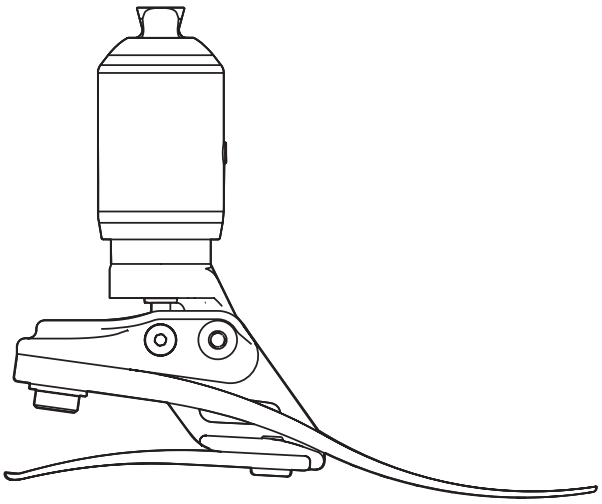


Clinical Studies Compendium

Hydraulic Ankle-Foot Edition 3 (2011-2020)

Blatchford

Foreword

This third edition compendium provides a summary of th
ankle-foot products up to 2020. As such, it acts as a
in order to help them make the most informed decision
previous compendium edition in 2014, the amount of new
This compendium includes 23 peer-reviewed journal publ
technology, as well as nine key conference abstracts.
concise overview of each research study. For a more de
to the original authored and published articles.

What's new?

- **Microprocessor-Controlled Hydraulic Ankles**

  Prosthetic microprocessor-control hydraulic ankle fun
  Later, in 2015, this technology was incorporated into
  Whether walking uphill, downhill or quickly along lev
  and alter the levels of plantarflexion and knee exten
  retaining all the proven patient benefts reported wit
  reduced interface pressure), new studies have shown f
  microprocessor-control.

- **Hydraulic Technology for Lower Mobility Amputees**

  There is growing evidence in the prosthetics feld tha
  advanced technology ankle designed for lower K2 boi fo
  scientifc journal articles in recent years, which rep
  patient group, compared to non-hydraulic alternatives

- **Further Evidence**

  In addition to these new areas of study, the supporti
  grow (see graph opposite). Notable new fndings compar
  energy efciency during walking, greater adaptability
  in peak pressure under the sound foot.

Evidence Summary - Established Benefits

Current studies highlight the potential patient benefit areas that are known to be problematic for amputees.

Loading Symmetry

More even weight bearing between healthy and prosthetic limbs

Lower risk of developing osteoarthritis or lower back pain

Energy Expenditure

Less tiring to use

Less demand on the healthy limb

Pressure

Less pressure on residual limb

Less pressure under the healthy foot

Protects against skin breakdown

Falls Risk

Toe clearance is increased when swinging through – less chance of tripping

Fewer trips means fewer falls

Better balance when standing on uneven ground or slopes

Gait Quality

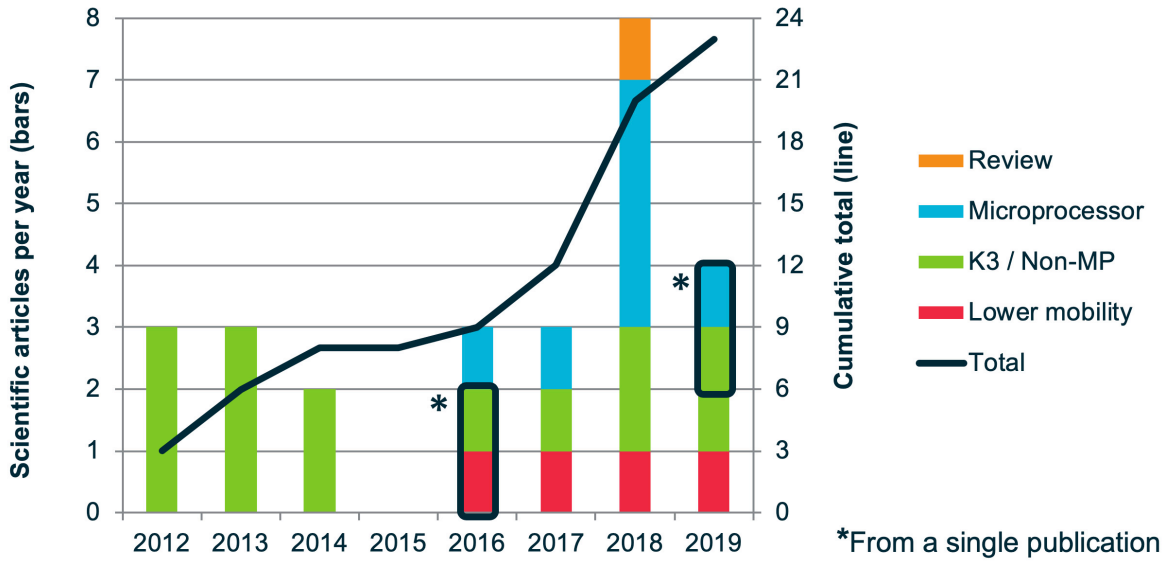
Faster walking speeds

Improved posture

More natural walking over sloped or uneven ground

User Satisfaction

Higher patient satisfaction scores for both low and high mobility amputees



*From a single publication

Studies Overview

		Device type		Activity level		Amputation level			Activity type					
		MPC hydraulic	Passive hydraulic	K3 - 4	K2	Transtibial	Transfemoral	Bilateral	Level ground	Uneven ground	Sloped ground	Stairs	Standing	Community living
Wurdeman	2019	•	•	•	•	•	•	•						•
McGrath	2019		•		•	•								•
Askew	2019		•	•		•			•		•			
Bai	2018	•	•	•			•				•			
Kannenberg	2018	•	•	•	•	•	•	•	•	•	•	•	•	•
McGrath	2018		•	•	•		•				•		•	
McGrath	2018	•	•	•		•					•			
Abdulhasan	2018	•		•			•				•			
Moore	2018		•	•		•	•		•					
Barnett	2018		•		•	•			•					
Alexander	2018	•		•			•		•		•			
Bai	2017		•	•			•		•	•				
Dotan-Mor	2017	•	•	•		•			•		•			
De Asha	2017	•		•		•			•					
Moore	2017		•		•	•	•	•						•
Struchkov	2016	•	•	•		•					•			
Moore	2016		•	•	•	•	•	•	•					
De Asha	2014		•	•		•			•					
Johnson	2014		•	•		•			•					
De Asha	2014		•	•		•	•		•					
Alexander	2014	•	•	•			•		•		•			
De Asha	2013		•	•		•			•					
Sedki	2013		•	•		•	•	•						•
De Asha	2013		•	•		•			•					
Krista	2012		•	•		•			•			•		
Erler	2012		•	•	•	•			•				•	
Portnoy	2012		•	•		•			•	•	•	•		
De Asha	2012		•	•		•			•					
Siev-Ner	2011		•	•		•			•	•	•	•		
Krista	2011		•	•		•					•		•	
De Asha	2011		•	•		•	•		•					
Brown	2011		•	•		•			•					

Study Findings and Clinical Interpretation

Findings		Improved gait quality	Improved inter-limb symmetry	Reduced pressure/ loading rate	Improved balance/ stability/ clearance	Improved [illegible] mechanics	Improved user satisfaction
[illegible]		Increase mobility	Reduced risk of back pain, OA	Reduced risk of pressure ulcers	Reduced risk of falls	Less tiring to use	Better quality-of-life
Quick reference							
Wurdeman	2019	•					
McGrath	2019	•	•	•	•	•	
Askew	2019	•				•	
Bai	2018	•	•		•		
Kannen-berg	2018	•	•	•	•	•	•
McGrath	2018		•		•		
McGrath	2018	•	•				
Abdulhasan	2018	•	•				
Moore	2018			•			
Barnett	2018	•	•				•
Alexander	2018					•	
Bai	2017	•	•				•
Dotan-Moram	2017		•				•
De Asha	2017	•				•	
Moore	2017	•					•
Struchkov	2016	•			•		
Moore	2016	•	•				
De Asha	2014	•				•	
Johnson	2014	•			•		
De Asha	2014	•					
Alexander	2014					•	
De Asha	2013	•	•			•	
Sedki	2012						•
De Asha	2012	•					
Kristal	2012	•		•			
Erler	2012	•	•		•	•	•
Portnoy	2012			•			•
De Asha	2012	•					
Siev-Ner	2011			•			
Kristal	2011		•		•		
De Asha	2011	•	•				
Brown	2011	•					

Full List of Studies

Full references found at the end of the compendium.

Mobility analysis of AmpuTees (MAAT 5): Impact of fve commo8n pr
with diabetic/dysvascular amputation

Anforderungen an eine geeignete Prosthesentechnologie für ä9lter
prosthesis technology for elderly, dysvascular amputees

Energy cost of ambulation in trans-tibial amputees using a 10dyna
insights from body centre-of-mass dynamics

A biomechanical assessment of ahnydd rwaiutlhiocu tammkilcer-ofporootc edsesvoirc ecso1nUirtohl
ambulation in trans-femoral amputees

Evidence on prosthetic feet with active dorsifexion feature12 pa
generation: a mini literature review

Microprocessor knees with “standing support” and articulat13g,
loading during quiet standing

The infuence of a microprocessor-controlled hydraulic ankle14on
walking: A case series

Gait termination on a declined lsmuprafcatceo finustimagnsn-ifcermoporraolceasms15r-ce
Efect of a prosthetic foot with a hydraulic ankle unit on 16e c
unilateral amputation

Individuals with unilateral tirtaynsl-etvieblisalwaalmkpumtcartei oqnuiacmkdlylowTeern au
articulating versus rigidly-attached prosthetic ankle-foot devi

Joint moments during downhill and uphill walking of a pers18n wi
and a rigid prosthetic ankle - a case study

Kinematic and biomimetic assessment of a hydraulic ankle-f19t i

Gait characteristics in trans-wtiithohiault aampnuiteeresprsaomdbeuslsatri-ngogonw2l0chl la

Which Prosthetic Foot to Prescribe?: Biomechanical Diferen21es F
Types Hold True 1 Year Later

Patient Evaluation of a Novel Prosthetic Foot with Hydraul22 An

Biomechanics of ramp descent inCoumpialraitseoma loftraamnsi-ctriolpiraolceasms23r-ce
conventional ankle–foot mechanisms

Efect on stance phase timing atsaytmimoent ruys iinng ihnyddirvaiudluiacl sa nwkilteh2uAnmiptus

Mechanical and physiological energetics when using an Eche25n h

Toe clearance when walking in people with unilateral trans26tibi

Impact on the biomechanics of over ground gait of using an27Ech
and trans-femoral amputees

Joint loading during graded walking with diferent prosthes28 –

Walking speed related joint kinetic alterations in trans-t29ial

Patient evaluation of the Echelon foot using the Seattle P30sth

Attenuation of centre-of-pressure trajectory fuctuations u31der
attachment compared to fxed attachment

Kinematics, kinetics and internal mechanical stresses of t32ans-

Einfuss der Eigenschaften eines Prothesenfusses auf das Ga33bil
characteristics of a prosthetic foot on the gait of trans-tibia

Outdoor dynamic subject-specifc evaluation of internal str34sses
compared to conventional energy-stored prosthetic feet

Prosthetic-limb ankle kinetics, energy storage and return w35en

Outdoor biomechanical evaluation of a hydraulic prosthetic36foot

Evaluation of a Hydraulic Prosthetic Foot While Standing o37Slo

Efects of a hydraulic ankle onergaalitlofwuenrctliiommb aanmdpustyemmsetry 38un

Roll-over characteristics and ankle joint kinetics using l39w-pr
in trans-tibial amputees

Mobility analysis of AmpuTees (MAAT 5): I
ankle-foot categories for individuals with diabetic/dysvascular amputation

Authors: S. R. Wu[1,2], de Pm M[1], Ste J. e H[3], ns C[1] a m p b e l l

[1] D e p a r t m e n t o f C l i n i c a l a n d S c i e n c e s, t i T X c, A U S A i r s, H a n g e

[2] S c h o o l o f A l l i e d H e a l t h S c i e n c e s, o B a y T X o, r U C S o A l l e g e o

[3] S c h o o l o f M e d i c i n e, U n i v e r s i t y o f U t a h, S a l t L a k e

Published in: J o u r n a l o f R e h a b i l i t a t i o n a n d A s s i s t i v e T e c h n o l o

Summary

T h e f u n c t i o n a l m o b i l i t y s c o r e s o f 7 3 8 d y s v a s c u l a r p a t i
r e t r o s p e c t i v e l y a n a l y s e d a n d c o m p a r e d.

Method

Components: M P F: m i c r o p r o c e s s o r a n k l e - f o o t, H A 5 9 6 8 – h y d r a u
s y s t e m w i t h v e r t i c a l l o a d i n g p y F F 5 9 8 0, F W S 5 9 8 1 f o e t f s y s t a m k

Measurements: T - s c o r e f r o m f u n c t i o n a l m o b i l i t y a s s e s s m e n t (P L

S u b j e 7 3 8 s: (f e m a l e s i n b r a c k e t s) a m p u t e e n s t s, K 3, d i a b e t i c /

MPF: 2 8 (4) i n d i v i d u a l s, (1 4 u e n r i a l l a t t e r r a a n l s - t f r e a m m o s r - a t l i b (i T a F l), (T 7 T
9 8 . 7 ± 1 6 . 8 k g

VL5987: 1 5 5 (1 1) i n d i v i d u a l s (1 2 1 T T, 1 6 T F, 1 8 B), 5 7 . 7 ± 1

FWS5981: 3 4 2 (8 6) i n d i v i d u a l s (2 4 1 T T, 6 7 T F, 3 4 B), 5 8 . 8 ±

FF5980: 1 2 3 (3 4) i n d i v i d u a l s (8 0 T T, 3 1 T F, 1 2 B), 5 8 . 6 ± 1 1

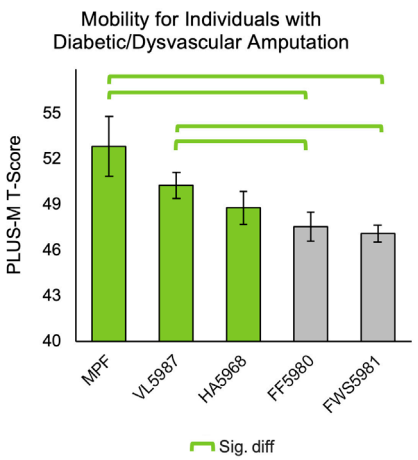
HA5968: 9 0 (1 5) i n d i v i d u a l s (6 6 T T, 7 T F, 1 7 B), 6 1 . 1 ± 1 0 . 2

Data collection protocol: P a t i e n t s w e r e a s k e d t o c o m p l e t e t h e P L U S - M
o f c a r e a p p o i n t m e n t. T h e s e w e r e t h e n c o l l e c t e d a n d s o r
i n c l u d e d q u e s t i o n n a i r e s w e r e s u m m e d a n d c o n v e r t e d t o a

Analysis: P a t i e n t s w e r e d i v i d e d i n t o g r o u p s d e p e n d e n t o n w h a
l i n e a r u n i v a r i a t e m o d e l w a s u s e d t o c o m p a r e g r o u p s a n d
d i f e r e n c e s.

Results

A s i g n i f c a n t d i f e r e n c e i n m o b i l i t y w a l
I n d i v i d u a l s u s i n g M P F h a d t h e g r e a t e t h o
s i g n i f c a n t l y m o r e t h a n t h e v e r t i c a l V L 5
h a d t h e s e c o n d h i g h e s t m o b i l i t y s c o r s i
b e t w e e n t h e V L 5 9 8 7 c o n d i t i o n a n d t h e r a n
(H A 5 9 6 8) c o n d i t i o n, h o w e v e r t h F W S 5 9 8 1 l k
c o n d i t i o n s b o t h h a d s i g n i f c a n t l y l o w o b i
t w o c o n d i t i o n s.



Conclusion

T h e a u t h o r s s u g g e s t t h a t, b a s e d o n f i t y
a p p r o a c h s h o u l d b e u t i l i s e d w i t h i n a n g
v a s c u l a r p a t i e n t s. S h a n k - f o e m s w i t h s u c h p y
E l i t e 2, r e s u l t e d i n a m o b i l i t y s c o r e n o t d i s s i m i l a r t o
c o n t r o l l e d f o o t, s o s h o u l d b e c o n s i d e r e d, a l o n g w i t h h
m i c r o p r o c e s s o r o p t i o n h a s b e e n r u l e d o u t a n d a h e a d o f

Products with Related Technology:

Elan, Echelon, EchelonVT, EchelonVAC, Elite2, EliteVT, Elite Blade, Elite BladeVT

Anforderungen an eine geeignete Prosthesentechnologie für ältere, dysvaskuläre Amputierte - Requirements of a suitable prosthesis technology for elderly, dysvascular amputees

Authors: M. McGrath[1], M. Moser[2], T. Baier

[1]Blatchford Limited, Basingstoke UK

[2]Blatchford Deutschland, Kulmbach Germany

Published in: Orthopädie Technik 2019; 11: 42-46

Summary

An informative review was produced highlighting the mo
Evidence of the benefts gained from existing technolog
perforated liners) was collated and presented as a pot

Method

Components: Hydraulic foot technology (namely Avalon)

Measurements: Review paper

Subjects:

Data collection protocol: N/A

Analysis: A review of existing literature and technology in

Results

Although there were many contributing factors, falling
highlighted as the predominant risk factors within the
was presented as an independent factor that would have
helping reduce the number of trips and falls by confor
toe clearance during swing phase. The Avalon has been
sit-to-stand by 33% and was seen to increase both ambu
suspension was found to reduce movement at the residuu
proprioception. The negative pressure produced by the
can promote wound healing, especially when combined wi
temperature regulation.

Conclusion

Although falling and soft tissue damage pose challenge
risk factors and, when using a combination of proven t
also has benefcial implications long-term.

Products with Related Technology:

Avalon, Elan, Echelon, EchelonVAC

Energy cost of ambulation in trans-tibial amputees using a dynamic-response foot with hydraulic versus rigid 'ankle': insights from body centre-of-mass dynamics

Authors: G. Askew A.[1], McA Ar E[2], a nM i n e G t.[3] t B u c k l e y

[1] S c h o o l o f B i o m e d i c a l S c i e n c e s U, n i F v a e c r u s l i t t y o f f B L i e e c l d o s g, i d U

[2] D e p a r t m e n t o f P a t h o p h y s i o l o g y a n d T r a n s p l a n t a t i o n ,

[3] D i v i s i o n o f B i o m e d i c a l E n g i n e e r i n g , S c h o o l o f E n g i n e e r i n g , U n i v e r s i t y o f B o a d f o r d , U K

Published in: J o u r n a l o f N e u r o e n g i n e e r i n g a n d R e h a b i l i t a t i o n 2

Summary

T r a n s - t i b i a l a m p u t e e s , w a l k i n g a t v a r i o u s s p e e d s a n d o
w h e n u s i n g a h y d r a u l i c a n k l e u n i t t h a n w h e n t h e y w e r e

Method

Components: H y d r a u l i c a n k l e - f e e t (H y A n k – E c h e l o n) a n d e n e r g

Measurements: O_2 uptake and CO_2 p r o d u c t i o n , m o t i o n c a p t u r e d u r i n g t r e

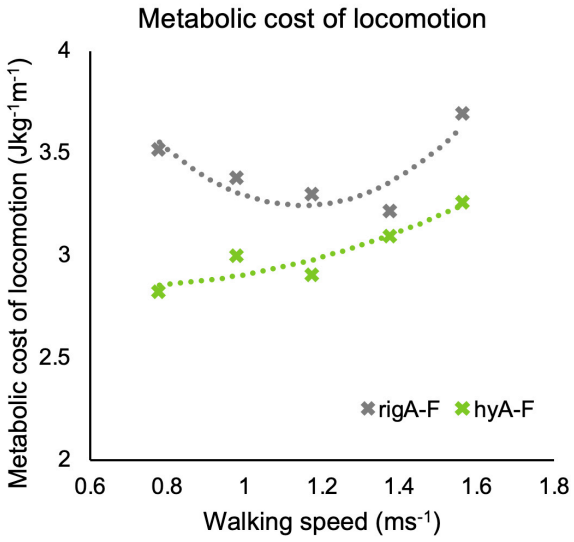
Subjects: u n i l a t e r a l t r a n s - t i b i a l a m p u t e e s (a l l s , m a l e s , h e i g h t 1 . 7 9 ± 0 . 0 7 m)

Data collection protocol: T h e p a r t i c i p a n t s w a l k e d o n a l e v e l t r e a d m i l
w a l k i n g s p e e d) a n d o n a t t w o a d d i t i o n a l g r a d i e n t s (+ 5 ° a n d
r e p e a t e d t h e p r o t o c o l w i t h a n E S R a n d a H y A n k .

Analysis: 3 D m o t i o n c a p t u r e m e a s u r e d b o d y s e g m e n t k i n e m a t i c s
d y n a m i c s (B C O M) , i n t e r - l i m b s y m m e t r y a n d $_2$ e u n p e t r a g k y e r w e a c s o v a e l
u s e d t o q u a n t i f y m e t a b o l i c c o s t . R a n d o m i n t e r c e p t s m o d
a p p l i e d .

Results

T h e m e t a b o l i c c o s t o f l o c o m o t i c d u
(p < 0 . 0 0 1) b y H y A n k c o m p a r e d t o d
a c r o s s a l l l e v e l w a l k i n g s p e e d s o f
l o c o m o t i o n r e d u c e d w a s b y 1 1 . 8 ± a g
a c r o s s a l l g r a d i e n t s a t t h e c u s a b
c o s t o f l o c o m o t i o n r e d u c e d w a s n k
A t m e t a b o l i c c o n s t a n t s o f 1 . 7 4 m l $^{-1}$ k g $^{-1}$ m i n $^{-1}$ (1 1 . 8 m l $^{-1}$ k g $^{-1}$ m $^{-1}$) w e
t h e m e a n c u s t o m a r y w a l k i n g s p e e d s o f
1 . 0 9 a n d 1 . 3 3 m s $^{-1}$, r e s p e c t i v e l y . W i t h H y
i n c r e a s e d b y 6 - 7 % , t o 1 . 1 8 a n d 1 . 4 2 m s $^{-1}$, r e s p e c t i v e l y . H y A n k
u s e a l s o s i g n i f c a n t l y r e d u c e d t h e p e a k n e g a t i v e w o r k p e r f o r m e d
o n a g r a d i e n t a n d i n c r e a s e d t h e p e a k p o s i t i v e w o r k . T h e
m e c h a n i c a l e n e r g i e s o f t h e B C O M w e r e a l s o r e d u c e d b y H y A n k ,
t o a s i g n i f c a n t i n c r e a s e i n l o c o m o t i o n r e l a t i v e t o E S R (p = 0 . 0 1) .
F i n a l l y , i t a l s o i n c r e a s e d i n t e r - l i m b s y m m e t r y i n t h e s a g i t t a l p l a n e
c o m p e n s a t i o n s .



Conclusion

T h e a u t h o r s c o n c l u d e t h a t t h e a n k l e f e a t u r e s h o w g e s t p r o v i d e m
u s e r ' s e v e r y d a y w a l k i n g b y i m p r o v i n g e n e r g y e f c i e n c y .
w h o c a n w a l k a t d i f e r e n t s p e e d s a n d o v e r d i f e r e n t g r a d

Products with Related Technology:

Linx, Elan, Echelon, EchelonVT, EchelonVAC, Avalon

A biomechanical assessment of hydraulic ankle-foot devices with and without microprocessor control during slope ambulation in trans-femoral amputees

Authors: X. [1], B. D. [1], E. [2], A. S. C., W. X.

[1] Department of Mechanical Engineering, G. S. [illegible], UK

[2] Gait Laboratory, Queen Mary's Hospital, Roehampton

Published in: PLoS ONE 2018; 13(10): e0205093.

Summary

The biomechanical efects of hydraulic ankle and rigidly-attached mechanical hydraulic ankle were measured during slope ascent and showed improved bio-mimicry in both walking conditions

Method

Components: Esprit, Echelon, Elan

Measurements: 3D gait analysis on a 5° slope

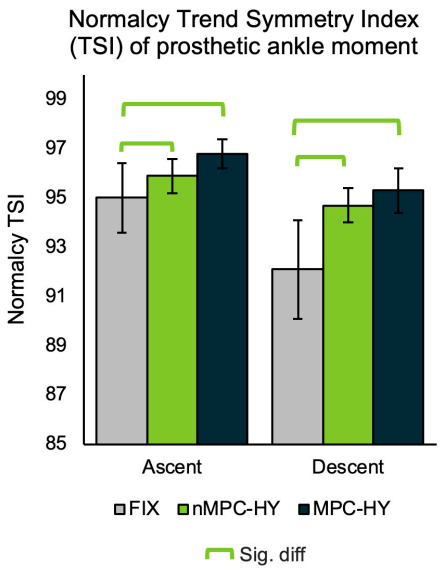
Subjects: active unilateral, trans-femoral amputees (42±17 years, 107±16 kg, 14 non-amputee subjects (5 male, 9 female, 26±2 years,

Data collection protocol: Each of the amputees used a fixed ankle, a microprocessor-controlled hydraulic ankle with their h and kinetic data as the subject walked up and down a slope. The amputees were also asked to complete a feedback qu

Analysis: Trend Symmetry Indices (TSI) were calculated for s 'normalcy' (compared to control subjects). Shapiro-Wil measures one-way ANOVA tests were performed for walkin were conducted with post-hoc Tukey tests.

Results

The mean walking speeds were not signifcantly diferent conditions. The hydraulic ankles pr compared to the rigidly-attached fo the prosthetic ankle moment, indica the hydraulic ankles increased mid- extensor moment during downhill wal hydraulic ankle, the microprocessor parameters, signifcantly increasing extensor moment during downhill walk the hydraulic ankle ofered improvem highlighting the improved safety of



Conclusion

The authors conclude that the sm, compared to rigidly-attached feet, are slope increased safety during slope desce normalcy TSI values indicate better in prosthetic knee extensor moment improved knee stability, allowing a safer descent. The hydraulic ankle further improved knee stability in slo

Products with Related Technology:

Linx, Elan, Echelon, EchelonVT, EchelonVAC, Avalon

Evidence on prosthetic feet with active c microprocessor control and active ankle power generation: a mini literature review

Authors: A. Kan[1]nenberg

[1]Department of Medical Afairs, Otto Bock HealthCare

Published in: Canadian Prosthetics and Orthotics Journal 2018;

Summary

A literature review was undertaken of the published sc dorsifexion features (including hydraulic ankles), mic advance in technology was reported to produce extra pa

Method

Components: Prosthetic feet with active dorsifexion (hydrau

Measurements: Review paper

Subjects:

Data collection protocol: N/A

Analysis: A review of previous scientifc literature.

Results

Non-microprocessor feet with the active dorsifexion fe during walking, compared to feet without this feature, force during level walking was thought to contribute t type of prosthetic foot. Microprocessor feet that reta reduced likelihood of tripping. They may also reduce e and stair negotiation. Both non-microprocessor and mic reduce pressures at the interface between residual lim and further improve energy efciency.

Conclusion

The author concludes that prosthetic feet with damped be well suited to amputees with reduced toe clearance, those who experience increased residual limb stress wh

Products with Related Technology:

Linx, Elan, Echelon, EchelonVT, EchelonVAC, Avalon

Microprocessor knees with "standing support" and articulating, hydraulic ankles improve balance control and inter-limb loading during quiet standing

Authors: M. McGrath[1], L. Laszczak[1], D. Moser[1]

[1]Endolite Technology Centre, Basingstoke UK

Published in: Journal of Rehabilitation and Assistive Technolo 5: 2055668318795396. Smart Limb Technology Special Issu

Summary

The biomechanical diferences were measured when trans- hydraulic ankles, while stanMdPiKn-gendnmanacesdlosptea.ndTimeg amcotdiev on and of. Both advanced technologies brought about im combination of hydraulic ankle iamnedd MtPdK psrtoavniddiengt hmeo dbee swi

Method

Components: Echelon VT, Esprit, Orion3 microprocessor knee

Measurements: Kinematics and kinetics during static standing

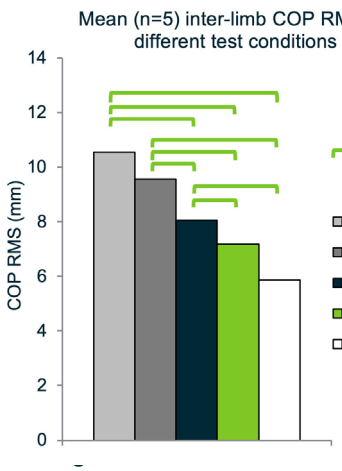
Subjects: trans-femoral amputees (47 male, 2 female; 62.2±20.1kg) matched; 41 controls (27.4±2.9 years; 66.8±10.3kg)

Data collection protocol: Each amputee was asked to stand for trials of 14 seconds at a time, while their joint angles, ground monitored. This was repeated multiple times. The proto hydraulic ankle-foot unit, initially treated as comfortable as they were condition.

Analysis: Degree of asymmetry (DOA) was used to compare int square (COP RMS) was used as a measure of balance. Pai used to identify signifcant diferences.

Results

In terms of kinematics, the diferenc noticeable. The rigidly attached foo on the prosthetic side in order to a ankle complied with the slope, allow MPK standing mode of, the efect of wa pronounced. Four of the five amputees the prosthetic side (7-24%, p<0.001) all five showed increased prosthetic s sound side, normal GRF reduced for t reduced for four (14-53%, p<0.001) wh all amputees, DOA of normal GRF was indicating a more even inter-limb loa reduced for three amputees when using rigidly-attached foot, with MPK in stance reduced for all five with standing mode on, implying inc user. The cohort mean inter-limb COP RMS was calculated of hydraulic ankle on balance was greater (24-25%) than technologies produced the result closest to that of the



wo ase ', ht GRF ase hyd %, .00 the ing CO kle d w

Conclusion

Less kinematic compensation was required to achieve fo ankle, due to its ability atdoi esnetl ft-haalni gtnh ea nrdi gaidda patn kbleet.t the sound limb joints and improves balance.

Products with Related Technology:

Linx, Elan, Echelon, EchelonVT, EchelonVAC, Avalon

The influence of a microprocessor control
symmetry of trans-tibial amputees during ramp walking: A case series

Authors: M. McGrath[1], Las Zach[1], Ded Moser[1]

[1]Endolite Technology Centre, Basingstoke UK

Published in: Journal of Rehabilitation and Assistive Technolo
5:2055668318790650. Smart Limb Technology Special Issu

Summary

The microprocessor-control of an Elan hydraulic ankle
a 5° slope. Gait analysis was performed to identify di
on and of conditions.

Method

Components: Elan

Measurements: 3D gait analysis

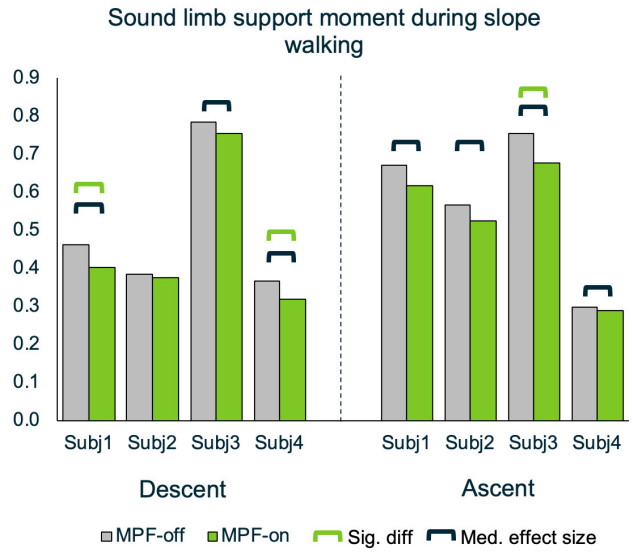
Subject cohort: trans-tibial amputees, 1K34 (2 old) male; 36.8±10

Data collection protocol: 3D gait analysis was performed adf down a 5 on
and for two prosthetic foot settings (MPF-on and MPF-o
participants were given a 30 minute acclimatisation pe

Analysis: The main outcome measure was the integral sup of. The gr
of asymmetry (DOA) was used to compare inter-limb symm
normality, before either paired t-tests or non-paramet
foot conditions. The efect size was also evaluated usi
size).

Results

During slope descent, the lar
integral were at the prosthet
The transition from dorsifexi
occurred at approximately 10–
MPF-on, compared to approxima
with the MPF-of, implying les
and more resistance to dorsif
the four showed significant ir
(all four d ≥0.4), and two sh
in sound MI_{sup} (three of four d ≥0.4
closer to 0 (i.e. improved sy
showed greater reliance on th
sound side. During slope asce
increases in prosthetic MI_{sup}. All four showe
sound MI_{sup} (d ≥0.4).



Conclusion

The authors equate the moment-time integrals at the
prosthetic 'ankle' to the MPF altering the hydraulic r
the 'assistance' efect during ascent. This had the efe
slope descent and ascent.

Products with Related Technology:

Linx, Elan

Gait termination on a declined surface in trans-femoral amputees: Impact of using microprocessor-controlled limb system

Authors: Z. M. Abd Al.haJ.S.an Scal.y Buckley

[1]Division of Biomedical Engineering, School of Engi

[2]School of Health Studies, University of Bradford,

Published in: Clinical Biomechanics 2018; 57: 35-41

Summary

Eight trans-femoral amputees performed gait termination trials in level walking and downhill. Two prosthetic conditions were tested; microprocessor active (MCon) and inactive (MCoff) of the prosthetic limb with the microprocessor active (MCon) and inactive (MCoff), where hydraulic resistances provided reliance on the healthy limb.

Method

Components: Linx (microprocessor-control active and inactive

Measurements: 3D gait analysis

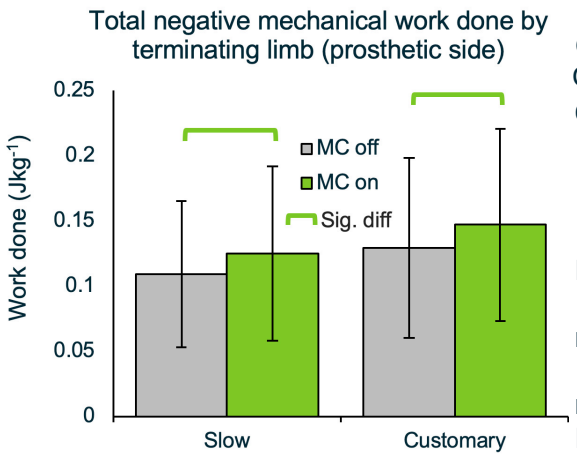
Subjects: Eight unilateral trans-femoral amputees (7 ± 13.1 (age); 1

Data collection protocol: Participants wore an integrated limb (Linx and microprocessor hydraulic ankle-foot, which communi They completed repeated gait analysis trials walking a walking speeds. They were asked to perform gait termin performed with Linx's microprocessor-control active (M inactive (MCoff), where hydraulic resistances provided user.

Analysis: Data were analysed using a random-efects regressio Factors and interaction between these factors tested w (2) Microprocessor condition: two levels, inactive (MC

Results

The time taken to stop was sign t condition (p=0.021). Negative m on prosthetic limb was signifcantl Co (p=0.004), by an average of 14% d walking speeds, respectively.



Conclusion

The authors conclude that the i k a greater involvement of the pr fn suggest that using an integrate ng stopping on ramps. They hypothe a should provide clinically meani ns amputees in their everyday life ha walking surfaces and giving ther.. . n prosthesis.

Products with Related Technology:

Linx, Elan

Efect of a prosthetic foot with a hydraul
peak plantar pressures in individuals with unilateral amputation

Authors: R. Moore
[1]Luton and Dunstable Hospital Trust, Luton, Bedfords

Published in: Journal of Prosthetics and Orthotics (JPO) 2018;

Summary

Plantar pressure under the sound foot was measured for and without hydraulic ankle units. There was a signifc ankle.

Method

Components: Echelon, previous non-hydraulic ankle-foot

Measurements: Contralateral foot plantar pressure

Subjects: Thirteen unilateral K3 amputees, (12 males, 1 femal

Data collection protocol: Participants walked over an Amcube pressu back and forth along a 6m walkway, with their original minutes in order to record a sufcient number of steps. acclimatised to the device for a period of one week, th plantar pressure measurement test, this time using the

Analysis: Paired t-tests comparing peak pressures with and

Results

All 13 patients showed a decrease in contralateral foo the hydraulic ankle unit. The mean reduction was 48kPa femoral patients (165kPa and 129kPa reductions, respec

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	Mean
Pre-Echelon (kPa)	132	221	192	185	331	200	105	131	162	176	186	274	150	188
Echelon (kPa)	92	134	162	156	166	199	90	84	138	149	158	145	143	140
Diference	-40	-87	-30	-29	-165	-1	-15	-47	-24	-27	-28	-129	-7	**-48**

Conclusion

The authors conclude that maintaining the contralateral inclusion of a hydraulic ankle on the prosthetic side longevity of the sound limb. With respect to the two l state that because these reductions were observed at t reduced the necessity to hip-hike, due to its greater

Products with Related Technology:

Linx, Elan, Echelon, EchelonVT, EchelonVAC

Individuals with unilateral trans-tibial amputation and lower activity levels walk more quickly when using a hydraulically articulating versus rigidly-attached prosthetic ankle-foot device: A case series

Authors: C. B[1]a, r D[1]e, t B[1]r, M[1]w, B[2]i, M[2]e, B[3]r, A[3]w, D[3]e, A[4]s, S[4]a, t r[4]u, t z e n b e r g e r

[1]School of Science and Technology, Nottingham Trent

[2]HAS Motion Inc., 27 Sydenham Street, Kingston, ON,

[3]C-Motion, Inc., 20030 Century BUSA. Suite 104A, Ge

[4]Department of Sport Science and Kinesiology, Unive

Published in: Journal of Prosthetics and Orthotics (JPO) 2018;

Summary

Two minute walk tests and 3D gait analysis were perfor attached ankle-foot and an a The hydraulic device was sh speed and inter-limb loading symmetry.

Method

Components: Avalon, Navigator

Measurements: 3D gait analysis, two minute walk test (2MWT), scale, Houghton scale, Prosthetic Limb Users Survey of

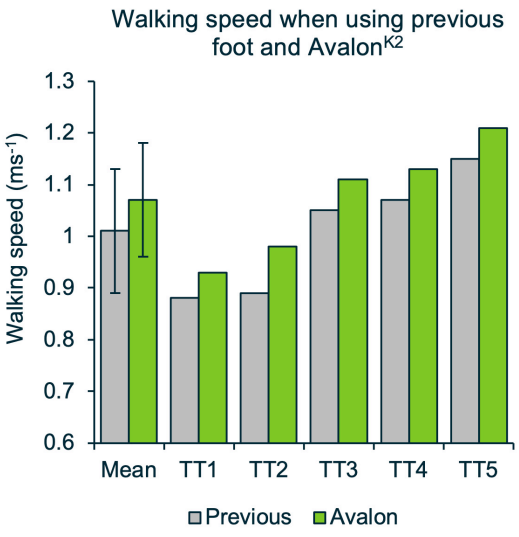
Subjects: K2 unilateral, trans-tibial amputees, 86.7 ± 12.1 k

Data collection protocol: 3D gait analysis recorded kinematic and ki ground gait trials. This protocol was repeated with a hydraulically articulating ankle-foot device (HYD).

Analysis: Case series analysis, diferences were quantifed us or a 'medium efect size', being defned as clinically m

Results

Walking speed was increased by 6 (Avalon) condition, compared to (d = 0.4). Participants displaye loading (d = 0.8), increased min velocity (d = 0.8) and increased (d = 1.0) when using the HYD com prosthetic energy efciency was d



Conclusion

The authors conclude that hydrau and walking ability in the K2 po walk faster and hence further du articulation of the ankle in ear stance braking efect, which part measured increase in walking spe

Products with Related Technology:

Avalon

Joint moments during downhill and uphill walking of a person with trans-femoral amputation with a hydraulic articulating and a rigid prosthetic ankle - a case study

Authors: N. Alexander[1], Struan Grant[2], Jennifer Hobbs[2], Heiko Schwameder[1]

[1]Department of Sport Science and Kinesiology, Universität Salzburg, Austria

[2]School of Science and Technology, Nottingham Trent University, UK

Published in: Journal of Prosthetics and Orthotics (JPO) 2018; 30(1): 2-10

Summary

This gait analysis study sought to investigate the effect of the microprocessor-controlled hydraulic ankle to a fixed ankle design when walking at a range of slopes from -12° to +12°.

Method

Components: Dynamic response style foot (Esprit, "RIGID") and microprocessor-controlled hydraulic ankle (Elan "ARTIC"). The subject used a microprocessor-controlled knee.

Measurements: 3D gait analysis with 12 cameras (Vicon) and force plates (Kistler) built into a hydraulically adjustable ramp walkway.

Subjects: A single unilateral trans-femoral amputee (male, 184cm, 84kg, 10 years since amputation, mixed etiology, previous). Able-bodied control group (n=18; all male; 180cm; 80kg).

Data collection protocol: Randomised crossover testing of each foot condition at self-selected speed on a ramp at five different gradients: -12°, -4°, 0°, +4°, +12°. Three trials were collected for each prosthetic condition. No data existed at 4° gradient for the able-bodied group. Statistical comparisons were limited to level-ground walking and gradient walking.

Analysis: Measurements were time-normalised over stance phase. Statistical parametric mapping was calculated for each outcome measure over the five test conditions.

Results

The changes in gradient effected the peak joint moments in the able-bodied group. The prosthetic ankle-foot condition had the greatest effect on the amputee participant. Compared to the RIGID condition, the "ARTIC" reduced the mean hip extension moment by 0.15 Nm/kg (-12°) to 0.25 Nm/kg (+12°) depending upon slope gradient. Peak knee extension moment was reduced by 0.12 Nm/kg (-12°) to 0.19 Nm/kg (+12°). The RIGID foot provided a greater plantarflexion moment in the able-bodied group on a downhill slope when compared to the ARTIC and an increased dorsiflexion moment during uphill walking when compared to the RIGID condition.

Conclusion

The Authors conclude that the effect of the microprocessor-controlled ankle was beneficial to downhill walking for the amputee participant. The reduction in hip and knee extension moments may have resulted in more efficient gait and decreased energy consumption as compared to the RIGID foot.

Products with Related Technology:

Linx, Elan

Kinematic and biomimetic assessment of a hydraulic ankle-foot in level ground and camber walking

Authors: X. [1], B a D i. [1] E, [2] w i An. s D. C, r o W t. [1] o m X o u e

[1] D e p a r t m e n t o f M e c h a n i c a l E n g i n r e e r y i, n G u S i d e f o r o r d s, U K n i

[2] G a i t L a b o r a t o r y, Q u e e n M a r y ' s H o s p i t a l, R o e h a m p t o n

Published in: P L o S O N E 2 0 1 7 ; 1 2 (7) : e 0 1 8 0 8 3 6

Summary

T h e b i o m e c h a n i c a l e f e c t s o f a h y d r a u l i c a n k l e , c o m p a r e
w a l k i n g a t n o r m a l a n d f a s t s p e e d a n d d u r i n g c a m b e r e d w
s y m m e t r y a n d p r o d u c e d j o i n t m o m e n t s c l o s e r t o t h o s e o f

Method

Components: E c h e l o n , E s p r i t

Measurements: 3 D g a i t a n a l y s i s o n a l e v e l w a l k w a y a n d a 2 . 5 °

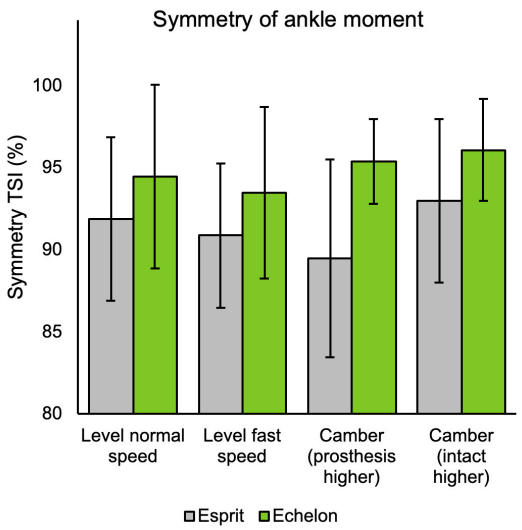
S u b j e c F t i s v : e a c t i v e u n i l a t e r a l , t r a s n , s - 1 f 0 e 7 m . o 4 r ± a 1 l 2 . a 1 m k p g u) t e a e n s d (1 4
s u b j e c t s (5 m a l e , 7 f e m a l e ; 2 6 ± 2 y e a r s ; 6 8 ± 1 5 k g)

Data collection protocol: E a c h o f t h e a m p u t e e s u s e d a f a x n e k d l e a n w k i l t e h o t r h e
h a b i t u a l p r o s t h e t i c k n e e . 3 D g a i t a n a l y s i s r e c o r d e d k i
a n d f a s t s p e e d s o n a l e v e l s a u c r e f a w c i e t . h T a h e 2 y . 5 a ° l s o c a m w b a e l r k . e d T r o i
t h e p r o s t h e t i c f o o t h i g h e r u p t h e s l o p e a n d w i t h t h e s
p e r f o r m e d t h e s e t e s t s . T h e a m p u t e e s w e r e a l s o a s k e d t o

Analysis: T r e n d S y m m e t r y I n d i c e s (T S I) w e r e c a l c u l a t e d f o r s
' n o r m a l c y ' (c o m p a r e d t o c o n t r o l s u b j e c t s) . R e p e a t e d m e
c o n d i t i o n a n d f o r p r o s t h e t i c f o o t . P o s t - h o c a n a l y s e s w

Results

T h e a m p u t e e s w a l k e d w i t h s i g n i f c a w
t h e E c h e l o n (p = 0 . 0 2 6) a n d a t i f s a s t a l
p a r a m e t e r w a s n o t s t a t i s t i c a l l y s n t
w e r e f o u n d b e t w e e n t h e p r o s t h e t i c h e
a n d f x e d d e v i c e s , i n b o t h s y m m e t r (p
i n t w o T S I p a r a m e t e r s) , w h e r e t h e d
T S I v a l u e s t h a n t h e E s p r i t a f l o o n t g a l
c o n d i t i o n s . T h e q u e s t i o n n a i r e f e e t
a n k l e f e l t m o r e s t a b l e , m a d e s w i r v i
b a l a n c e d f e e l i n g , w a s l e s s l i m i t i p r
o v e r a l l s a f e r f e e l i n g . T h i s i o w a s s . t k i



Conclusion

T h e a u t h o r s c o n c l u d e t h a t t h e i m p s y
a n d b i o - f d e l i t y i n d i c a t e a m a j o r u l
u s e r s . T h e s e a d v a n t a g e s c a n b e m e a s u r e d c o n s i s t e n t l y ,
d i f e r e n t w a l k i n g s p e e d s a n d n o n - l e v e l g r o u n d , w h i c h r e
t o r e a l w o r l d s c e n a r i o s . T h e i n c r e a s e d s t r i d e l e n g t h a
p e r f o r m a n c e w h i l e t h e q u e s t i o n n a i r e s h o w s a u s e r p r e f e

Products with Related Technology:

Linx, Elan, Echelon, EchelonVT, EchelonVAC, Avalon

Gait characteristics in trans-tibial amputees ambulating with and without a microprocessor-controlled hydraulic prosthetic ankle

Authors: Y. Dotan[1,2], M. Sorani[3], A. Kristal[4], I. Aron[1], S. Gev-Ner[2]

[1]Department of Orthopedic Rehabilitation, Sheba Med
[2]Centre of Advanced Technologies in Rehabilitation,
[3]Department of Occupational Therapy, Faculty of Med
[4]Department of Physical Medicine and Rehabilitation, Ben Gurion University of the Negev, Beer Sheva, Israel

Presented at: International Society for Prosthetics and Orth
Cape Town, South Africa

Summary

The difference between microprocessor-controlled and no
devices were assessed using an instrumented treadmill.
used as outcome measures.

Method

Components: Elan, Echelon

Measurements: Plantar pressure, centre-of-pressure (COP) tra
– a patient reported outcome measure instrument

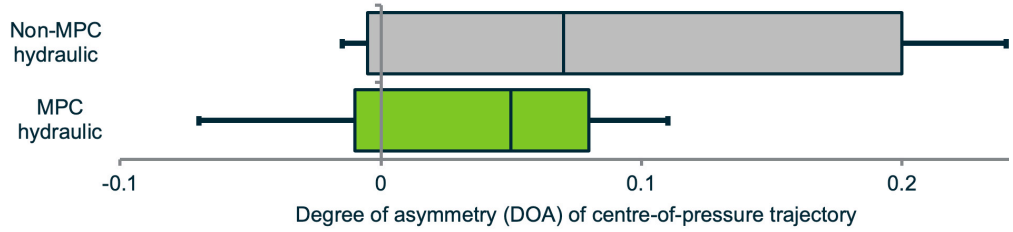
Subjects: Twelve, unilateral, trans-tibial amputees (60.4±9

Data collection protocol: Each participant walked for three minutes
conditions. These were level at self-selected and fast
satisfaction and perception of their own mobility were
with the amputees' habitual Echelon ankle-foot device
weeks to acclimatise to the device, after which the pr

Analysis: Degree of asymmetry (DOA) was used to compare the
prosthetic and sound feet. Wilcoxon signed-rank tests
pressure, COP trajectory and PEQ responses.

Results

Using the Elan, the COP trajectory prosthetic and decreased signi level (self-sel and inclined wa Signifcant incr plantar pressure under the prosthetic heel were reported when using Elan for fast and inclined walking (p=0.001) compared to Echelon (75.5). Scores improved b their own ability to walk up and down steep hills, res



Conclusion

The authors stated that the decreased DOA of the COP t
weight transfer over the ankle. The greater force unde
function the microprocessor-control provides. For thes
provide greater energy return from the heel spring.

Products with Related Technology:

Linx, Elan

Which Prosthetic Foot to Prescribe?: Bion Single-Session Comparison of Diferent Foo

Authors: A. De[1], ACs.ha[2]B,a rVn.e tSt[3],r uJc.hkBouvc k l e y

[1]C-Motion Inc, Germantown, Maryland, UK

[2]School of Science and Technology, Nottingham Trent

[3]Division of Medical Engineersinty, Sf cBhroaldfordEngUKnee

Published in: Journal of Prosthetics and Orthotics (JPO) 2017;

Summary

A case study was performed ina swsheiscsh tghaei tgaainta loyfs ias uwnaisl a using Epirus and Elan feet. The process was repeated 1 between the two feet types.

Method

Components: Epirus, Elan

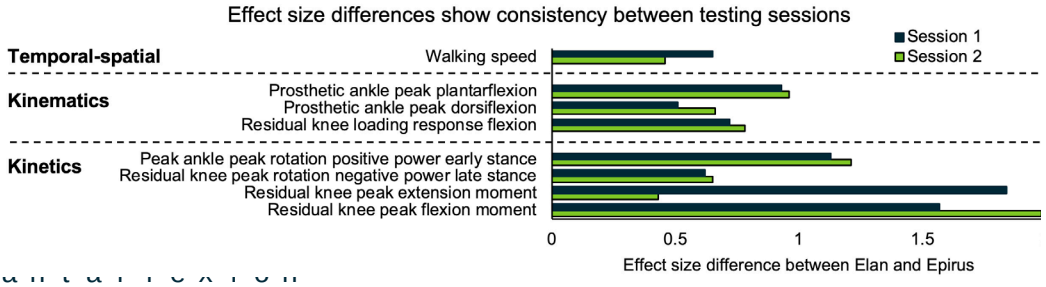
Measurements: 3D gait analysis

SubjeAct:ssi:ngle K4 unilateral trans-(tisbtiasle sasmipount)e;e 9(63.54.k8g

Data collection protocol: 3D motion was captured as the amputee comp speed, over an 8m walkway with two integrated force pl amputee's habitual foot was an Echelon VT so acclimati was conducted 14 months later where the protocol, tria were identical. The same method was employed to align

Analysis: Various gait parameters were compared and clinica with an efect size diference (d) between prosthetic co statistical tests were applied.

Results



Clinically mea diferences bet were observed parameters dur session and ag the second ses parameters wer speed, peak pl and dorsifexion at the prosthetic ankle, residual knee loading response fexio ankle, peak negative residual knee power during late s moments at the residual knee. The mean efect size dife for each parameter, respectively.

Conclusion

The authors conclude that given the comparable diferen change in patient condition, a shaondustegl wsh sianctom for identifying biomechanical gait diferences between diferent feet, the higher self-selected walking speed 1 & 2, respectively), compared with Epirus (1.31±0.10m can be considered a global descriptor of improved gait negative residual knee power in late stance when using & 2, respectively), compared to Epirus (1.76±0.25m/s a benefcial change.

Products with Related Technology:

Linx, Elan

Patient Evaluation of a Novel Prosthetic
Persons with Amputation with Lower Activity Levels

Authors: R. Moore[1]

[1]Luton and Dunstable Hospital NHS Foundation Trust,

Published in: Journal of Prosthetics and Orthotics (JPO) 2017

Summary

A group of limited community walkers were asked to eva
Avalon hydraulic ankle-foot device. After a four week

Method

Components: Multifex, Avalon

Measurements: Prosthesis Evaluation Questionnaire (PEQ) – a

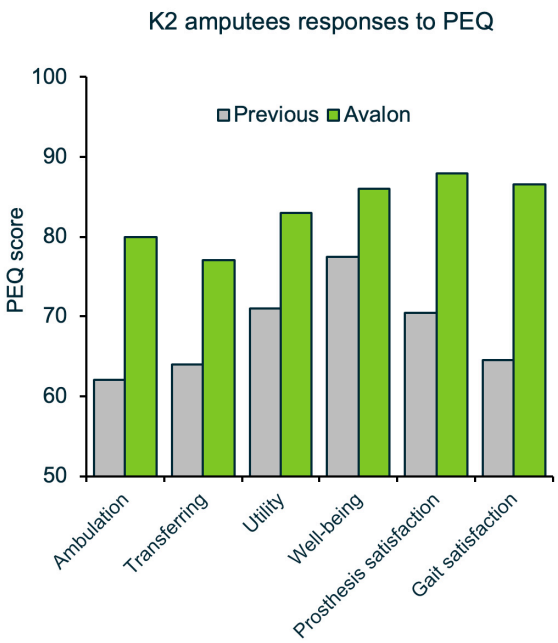
Subjects: Fourteen K2 patients (12 male, 2 female; 11 unilateral trans-femoral; 38-84 years).

Data collection protocol: Patients were asked to complete the PEQ in then supplied with an Avalon hydraulic ankle-foot devi weeks. At the end of the trial, they were asked to com foot.

Analysis: Scores from the questionnaire were separated by an question (ambulation, transferring, utility, well-bein evaluations were compared between amputation levels an

Results

When considering the subject gr in each of the six question fo the Avalon. The mean improvemen 14.7 points. This included a 17 ambulation, a 17.2 point improv and a 21.9 point increase in ga down by amputation level, trans improvement across all categori femoral amputees the cross-cate



Conclusion

The author concludes that the s improvements in gait and overal using the Avalon highlight the further gait analysis could be o these perceived improvements.

Products with Related Technology:

Linx, Elan, Echelon, EchelonVT, EchelonVAC, Avalon

Biomechanics of ramp descent in unilateral trans-tibial amputees: Comparison of a microprocessor-controlled foot with conventional ankle–foot mechanisms

Authors: V. St[1]r, u cJh. KGo. v' Buckley

[1]Division of Medical Engineersi ntgy, S fc hBoo al d fo o rd E, n g U k n e e

Published in: Clinical Biomechanics 2016; 32: 164-170.

Summary

A microprocessor-controlled ankle-foot device was comp terms of its efect on gait parameters during ramp desc

Method

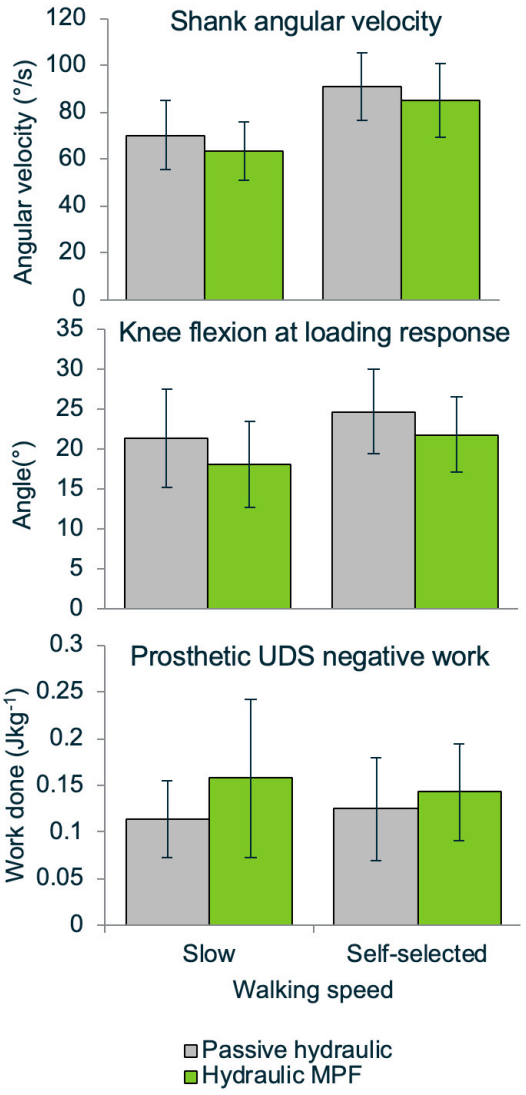
Components: Elan, Epirus

Measurements: 3D gait analysis, temporal-spatial parameters

Subjects: K3, unilateral, trans-tibial amputees (41.2 ±

Data collection protocol: Subjects repeatedly walked down a 5° ramp w walking speed and a self-selected speed. Each limb was tested with settings optimised for a device known as the 'microprocessor-controlled foot' ('MPC').

Analysis: Residual limb kinematics, joints moments/powers a averaged across trials for each subject and normalised normal distributions and a repeated measures ANOVA was categories. To assess the efects of habitual use of pr some subjects, analyses were repeated using a mixed-de ANOVA with the patient's habitual Signifcant results were analysed



Results

Foot-fat occurred earliest with t earliest with the MPC (p<0.001); speed across both foot types (p< support mean rotation velocity (p (p<0.001) were reduced by walking Negative work done was decreased and increased in the prosthetic s using the MPC, irrespective of sp sound side compensation.

Conclusion

The authors conclude that using M the biomechanical compensations u Unilateral trans-tibial amputees descending slopes more slowly – t ankle work during stance phase i to dorsifexion, or 'braking efect reduced prosthetic shank rotation using the active hydraulic ankle helps to control descent speed, i

Products with Related Technology:

Linx, Elan

Efect on stance phase timing asymmetry in hydraulic ankle units

Authors: R. Moore[1]

[1]Luton and Dunstable Hospital NHS Foundation Trust,

Published in: Journal of Prosthetics and Orthotics (JPO) 2016;

Summary

The gait kinematics of a number of lower limb amputees hydraulic ankle), before a period of acclimatisation w reassessed. The focus of the study was directed toward duration of the prosthetic and sound limbs.

Method

Components: Non-hydraulic feet, Echelon and Avalon feet.

Measurements: Temporal-spatial gait parameters and plantar

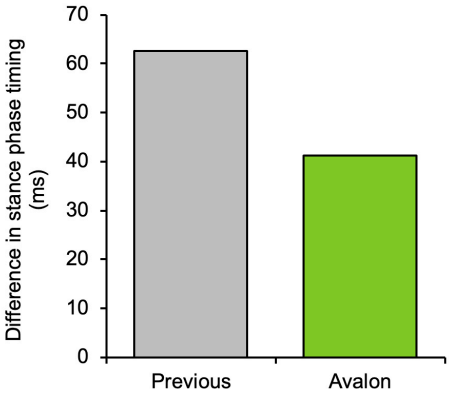
Subjects: Twenty-four lower limb amputees (22 male, 2 female)
K2: 4 unilateral trans-tibial, 1 bilateral trans-femoral, trans-tibia
K3: 3 unilateral trans-tibial, 2 bilateral trans-femoral, trans-tibia

Data collection protocol: Using their current prescription of non-h at a self-selected walking speed across a 6m level walkw pressure platform. This time allowed for a large enoug were prescribed Avalon feet and the K3 amputees were p period followed for the amputees' newly prescribed pro

Analysis: Paired t-tests to determine signifcant changes fr the main outcome measure, with comparisons made betwee

Results

For all unilateral subjects, the sound side had a longe duration than the prosthetic side. I e spent on their "dominant" leg. When i diference in the stance phase timing d limbs decreased for 75% of the subj d For the Echelon subjects, six out o h symmetry, one saw no diference and d decrease. There was no correlation b sy amputation level. The mean stance ph s decreased by 21.3ms (p=0.03) represe ve Avalon subjects, the results were in w one remaining the same and one show me mean stance phase diference was also s due to a greater initial degree of asymmetry for the K2 to a 34% improvement.



Conclusion

The author concludes that the results showed a statist duration when using prostheses that included a foot wi of the patients' activity level. He further states tha experience a more symmetrical stance phase duration, w side loading. He cites studies linking increased sound problems, including increased risk of osteoarthritis a

Products with Related Technology:

Linx, Echelon, Elan, EchelonVT, EchelonVAC, Avalon

Mechanical and physiological energetics when using an Echelon hydraulic ankle-foot device in unilateral trans-tibial amputees

Authors: A.R. Dee, G.A. Ashcroft[2], A.W. Kerr[1], G. Buckley[1]

[1]School of Engineering, Design and Technology, Univ

[2]School of Biological Sciences, University of Leeds

Presented at: AOPA National Assembly, Las Vegas, NV, USA. Sept

Summary

The compensatory joint kinetics and energetics of unilateral trans-tibial amputees using a hydraulic ankle-foot device at different speeds, using rigid and hydraulic ankle pr led to increased walking speed with concurrent reducti the metabolic cost of gait.

Method

Components: Hydraulic ankle-feet (HyAnk – Echelon) and energ

Measurements: 3D gait analysis during walking.

Subjects: Eight unilateral trans-tibial amputees (for metabolic cost measurements).

Data collection protocol: The first set of eight amputees walked at customary and fast walking speeds. The second set walked at customary speed on 0°, 5° and 10° declines (customary speed only). Both gr

Analysis: Moments and powers at the distal end of the prosth the metabolic cost of gait were compared between attac

Results

Overground: Self-selected walking speed was consistent with regards to speed, the joint work done per metre t using the HyAnk. Considering the ankle power, the HyAnk showed return in the early to mid-stance region of gait.

Treadmill: There was a reduction in the metabolic cost (mean reduction of 12%). Reductions were greatest at s walking speed of 1.18m/s would be the case even though HyAnk be achieved with ESR.

Conclusion

The authors conclude that their findings suggest that the costs of gait were reduced when participants used HyAn more energy being absorbed, and less returned, by the

Products with Related Technology:

Linx, Elan, Echelon, EchelonVT, EchelonVAC, Avalon

Toe clearance when walking in people with unilateral trans-tibial amputation: Effects of passive hydraulic ankle

Authors: L. Johnson, R. De Asha, J. Kulkarni, G. Buckley [illegible]

[1]School of Engineering, Design and Technology, Unive

[2]School of Health Studies, University of Bradford, U

[3]Mobility & Specialised Rehabilitation Centre, Nort

[4]Disablement Services Centre, University Hospital o

Published in: Journal of Rehabilitation Research and Developme

Summary

The minimum toe clearance (MTC) [illegible] comparative effects of 2 different foot mechanisms, fixed

Method

Components: Trans-tibial prostheses fitted with a range of dy foot (habF). The feet exchanged with a hydraulic ankle

Measurements: Kinematics, 3D motion capture gait lab (Vicon)

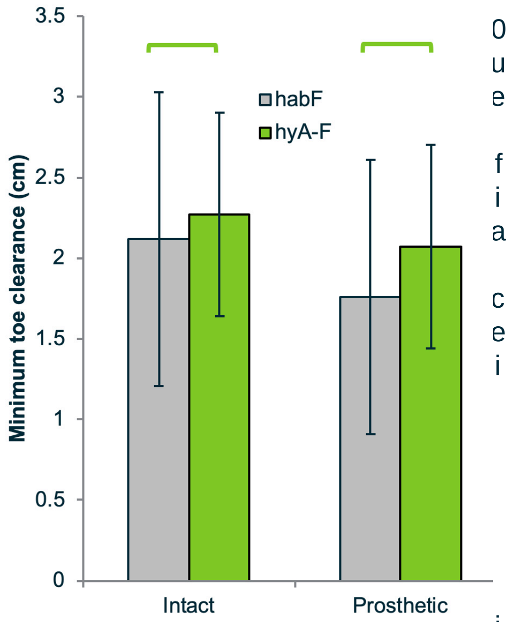
Subjects: [illegible] active unilateral trans-tibial amputees; [illegible]

Data collection protocol: Prosthetic intervention and exchange of th acclimatisation, collected [illegible] foot.

Analysis: 3D kinematic modelling, minimum toe clearance (MTC analysis.

Results

Mean MTC was significantly affected limb (p = 0.04). MTC increased fo compared with habF (2.17 vs 1.90cm sound side compared to the prosth mean foot angle at MTC was signif (p=0.01). Mean MTC on the prosthe compared to habF (2.07 vs 1.76cm) (indicating a slightly less toes compared to sound side (-17.7° vs was only significant on the prosth was significantly greater using th the habF (p<0.001). Irrespective correlation between walking speed



Conclusion

The authors conclude that MTC is ankle, and that this may reduce t while increased MTC variability o it did not contribute to any added increased risk of t increased MTC is partly driven by the dorsiflexed posit in swing phase.

Products with Related Technology:

Linx, Elan, Echelon, EchelonVT, EchelonVAC, Avalon

Impact on the biomechanics of over ground gait of using an 'Echelon' hydraulic ankle-foot device in unilateral trans-tibial and trans-femoral amputees

Authors: A. R. De Asha[1], Munjal Kulkarni[2], Graham Buckley[3]

[1]School of Engineering, Design and Technology, Unive
[2]Mobility & Specialised Rehabilitation Centre, Nort
[3]Disablement Services Centre, University Hospital o

Published in: Clinical Biomechanics 2014; 29: 728-734

Summary

In this paper the dynamics of forwards shank rotation was examined in unilateral trans-tibial and trans-femoral amputees. The effect of ankle-foot mechanism on progression characteristics was determined.

Method

Components: Trans-tibial and trans-femoral prostheses fitted with hydraulic ankles as the habitual footwear (hyA-F) in conjunction with an Echelon foot.

Measurements: Kinematics, 3D motion capture gait lab (Vicon).

Subjects: Nineteen K3 lower limb amputees (6 trans-tibial, 13 trans-femoral; 83±15 years; 84.5±17.3kg).

Data collection protocol: Prosthetic intervention and exchange of the acclimatisation collected in level surface walkways.

Analysis: Spatio-temporal parameters, COM trajectory, mixed

Results

When using the hydraulic ankle (hyA-F) both subject groups centre-of-pressure beneath the prosthetic hindfoot (p<0.001) velocity during prosthetic stance (p<0.001). The freedom using the hyA-F (p<0.005). In both groups stance and swing condition. Step length increased bilaterally using the hyA-F types was comparable across subject groups.

			Negative COP displacement (cm)	Time COP anterior to shank (% stance)	COM velocity minima during single support (ms^{-1})	Walking speed (ms^{-1})
Trans-tibial	habF	Mean	2.11	34.9	1.01	1.14
		St Dev	(0.97)	(3.5)	(0.15)	(0.14)
	hyA-F	Mean	0.82	31.8	1.09	1.22
		St Dev	(0.64)	(4.1)	(0.15)	(0.11)
Trans-femoral	habF	Mean	1.21	33.7	0.83	0.94
		St Dev	(1.51)	(7.7)	(0.17)	(0.11)
	hyA-F	Mean	0.35	26.9	0.89	0.99
		St Dev	(0.39)	(6.4)	(0.20)	(0.10)

Conclusion

The authors conclude that use of the hydraulic ankle-foot device reduced the 'sawtooth' ankle-foot moment (resisting forwards progression) for both amputee groups. The finding foot in early stance may be more important to prosthetic

Products with Related Technology:

Linx, Elan, Echelon, EchelonVT, EchelonVAC, Avalon

Joint loading during graded walking with

Authors: N. Ale[1], xan. de Sr ru[1], t za[1] j[1] b[1] k[1] r[1] g[1] e[1] C[1], h[1] r[1] T[1] s[1] t[1] W[1] a[1] H[1] m[1] s[1] c[1] S[1] h[1] w[1] a[1] m[1] e[1] d[1] e[1] r[1]

[1]Department of Sport Science and Kinesiology, Unive

Presented at: 1st Clinical Movement Analysis World Conference Movement, Analysis in Adults and Children (ESMAC), Rom

Summary

This gait analysis study so ua gp ht ti v te o hi yn dv re as ut li ig ca ta en kt lh ee se yf se ankle design when walking at ga fr ra om mg e- 1 o2 f t go r a+ d1 e2 d ie ng o r le ie ns e.

Method

Components: Dynamic response style foot (Esprit, “ES”), a pa microprocessor-controlled hydraulic ankle (Elan “EL”)

Measurements: Kinematics and kinetics, 3D motion capture fro from 2 force plates (AMTI) built into a hydraulically

Subjec At ss: ingle unilateral trans-femoral amputee. Microp

Data collection protocol: Randomised cross over testing of each foo 4° and 12°, data normalisation and reduction 5 clean t

Analysis: Gait temporal-spatial parameters, ground reaction

Results

The authors report that gait parameters (e.g. temporal inclination, but were not afected by the change in ank lowest using EL, with ES producing the largest joint m joint moments 6-78% higher when using ES compared to t in every condition using EL. On the residual hip exten The residual hip fexion moments using ES were 40% larg

Conclusion

The study concludes that the greatest changes are seen foot function when walking o a gr a e d pi o l 0 es i e s i a m mechanism. The authors conclude that the reduction in advantageous for use in trans-f a o a li p u s when wa

Products with Related Technology:

Linx, Elan, Echelon, EchelonVT, EchelonVAC, Avalon

Walking speed related joint kinetic alterations in trans-tibial amputees: impact of hydraulic 'ankle' damping

Authors: A. R. [illegible] D, e RA. s hMa uJ n: j a k u l a r a G i [1] B u c k l e y

[1] S c h o o l o f E n g i n e e r i n g , D e s i g n a n d T e c h n o l o g y , U n i v e

[2] M o b i l i t y & S p e c i a l i s e d R e h a b i l i t a t i o n C e n t r e , N o r t

[3] D i s a b l e m e n t S e r v i c e s C e n t r e , U n i v e r s i t y H o s p i t a l o

Published in: J o u r n a l o f N e u r o E n g i n e e r i n g a n d R e h a b i l i t a t i o n

Summary

T h e p r e s e n t s t u d y d e t e r m i n e d w h e t h e r a t r a n s - t i b i a l p r a t t a c h e d t o t h e s h a n k v i a a n - F a) r t l i e c s u s l e a n t e i d h g s p h e y e d d r - a r u e l l i a c t e d d e k i n e t i c s c o m p a r e d t o w h e n t h e f o o t w a s a t t a c h e d v i a a

Method

Components: T r a n s - t i b i a l p r o s t h e s e s f t t e d w i t h a r a n g e o f d y f o o t (h a b F) i n c o m p a r i s o n t o a h y d r a u l i c a n k l e (h y A - F ,

Measurements: K i n e m a t i c s , 3 D m o t i o n c a p t u r e g a i t l a b (V i c o n)

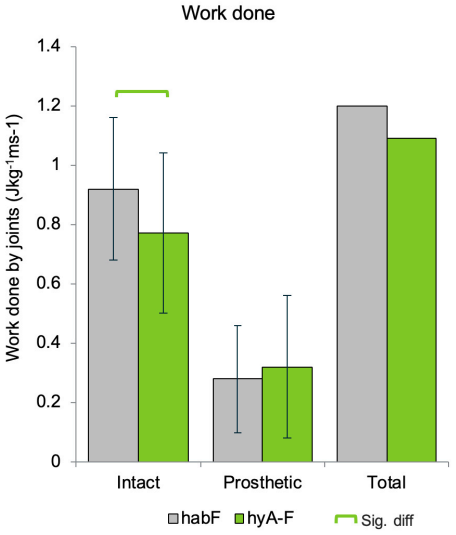
S u b j e c E t i s g : h t , m a l e , u n i l a t e r a l , K y 3 e a t r r s a ; n s 8 - 3 t . i 3 b ± i 1 a 9 l . 0 a k m g p) u t e e s

Data collection protocol: P r o s t h e t i c i n t e r v e n t i o n a n d e x c h a n g e o f t a c c l i m a t i s a t i o n , c o l l e c t e d i e n v e 2 l s s e u p r a f r a a c t e e a b t l 0 3 c k s s e , l f w - a s l e k l i e c o m f o r t a b l e ' s l o w ' a n d c o m f o r t a b l e ' f a s t ' .

Analysis: S t a t i s t i c a l a n a l y s i s , r e p e a t e d m e a s u r e s A N O V A , a t t h o c t e s t s .

Results

T h e r e w a s n o c h a n g e i n t h e a m o u n t o e s p e e d o r a t t a c h m e n t c o n d i t i o n s . A s a s a n i n c r e a s e o n b o t h l i m b s i n t h e a m i n e d o n e , a n d i n c r e a s e s o n t h e p r o s t h e t . t e t h e h y A - F . H o w e v e r , b e c a u s e a l l w a l w w h e n u s i n g t h e h y A - F , t h e s o u n d l i m i n p e r m e t e r t r a v e l l e d w e r e s i g n i f i c a n t 1 m s - 1 , 0 c o n s t i t u t i n g a ~ 1 7 % r e d u c t i o n) ; p a r h e l e v e l (p = 0 . 0 4 7) . T h i s w a s t h e c a s e d e n e r g y d u r i n g s t a n c e . O v e r a l l n o s i i j o i n t w o r k w a s o b s e r v e d . H o w e v e r , t m e i n c r e a s e d a t t h e r e s i d u a l k n e e w h e n s i n c r e a s e d l o a d i n g i n v o l v e m e n t o f t h .



Conclusion

F i n d i n g s i n d i c a t e t h a t a t r a n s - t i b i a l p r o s t h e s i s i n c o r c h a n g e s i n c o m p e n s a t o r y s o u n d - w a i m b a j t d a n c h e k i n v e i a s w h e n d e v i c e c o m p a r e d t o r i g i d a t t a c h m e n t . A r e d u c t i o n (~ 1 7 % t h e p h y s i c a l d e m a n d s o f w a l k i n g w e r e r e d u c e d w i t h u s e o f m e a s u r e d a d a p t a t i o n t o j o i n t k i n e t i c s " e n e r g y r e t u r p r o s t h e t i c f o o t .

Products with Related Technology:

Linx, Elan, Echelon, EchelonVT, EchelonVAC, Avalon

Patient evaluation of the Echelon foot using the Seattle Prosthesis Evaluation Questionnaire

Authors: I. [1]Se[illegible]k i[1]Moore

[1]Luton and Dunstable Hospital NHS Foundation Trust,

Published in: Prosthetics and Orthotics International 2013; 3

Summary

In this case report, the clinical impact and user sati
compared to a non-hydraulic foot system was examined f

Method

Components: Echelon hydraulic ankle-foot, compared to eithe

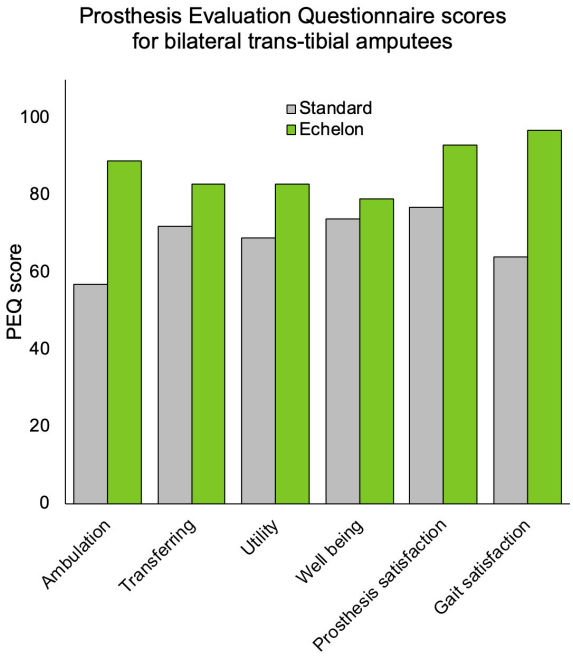
Measurements: Seattle Prosthesis Evaluation Questionnaire (PE

Subjects: [illegible]9 male patients (3 unilateral trans-tibial, 3 bilateral trans-tibial, 3 [illegible]a

Data collection protocol: Patients were asked to evaluate their cur
post ftting using the Echelon.

Results

Statistically significant increa[illegible]ere
most PEQ assessment domains wit[illegible]ner
for 'ambulation satisfaction' ([illegible]hes
satisfaction' (+19.6 points) an[illegible](+
all p<0.01. The largest magnitu[illegible]re
by the bilateral amputee group [illegible]rov
in gait satisfaction.



Conclusion

Use of a hydraulic ankle improv[illegible]sa
across amputation levels. In pa[illegible]hy
self-aligning ankles should be [illegible]at
where the patient is able to ac[illegible].

Products with Related Technology:

Linx, Elan, Echelon, EchelonVT, EchelonVAC, Avalon

Attenuation of centre-of-pressure traject foot when using an articulated hydraulic attachment

Authors: A. R. De LA. shJao,[2] hn Rs. om M ud j. a K, ul Jk. aGr. n[1] i Buckley

[1] Division of Medical Engineeriamgd, TSe chmoollogy, Eb ginee

[2] School of Health Studies, University of Bradford,

[3] Mobility & Specialized Rehabilitation Centre, Nort

[4] Disablement Services Centre, University Hospital o

Published in: Clinical Biomechanics 2013; 28(2): 218-224

Summary

The centre-of-pressure (COP) trajectory refects how bo and is governed by foot and ankle design. This study s symptomatic as a 'dead spot' in rollover are reduced w

Method

Components: Habitually used, dynamic response feet, with ri elastic foot (Echelon).

Measurements: Kinematics and kinetics, opto-electronic motio (AMTI).

Subject Twse:nty physically active trans-tibial amputees (4

Data collection protocol: P2 blocks of 10 walking trials with each tests at freely selected comfortable walking speed.

Analysis: Temporal-spatial parameters and lower limb kinemat

Results

The magnitude of the peak negative COP velocity was re was reduced (p=0.001) with use of the hydraulic foot a during double support was signifcantly increased (p<0. increased (p=0.001) with use of the hydraulic ankle.

		Negative COP displacement (m)	Max negative COP velocity (ms^{-1})	Mean COP velocity variability in single support (ms^{-1})	Shank mean angular velocity in single support ($°s^{-1}$)	Walking speed (ms^{-1})
habF	Mean	-0.022	-0.153	0.273	94.5	1.12
	St Dev	(0.018)	(0.110)	(0.070)	(20.2)	(0.14)
hyA-F	Mean	-0.010	-0.043	0.210	101.7	1.17
	St Dev	(0.008)	(0.066)	(0.063)	(19.2)	(0.15)

Conclusion

The alteration to the COP trajectories, the increased customary speed suggest that the hydraulic ankle reduc a way that may be functionally benefcial for active am

Products with Related Technology:

Linx, Elan, Echelon, EchelonVT, EchelonVAC

Kinematics, kinetics and internal mechanical stresses of trans-tibial amputees walking and climbing stairs with hydraulic feet

Authors: A. Kristal[1,2], Oren Gaviv[2], Zvi Yizhar[3], Sivan Klein[1], Hillel Laufer[1]

[1]Department of Orthopaedic Rehabilitation, Chaim Sheba Medical Center, Tel Hashomer, Israel

[2]Department of Biomedical Engineering, Tel Aviv University, Israel

[3]Physical Therapy Department, Chaim Sheba Medical Center, Tel Hashomer, Israel

Published in: Orthopädie + Reha-Technik 2012; 3-6

Summary

This study sought to examine the efficiency, safety and amputees for level ground and stair walking.

Method

Components: Hydraulic foot and ankle system (Echelon), user

Measurements: Kinematics and kinetics, opto-electronic motio pressure measurement system.

Subjects: 10 active, unilateral trans-tibial amputees (43±1

Data collection protocol: Two test sessions, (i) using habitual foo comfortable self-selected speed and (ii) ascending and desc

Analysis: Kinematic analysis of sagittal hip, knee and ankle

Results

In comparison to the habitual alignment, the use of the hydrauli phase. Additionally, less hip flexion was measured during ankle plantarflexor moment and power was measured with residuum were also reduced ($p<0.01$).

Conclusion

The authors conclude that use of the hydraulic foot re smoother posterior-anterior acceleration path. The red lower the risk of internal injury of the soft tissues

Products with Related Technology:

Linx, Elan, Echelon, EchelonVT, EchelonVAC, Avalon

Einfuss der Eigenschaften eines Prothesen Unterschenkel-Amputierten – Infuence of t on the gait of trans-tibial amputees

Authors: M. [1]ErFerLayer, K. Sander, K. Erler, H. Ziegenthal
[1]Technische Hochschule Mittelhessen

Published in: Medizinische-Orthopädische Technik 2012; 1: 57-

Summary

The impact of diferent prosthetic foot design on the g kinetic and EMG measurements. Further balance tests an assessment showed objective and subjective advantages habitually used ankle-foot.

Method

Components: Echelon, patient's own non-hydraulic foot

Measurements: Gait analysis system (Vicon 460), bi-polar sur dynamic balance) and patient centred assessment.

Subjects: Thirteen K2-K4 trans-tibial amputees (12 male, 1

Data collection protocol: All investigations were undertaken with t and kinematic parameters as well as muscle activity we Tests to assess static and dynamic balance were undert

Analysis: After reduction to study relevant parameters with

Results

The test foot showed a reduction of stance phase durat a reduction of knee joint movement. Plantarfexion mome generated hip energy was reduced. Cadence decreased an was closer to a physiological intramuscular coordinati using the test foot. The patient-centred assessment sh comfortable and less strenuous in diferent walking sit

Conclusion

The test foot seems to have a positive impact on energ to 23.7% per step was achieved in the ankle joint. Almost activities of daily living (ADL) and to reduce the exh the pattern of able-bodied people using the test foot. limb and spinal cord and increase the quality of life.

Products with Related Technology:

Linx, Elan, Echelon, EchelonVT, EchelonVAC, Avalon

Outdoor dynamic subject-specifc evaluatio limb: Hydraulic energy-stored prosthetic stored prosthetic feet

Authors: S. Port[1], Anat Kristal[2], Alon Gefen[1], Siev-Ner

[1]Department of Biomedical Engineering, Tel Aviv Univ

[2]Department of Orthopaedic Rehabilitation, Tel Hashomer, Sh

Published in: Gait and Posture 2012; 35(1): 121-5

Summary

The pressure between the prosthetic socket and stump o range of walking activities, with conventional energy authors found signifcantly lower pressures with the Ec the hydraulic mechanism. They suggest the Echelon may amputees.

Method

Components: Echelon foot and the subjects' own energy-storag 1x C-walk, 1x Pathfnder and 1x Esprit were used).

Measurements: Socket interface pressure measured using a 3-e

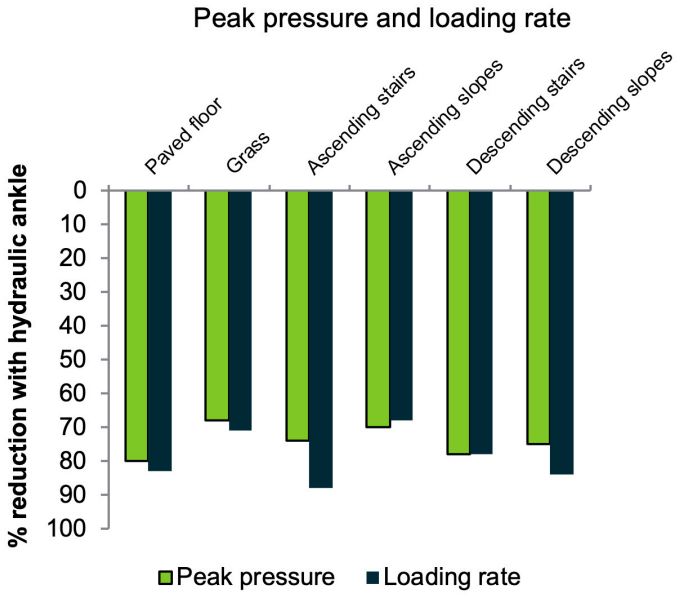
Subjects: male unilateral traumat 36 post amput at 42.7 years.

Data collection protocol: Subjects wore their own prosthetic feet a for 1 minute on a paved surface in addition, subjects walked on grass plus a stair ascent and descent outdoors. Pre were then fted with an Echelon foot, which they used measurements. Subjects were also interviewed at the en

Analysis: Five subsequent steps were taken from each walkin averaged peak and RMS internal von Mises stresses, and as the ratio of peak stress over the time interval fro

Results

All subjects were satisfed reports of abnormal pressur was a signifcant decrease i rate with the Echelon (the times lower). The internal Echelon signifcantly whilst ascending stairs.



Conclusion

The authors attribute the r hydraulic ankle mechanism. slowly, preventing sudden i likely to be injured, hence protect against deep tissue and return feet users may b stress impacts elsewhere in

Products with Related Technology:

Linx, Elan, Echelon, EchelonVT, EchelonVAC, Avalon

Prosthetic-limb ankle kinetics, energy storage and return when using a hydraulic ankle device in unilateral trans-tibial amputees

Authors: A.R. De LA.sh Jap hJn sok u Rk a M iu d j e G l [1] Buckley

[1] School of Engineering, Design and Technology, Unive

[2] Disablement Service Centre, University Hospital of

[3] Mobility & Specialised Rehabilitation Centre, Nort

Presented at: Joint World Congress of ISPGR and Gait and Menta 2012

Summary

This study sought to investigate biomechanical diferen response feet in comparison to hydraulic viscoelastic

Method

Components: Dynamic response feet, 15 with a rigid attachme (Echelon).

Measurements: Kinematics and kinetics, opto-electronic motio

Subject Twse: nty active, unilateral trans-tibial amputees.

Data collection protocol: Cross-over protocol design, 10 trials capt hydraulic ankle foot (Echelon).

Analysis: Stance phase kinetics were determined using standa

Results

With use of the visco-elastitcichnydsriagunlifcr ofmoopt;antthaer-mdoomres 10% earlier in the stance phase (p = 0.035). The energ COP peak negative velocity (p < 0.001) and backwards d by 25% (p = 0.007) from 0.168±0.053m to 0.123±0.045m. support (onto prosthesis) increased (p=0.001) 1.W7a±0i.1n5 (p = 0.002).

Conclusion

The authors conclude that thedankdueendmeind stramsei tioner more refective of able-bodied gait. Moreover the incre progression, and reduced roll-over radius are thought increase in self-selected normal speed and improved pr Overall the authors conclude dehaitceusefer ofbaihyedraulic ca stance kinetics more akin to able-bodied.

Products with Related Technology:

Linx, Elan, Echelon, EchelonVT, EchelonVAC, Avalon

Outdoor biomechanical evaluation of a hydraulic prosthetic foot

Authors: I. Sivan-Hirshberg[1], Arie Kristal[2], Gabi Segal[3], Sigal Portnoy[3]

[1]Department of Orthopaedic Rehabilitation, Chaim Sh
[2]Physical Therapy Department, Chaim Sheba Medical C
[3]Department of Biomedical Engineering, Tel Aviv Univ

Published in: Proceedings of the Journal of Prosthetics and Or

Summary

The internal socket interface pressures of trans-tibia
ankle-foot systems whilst ambulating on diferent surfa

Method

Components: Hydraulic foot and ankle system (Echelon), and
Measurements: Validated internal stress monitor (Flexiforce,
Subjects: active, male unilateral trans-tibial amputee
Data collection protocol: Each subject walked on inclines, stairs an
and again a month after fitting a hydraulic ankle-foot.
Analysis: Data from 5 consecutive steps for each test condit
internal von Mises stresses and the loading rates were

Results

The peak internal stresses and loading rates were sign
hydraulic foot compared to the user's own prosthetic f

Conclusion

The lower loading rates were attributed to the hydraul
residuum more slowly, thus preventing high impacts and

Products with Related Technology:

Linx, Elan, Echelon, EchelonVT, EchelonVAC, Avalon

Evaluation of a Hydraulic Prosthetic Foot

Authors: A. Kristal[1,2], Oren Portnoy[3], Hilla Shabat[4], Arie Gefen[2], Sigal Siev-Ner

[1]Department of Orthopaedic Rehabilitation, Chaim Sh
[2]Department of Biomedical Engineering, Tel Aviv Univ
[3]The CAREN VR lab, Chaim Sheba Medical Centre, Isra
[4]Physical Therapy Department, Chaim Sheba Medical C

Published in: Proceedings of the Journal of Prosthetics and Or

Summary

The efficiency of hydraulic and dampening ankle prosthetic systems is studied.

Method

Components: Hydraulic foot and ankle system (Echelon foot), and stan

Measurements: Kinematic and Kinetic, opto-electronic motion platform equipped with 2 force plates.

Subjects: active, unilateral trans-tibial amputees (43±

Data collection protocol: Each subject stood on the force plate, whi 20s) and backwards (10°, for 20s) and returned to leve

Analysis: Kinematic analysis of sagittal plane knee and ankle joint pressure (COP) trajectory.

Results

The hydraulic ankle enabled a larger range of ankle fe in both legs. The COP trajectories were more centraliz

Conclusion

The hydraulic ankle was shown to improve standing, bal

Products with Related Technology:

Linx, Elan, Echelon, EchelonVT, EchelonVAC, Avalon

Efects of a hydraulic ankle on gait funct
limb amputees

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Presented at: International Society for Prosthetics and Ortho
Compendium 7-8th October 2011, Hammersmith Hospital, L

Summary

This study sought to investiegastyes ttehme ceofmepcatrse do ft oa ah yfdxread
amputees in terms of gait function and symmetry during
femoral amputees.

Method

Components: Dynamic response feet, with rigid and semi atta
(Echelon).

Measurements: Kinematics and kinetics, opto-electronic motio
(AMTI).

SubjecTtesn: physically active amputees (6 trans-tibial, 4

Data collection protocol: randomised cross over design
speed were used for analysis.

Analysis: randomised cross over design, 10 “clean” trials u
for analysis.

Results

For the TT group use the hydraulic ankle increased ste
length increased signifcantly for both TT amputees (p=
contact fexion increased in all subjects on the prosth
between sides (hip asymmetry) reduced from 1.5° to 0.9
change in hip extension during terminal stance/pre-swi
GRFs in early or late stance, however the centre-of-pr
shank earlier in stance phase for all subjects (22% fr

Conclusion

The increase in hip fexion on the prosthetic side impr
of the COP is more refective of able-bodied gait, toge
reported subjective gait improvements whilst being abl

Products with Related Technology:

Linx, Elan, Echelon, EchelonVT, EchelonVAC, Avalon

Roll-over characteristics and ankle joint response foot with a fxed versus hydrauli

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Summary

This study reports on gait analysis including roll-ove gait when using a conventional dynamic response foot d

Method

Components: Dynamic response foot (Esprit), hydraulic visco

Measurements: Opto-electronic motion capture system with gro

Subjects: trans-tibial amputees (37.3±3.3 years; 74.8±

Data collection protocol: Randomised cross over study, design testin walking speed.

Analysis: Standard inverse dynamics modelling and analysis o shapes.

Results

Reduction to the radius of the roll-over shape (p = 0. ankle the transition from dorsifexion moment to planta p=0.018). The dorsifexion moment impulse was reduced b time was reduced by 68% (p=0.035); with peak positive were no signifcant diferences in the peak plantarfexio timings of when these occurred.

Conclusion

The authors conclude that the use of a hydraulic device t second rocker. Moreover, as there were no diferences i over radius was likely due to the centre-of-mass (COM) manner.

Products with Related Technology:

Linx, Elan, Echelon, EchelonVT, EchelonVAC, Avalon

Bibliography

1. Wurdeman SR, Stevens PM, Campbell JH. Mobility analysis of A ankle-foot categories for individuals with Unilateral Amputation. J Rehabil Res Dev 2016; 53: 755–768. DOI: 10.1682/JRRD.2015.05.0078.
2. McGrath M, Moser D, Baier A. Anforderungen an eine geeignete Requirements of a suitable prosthesis technology for elderly
3. Askew GN, McFarlane LA, Minetti AE, Buckley JG. Energy cost response foot with hydraulic versus rigid 'ankle': insights 2019; 16: 39.
4. Bai X, Ewins D, Crocombe AD, Xu W. A biomechanical assessmen processor control during slope ambulation in trans-femoral a
5. Kannenberg A. Evidence on prosthetic feet with active dorsif power generation: a mini literature review. Can Prosthet Ort
6. McGrath M, Laszczak P, Zahedi S, Moser D. Microprocessor kne ankles improve balance control and inter-limb loading during 2055668318795396.
7. McGrath M, Laszczak P, Zahedi S, Moser D. The infuence of a kinetic symmetry of trans-tibial amputees during Rehabilitation 2055668318790650.
8. Abdulhasan ZM, Scally AJ, Buckley JG. Gait transition from micr microprocessor-controlled limb system. Clin Biomech 2018; 57
9. Moore R. Efect of a Prosthetic Foot with a Hydraulic Ankle U with Unilateral Amputation. JPO J Prosthet Orthot 2018; 30:
10. Barnett CT, Brown OH, Bisele M, Brown MJ, De Asha AR, Strutz and Lower Activity Levels Walk More Quickly when Using a Hyd Foot Device. JPO J Prosthet Orthot 2018; 30: 158–64.
11. Alexander N, Strutzenberger G, Kroell J, Barnett CT, Schwame a Person with Trans-femoral Amputation with a Hydraulic Arti Prosthet Orthot 2018; 30: 46–54.
12. Bai X, Ewins D, Crocombe AD, Xu W. Kinematic and biomimetic camber walking. PLOS ONE 2017; 12: e0180836.
13. Dotan-Moram Y, Portnoy S, Kristal A, Sharon H, Siev-Ner I. G without a microprocessor-controlled hydraulic prosthetic ank
14. De Asha AR, Barnett CT, Struchkov V, Buckley JG. Which Prost during a Single-Session Comparison of Diferent Foot Types Ho
15. Moore R. Patient Evaluation of a Novel Prosthetic Foot with Activity Levels. JPO J Prosthet Orthot 2017; 29: 44–47.
16. Struchkov V, Buckley JG. Biomechanics of ramp descent in uni controlled foot with conventional ankle–foot mechanisms. Cli
17. Moore R. Efect on Stance Phase Timing Asymmetry in Individua Prosthet Orthot 2016; 28: 44–48.
18. De Asha AR, Askew G, Buckley JG. Gen. Meeting of the Int. Soc. of Electrophysiology and Kinesiology device in unilateral trans-tibial Paralympic athletics. Las Vegas, NV, USA, 2014.
19. Johnson L, De Asha AR, Munjal R, Kulkarni J, Buckley JG. Toe amputation: efects of passive 2h0y1d4r;au5l1i:c 4a2n9k.le. J Rehabil Res
20. De Asha AR, Munjal R, Kulkarni J, Buckley JG. Impact on the ankle–foot device in unilateral elest.raChlsi-nt iBbiicamle cahnd2 0t1r4a;ns2-9f:em7o2r
21. Alexander N, Strutzenberger G, Kroell J, Christian J, Wunsch diferent prostheses–a case study. In: 1st Clinical Movement Society for Movement Analysis in Adults and Children (ESMAC)
22. De Asha AR, Munjal R, Kulkarni J, Buckley JG. Walking speed of hydraulic 'ankle' damping. J Neuroengineering Rehabil 201
23. Sedki I, Moore R. Patient evaluation of the Echelon foot usi Int 2013; 37: 250–254.
24. De Asha AR, Johnson L, Munjal R, Kulkarni J, Buckley JG. Att prosthetic foot when using an articulating hydraulic ankle a 218–224.

25. Kristal A, Portnoy S, Gefen A, Givon U, Yizhar Z, Dvir Z, Sh
stresses of trans-tibial amputees walking and climbing stair
26. Erler M. Einfuss der Eigenschaften eines Prothesenfußes auf
dissertation, Diplomarbeit im Studiengang Orthopädie-und Reh
27. Portnoy S, Kristal A, Gefen A, Siev-Ner I, Yizhar Z, Dvir Z. Sh
limb: hydraulic energy-stored prosthetic foot compared to co
121–125.
28. De Asha AR, Johnson L, Kulkarni J, Munjal R, Buckley JG. Pro
using a hydraulic ankle device in Journal of Rehabilitation Sc
Function. Trondheim, Norway, 2012.
29. Siev-Ner I, Kristal A, Sharon H, Gefen A, Portnoy S. Outdoor
American Academy of Orthotists and Prosthetists - 37th Acade
USA, 2011.
30. Kristal A, Portnoy S, Elion O, Sharon H, Gefen A, Siev-Ner I
In: American Academy of Orthotists and Prosthetists - 37th A
Florida, USA, 2011.
31. De Asha AR, Johnson L, Kulkarni J, Bose R, Bavikatte G, McKe
function and symmetry in unilateral transtibial amputees: In
Annual Scientifc Meeting. Hammersmith Hospital, London, UK,
32. Brown S, De Asha AR, Johnson L, Kulkarni J, Munjal R, Buckle
low-profle dynamic response foot with a fxed versus hydrauli
Prosthetics and Orthotics (ISPO) UK Annual Scientifc Meeting

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435968939 Iss1 01/20. Information correct at time of print.