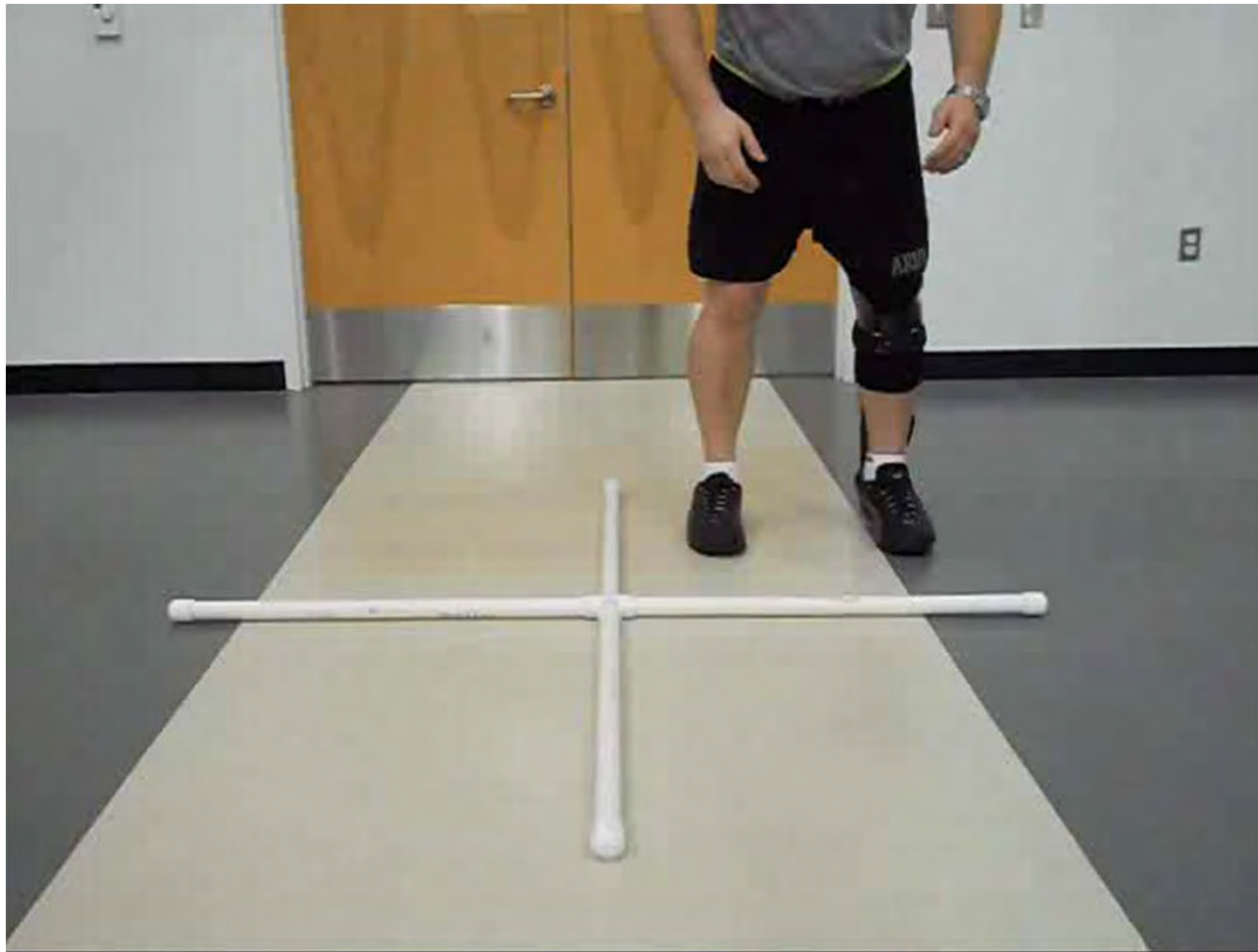


Four Square Step Test (FSST)

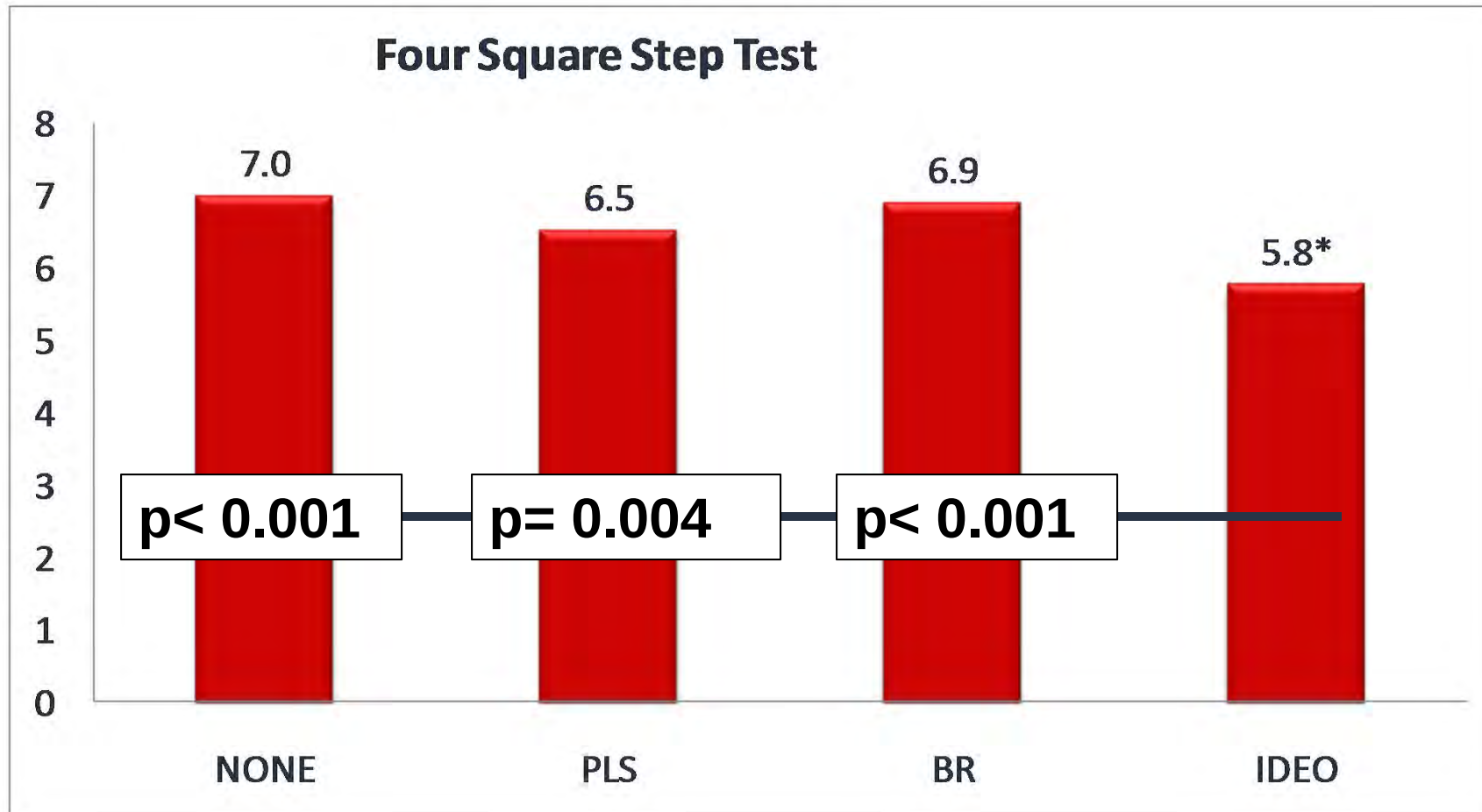
- A dynamic test of balance and mobility (Whitney, 2007)
- Test measures ability to move forward, backwards, and laterally over an approximately one inch obstacle
- One practice trial followed by 4 timed trials



Four Square Step Test



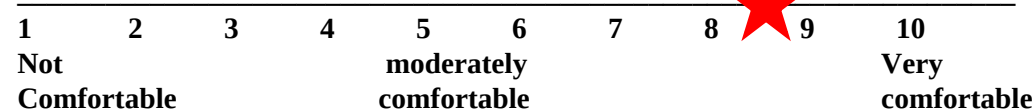
Four Square Step Test



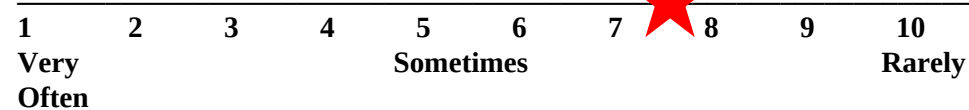
Results



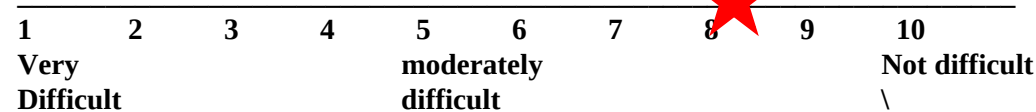
1. How comfortable do you find the IDEO?



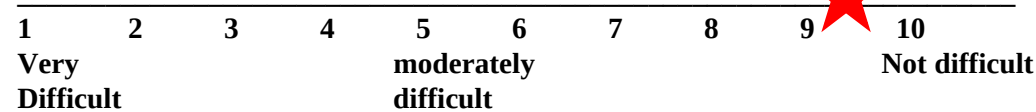
2. How frequently do you develop skin problems (blisters, rash, abrasions, etc) in the IDEO?



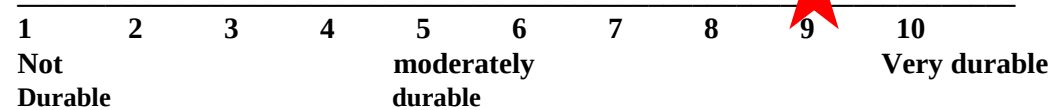
3. How difficult is it to put on or take off the IDEO?



4. How difficult do you find it to keep the IDEO clean?



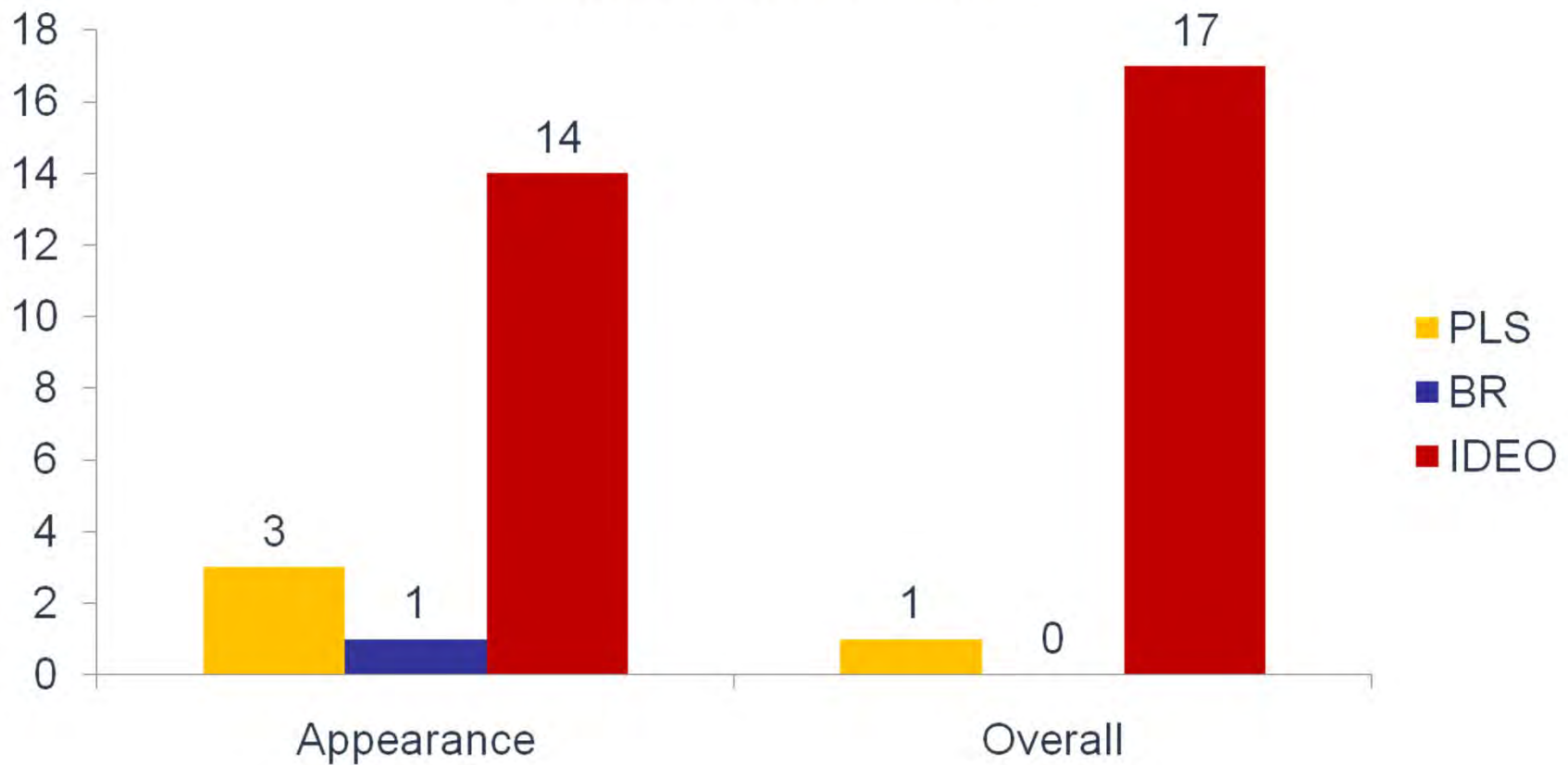
5. How durable do you find the IDEO?



Results



Orthosis Preference



Clinical Outcomes



- 13 patients were considering amputation
 - 8 selected to continue limb salvage
 - 2 undecided
 - 3 selected amputation
- Significant improvements in physical performance
- Continued room for improvement

Conclusion



- Recent advances in prosthetics and orthotics hold great promise for maximizing physical function for patients who have experienced severe extremity trauma

Acknowledgements



■ Collaborators

- LTC Scott Shaffer, PT, PhD
- LTC Stephen L. Goffar, PT, PhD
- Benjamin Darter, PT, PhD
- Jon Dingwell, PhD
- LTC Joseph Hsu, MD
- Ryan Blanck, CPO
- Johnny Owens, PT
- CPT Jeanne Patzkowski, MD



■ Student Researchers

- 1LT Jesse Ellwein, SPT
- CPT Rachel May, SPT
- 1LT Tyson Kovach, SPT
- 1LT Danny Matta, SPT
- 1LT Eric Tomalis, SPT

■ Funding

- Military Amputee Research Program
- Telemedicine and Advanced Technology Research Program

