Gait Parameter Differences Between Standard and Ertl Transtibial Amputees

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The investigators have no financial relationships to disclose

Introduction

- Ertl Technique
  - Advantages
    - Improved residual limb shape
    - Fibular stability
    - End bearing limb

- Ertl Technique
  - Disadvantages
    - Increased OR time
    - Increased tourniquet time
      - Gwinn, DE., Keeling, J., et al. FAI, 2008
    - Time to union
      - Delayed rehabilitation

- Scant objective data regarding Ertl procedure

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1. An alternative technique for the Ertl osteomyoplasty.
Berlet GC, Pokabla C, Serynek P.
Foot Ankle Int. 2009 May;30(5):443-6. No abstract available.
PMID: 19439146 [PubMed - indexed for MEDLINE]
Related articles

2. Amputation osteoplasty.
DeCoster TA, Homedan S.
Iowa Orthop J. 2006;26:54-9.
PMID: 16789450 [PubMed - indexed for MEDLINE]
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3. Fibular segment bone bridging in trans-tibial amputation.
Pinto MA, Harris WW.
Prosthet Orthot Int. 2004 Dec;28(3):220-4.
PMID: 15658634 [PubMed - indexed for MEDLINE]
Related articles

4. Controversies in amputation surgery.
Pinzur MS, Pinto MA, Schon LC, Smith DG.
Instr Course Lect. 2003;52:445-51. Review.
PMID: 12690870 [PubMed - indexed for MEDLINE]
Related articles

5. Modified Ertl osteomyoplasty for terminal overgrowth in childhood limb deficiencies.
Drvaric DM, Kruger LM.

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1. Distal tibiofibular bone-bridging in transtibial amputation.
Pinzur MS, Beck J, Himes R, Callaci J.
J Bone Joint Surg Am. 2008 Dec;90(12):2682-7.
PMID: 19047714 [PubMed - indexed for MEDLINE]
Related articles

2. Perioperative differences between bone bridging and non-bone bridging transtibial amputations for wartime lower extremity trauma.
Gwinn DE, Keeling J, Froehner JW, McGuigan FX, Andersen R.
Foot Ankle Int. 2008 Aug;29(8):787-93.
PMID: 18752776 [PubMed - indexed for MEDLINE]
Related articles

3. Controversies in lower extremity amputation.
Pinzur MS, Gottschalk F, Pinto MA, Smith DG.
Instr Course Lect. 2008;57:663-72. Review.
PMID: 18399614 [PubMed - indexed for MEDLINE]
Related articles

4. Health-related quality of life in patients with transtibial amputation and reconstruction with bone bridging of the distal tibia and fibula.
Pinzur MS, Pinto MA, Saltzman M, Batista F, Gottschalk F, Juknelis D.
Foot Ankle Int. 2006 Nov;27(11):907-12.
PMID: 17144951 [PubMed - indexed for MEDLINE]
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5. Amputation osteoplasty.
DeCoster TA, Homedan S.
Iowa Orthop J. 2006;26:54-9.

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- Published literature has focused on technique and patient perceived outcomes
  - Inconclusive
    - Pinzur, et al. FAI, 2006
    - Pinzur, et al. JBJS, 2008

Purpose

Determine gait parameter differences between military Ertl and Burgess transtibial amputees

Study Design

- IRB approved
- Retrospective review

- Inclusion Criteria:
  - Unilateral transtibial amputation
  - Available gait study >6 months from initial study
  - Independent ambulation
- Exclusion Criteria:
  - Requirement of assistive device
  - Ambulating independently < 6 months
  - Contralateral LE arthrodesis

- 10 Patients met inclusion criteria
  - 5 Ertl
  - 5 Standard
  - All subjects AD male
  - Average age 25 yrs (22-28)
- Two amputee groups compared
- All amputees compared to cohort of 20 non-amputee normal controls

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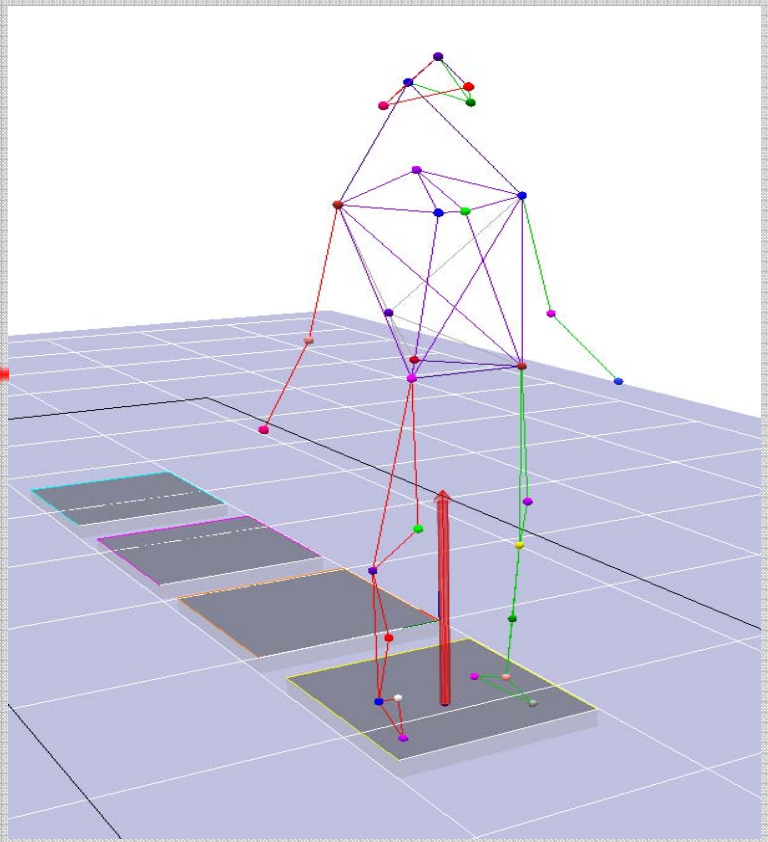
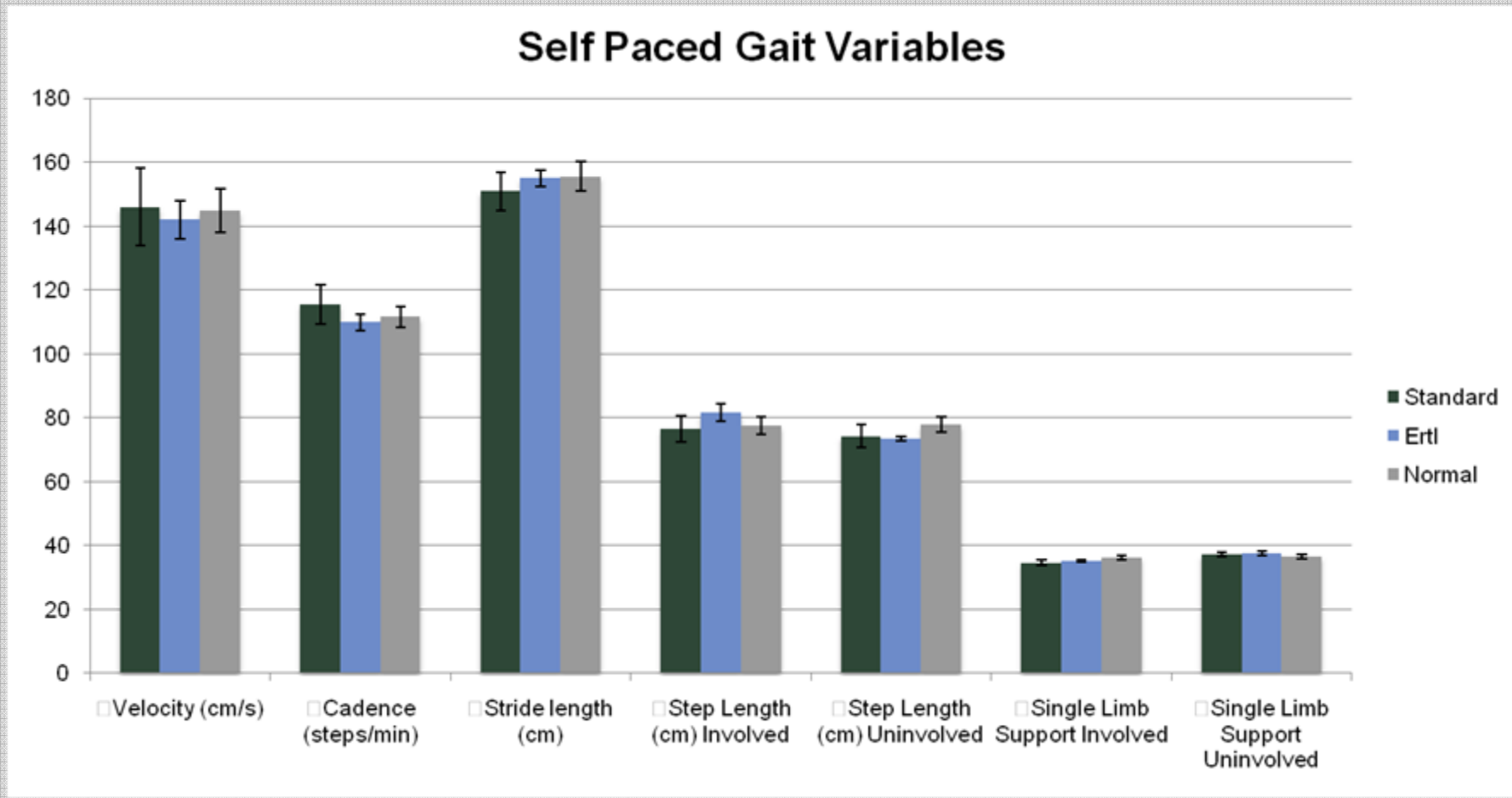
NMCSD Gait Analysis Laboratory



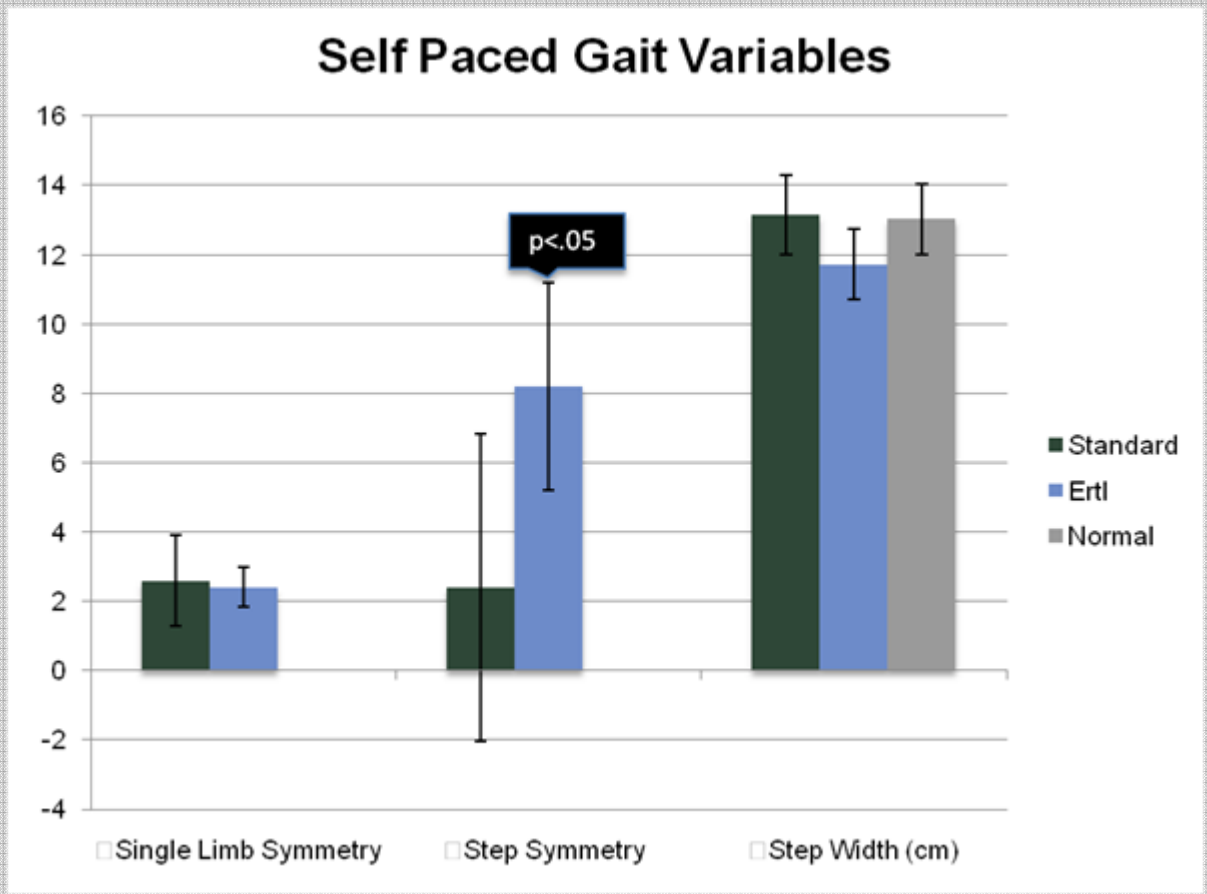
- Gait Parameters
  - gait velocity
  - cadence
  - stride length
  - step width
  - step length
  - step symmetry
  - single limb support
  - single limb stance symmetry
- Gait Kinematics
  - Ground reaction forces
    - Early stance
    - Mid Stance
    - Late Stance

- Statistics
  - ANOVA/T-test performed on SPSS software
  - Post hoc power analysis revealed 51 patients in each arm would be required for power of 80%

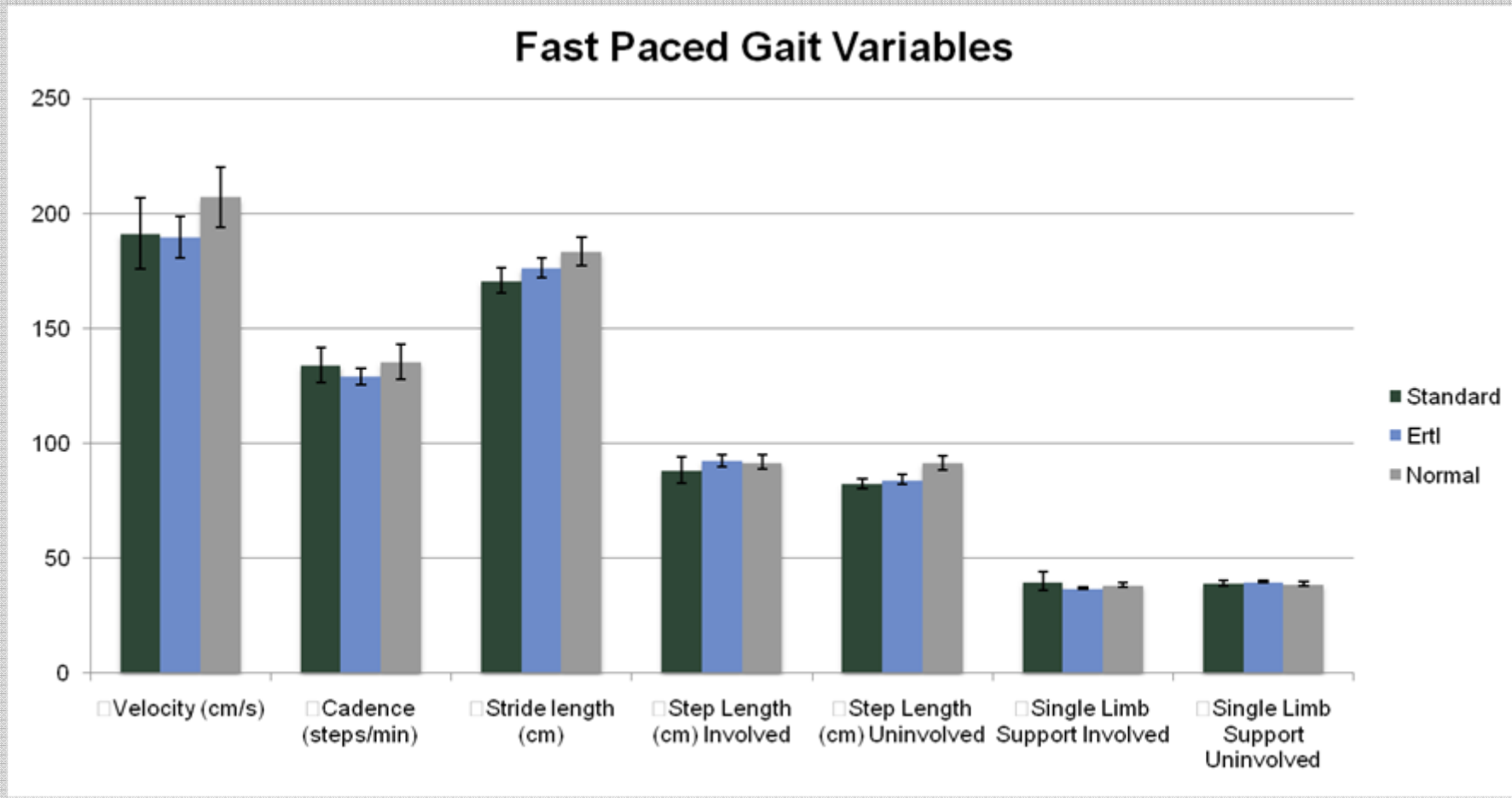
Results


Self Paced Gait Variables
180
160
140
120
100
80
60
40
20
0
Velocity (cm/s)
Cadence (steps/min)
Stride length (cm)
Step Length (cm) Involved
Step Length (cm) Uninvolved
Single Limb Support Involved
Single Limb Support Uninvolved
Standard
Ertl
Normal

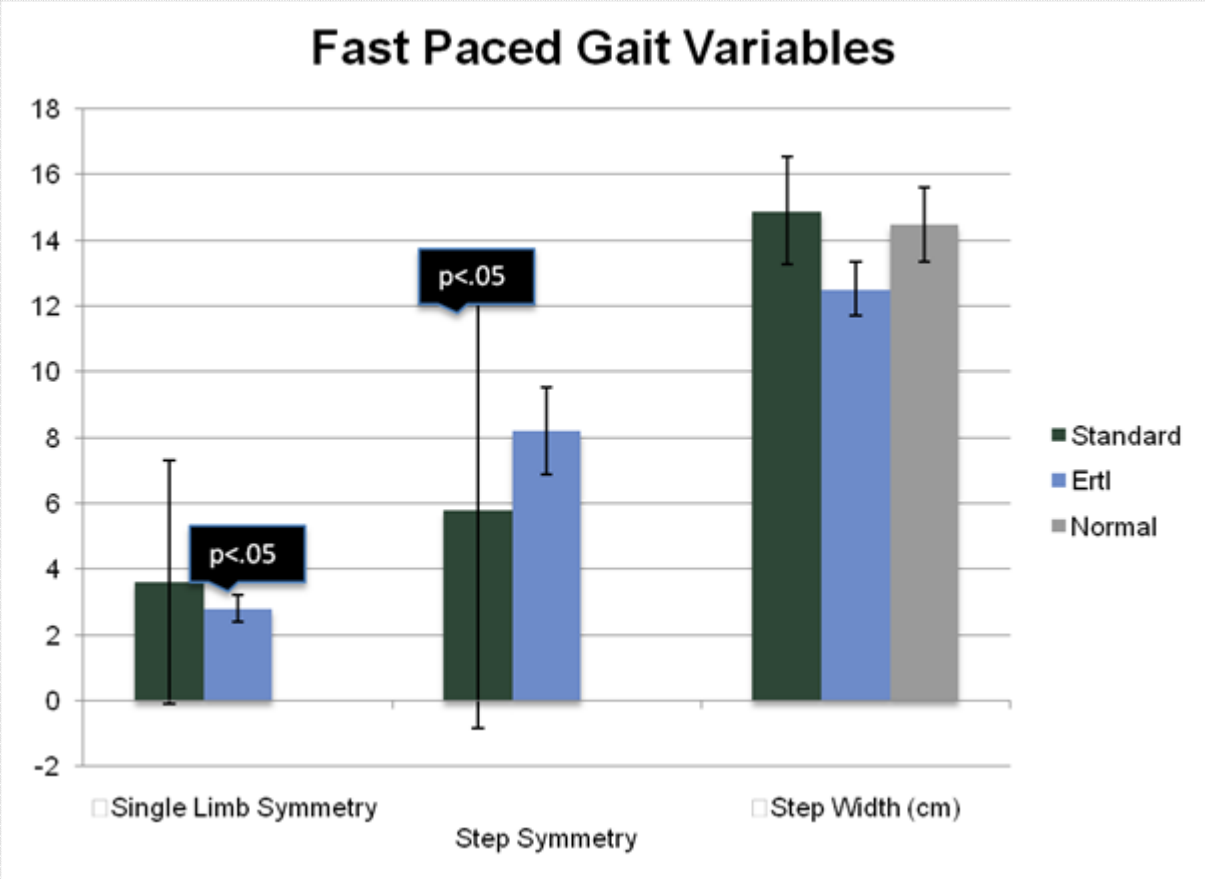
Results


Self Paced Gait Variables
16
14
12
10
8
6
4
2
0
-2
-4
p<.05
Standard
Ertl
Normal
Single Limb Symmetry
Step Symmetry
Step Width (cm)

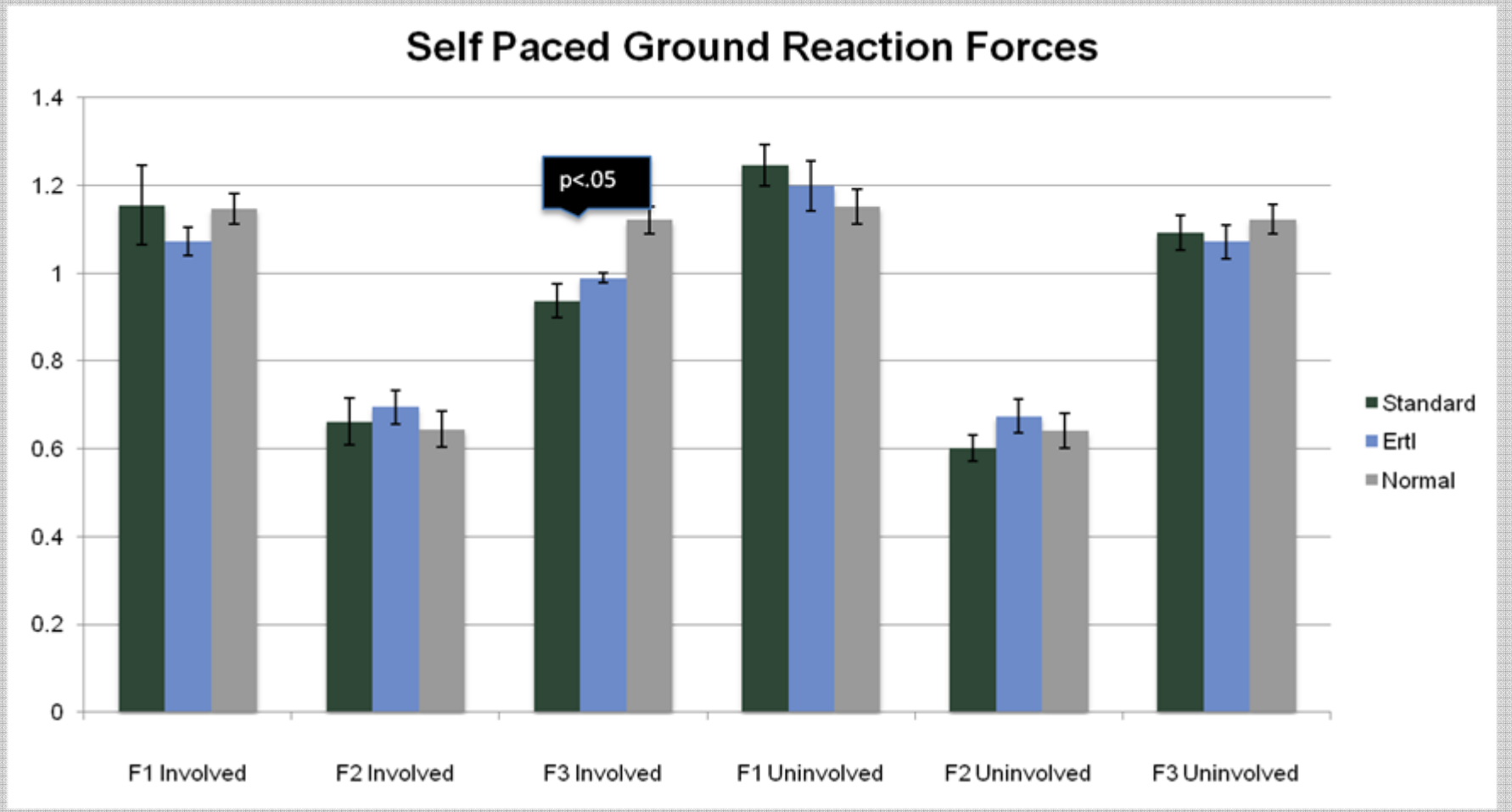
Results


Fast Paced Gait Variables
250
200
150
100
50
0
Velocity (cm/s)
Cadence (steps/min)
Stride length (cm)
Step Length (cm) Involved
Step Length (cm) Uninvolved
Single Limb Support Involved
Single Limb Support Uninvolved
Standard
Ertl
Normal

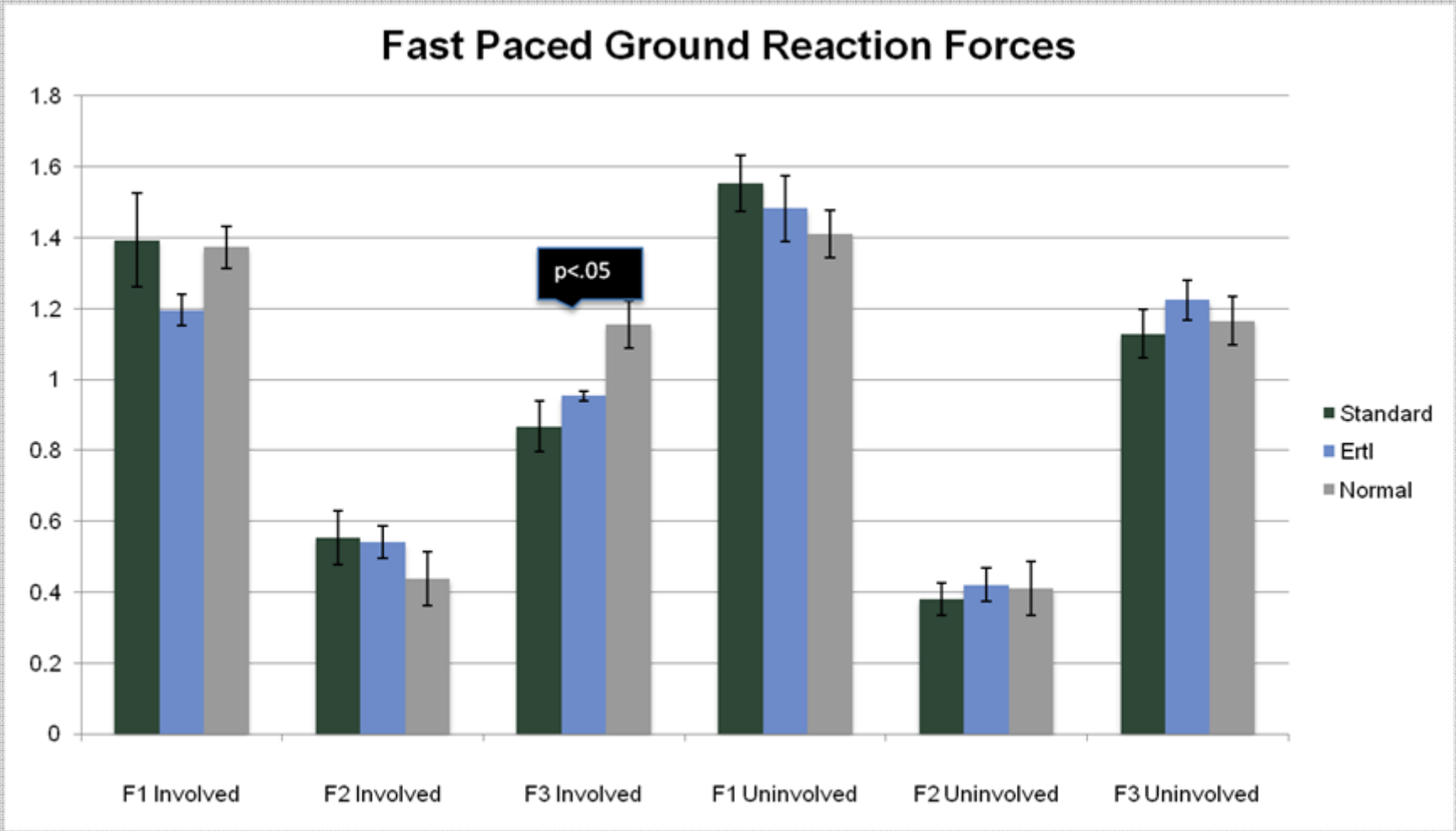
Results


Fast Paced Gait Variables
18
16
14
12
10
8
6
4
2
0
-2
p<.05
p<.05
Standard
Ertl
Normal
Single Limb Symmetry
Step Width (cm)
Step Symmetry

Results


Self Paced Ground Reaction Forces
1.4
1.2
1
0.8
0.6
0.4
0.2
0
p<.05
F1 Involved
F2 Involved
F3 Involved
F1 Uninvolved
F2 Uninvolved
F3 Uninvolved
Standard
Ertl
Normal

Results


Fast Paced Ground Reaction Forces
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
p<.05
F1 Involved
F2 Involved
F3 Involved
F1 Uninvolved
F2 Uninvolved
F3 Uninvolved
Standard
Ertl
Normal

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Conclusions

- Unique Study
- No significant ambulation differences found
- Continued study required

Limitations

- Underpowered
- No difference in prosthetic fitting between amputee groups

Thank You