THE INFLUENCE OF HYDRAULIC PROSTHETIC ANKLE ON WALKING OF A PERSON AFTER BILATERAL TRANSTIBIAL AMPUTATION – A CASE STUDY

VPLIV HIDRAVLIČNEGA STOPALA ZA PROTEZO NA HOJO OSEBE PO OBOJESTRANSKI TRANSTIBIALNI AMPUTACIJI – ŠTUDIJA PRIMERA

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Abstract

Background:
Several articles about hydraulic ankles can be found in the PubMed bibliographic database, but we did not find any study about the influence of passive hydraulic ankle on walking up- and downhill in persons after bilateral transtibial amputation. The aim of our study was to assess this influence in a person after bilateral transtibial amputation.

Methods:
The subject in our study was a 50-years old woman after bilateral transtibial amputation performed five years before the study due to complications of type I diabetes. Most measurements were performed three times – on the admission day with the patient's previous prostheses, after two weeks of training with the new prostheses with hydraulic prosthetic feet, and three months after discharge. We performed a structured interview, clinical tests, patient-reported outcome measures (PROMs) and kinesiological measurements during walking on flat, up- and downhill surfaces.

Results:
While the patient reported subjective improvement on all questions of the structured interview and PROMs, we did not detect any objective improvement with clinical tests and

Izvleček

Izhodišča:
V bibliografski podatkovni zbirki PubMed je več člankov o hidravličnih stopalih za proteze, vendar nismo našli nobene študije o vplivu pasivnega hidravličnega stopala na hojo navkreber in navzdol pri osebah po obojestranski transtibialni amputaciji. V študiji smo želeli oceniti morebitni vpliv hidravličnega stopala na protezi pri hoji pacientke po obojestranski transtibialni amputaciji.

Metode:
V raziskavo smo vključili petdesetletno žensko po obojestranski transtibialni amputaciji, opravljeni pet let pred raziskavo zaradi zapletov sladkorne bolezni tipa I. Večino meritev smo opravili trikrat – na dan sprejema z njenima prejšnjima protezama, z novima protezama s hidravličnim proteznim stopalom po dveh tednih vadbe in tri mesece po odpustu. Opravili smo strukturiran intervju, klinične teste, izpolnila je številne vprašalnike in naredili smo kineziološke meritve hoje po ravnem, po klančini navzgor in navzdol.

Rezultati:
Medtem ko je pacientka poročala o subjektivnem izboljšanju pri vseh vprašanjih strukturiranega intervjuja in na vseh vprašalnikih, s kliničnimi testi nismo ugotovili nobenega objektivnega

Poslano: 9. 5. 2022
Sprejeto: 3. 7. 2022
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only very small, probably clinically not important differences with kinesiological measurements.

Conclusions:
Clinical tests and kinesiologic measurements did not confirm the subjective improvement felt by the patient. It is not possible to generalise our results to other subjects after bilateral transtibial amputation.

Keywords:
bilateral transtibial amputation; passive hydraulic prosthetic ankle; walking downhill

izboljšanja, s kineziološkimi meritvami pa zelo majhne, verjetno klinično nepomembne razlike.

Zaključek:
Klinični testi in kineziološke meritve niso potrdili subjektivnega izboljšanja, ki ga je občutila pacientka. Naših rezultatov ni mogoče posplošiti na druge osebe po obojestranski transtibialni amputaciji.

Ključne besede:
obojestranska transtibialna amputacija; pasivno hidravlično protezno stopalo; hoja navzdol

INTRODUCTION

The main function of our lower limbs is to enable us safe and stable standing, walking and related activities, such as walking on different terrains, up and down stairs, jumping, running etc. After lower limb amputation, the functions of the amputated body part are replaced with a functions of prosthesis. For many years, prosthetic components were purely mechanical. The first fluid-controlled ankle was developed by Hans Mauch in 1950s (1). It did not enter clinical trial until the late 1970s, but due to seal leakage problems it was removed from the market (1). The interest in hydraulic ankles has been renewed in this millennium and today we have several commercially available devices. Their main advantage is that they permit much higher passive plantar (up to 50 degrees) and dorsal flexion than mechanical prosthetic ankles without fluid-control (1) and thus make it easier to ascend and descend slopes. Their performance was further improved by microprocessor control (MPC) (2-4).

In the PubMed bibliographic database, several articles about hydraulic ankles can be found, most of them are based on a small number of subjects after unilateral amputation; only three studies on non-MPC ankles include more than ten subjects (5-7). They found out that in subjects after unilateral transtibial amputation during level and decline walking with hydraulic ankles, there was reduced total mechanical work and metabolic energy expenditure (8), smoother and more rapid progression of centre of pressure (9, 10), the subjects chose faster walking speed (6, 9, 10) and there was reduced risk of tripping of the prosthetic limb when ascending and descending the ramp (7). On the other hand, they didn't find any difference in the torque at the distal end of the prosthetic socket during the single support phase, nor better socket comfort during walking at different slopes (11). One study included one bilateral amputee (5) and another study included three of them (12). They observed the largest increase in satisfaction in the bilateral amputees (12).

Selection of the most appropriate prosthetic components depends on the user's health condition, functional status and user's needs and wishes. In subjects after bilateral lower limb amputations, it is important to select components, which will allow stable standing and walking, but also comfortable walking on different terrains. When selecting the most appropriate components, the prosthetist has to find a balance between stability and function.

We did not find any study about the influence of passive hydraulic ankle on walking up and downhill in subjects after bilateral transtibial amputation. Hence, the aim of our study was to assess this influence in a subject after bilateral transtibial amputation.

METHODS

Subject

We included a 50-year old woman after bilateral transtibial amputation performed five years prior to the study, due to complications of type I diabetes. She has had diabetes since she was eight years old, nowadays treated by an insulin pump. Since birth she is blind on her left eye. For the last 14 years, she has also had rheumatoid arthritis, treated with biological drugs. She had prostheses with silicone liners and energy-storing and realising (ESR) prosthetic feet (Epirus foot from Blatchford). She was using her prostheses whole day and was able to walk around 10.000 steps daily using one stick. In the last two years, she did not fall. Her main complaint was about difficulty at walking on uneven terrain and up and down hills. She has both uneven terrain and hills around her home and has to overcome them every day. During walking downhill, she had pain at the anterior distal part of both stumps, more severe on her left side.

Procedure

Most measurements were performed three times (Table 1). On the admission day (T1) they were performed with the patient's previous prostheses. Immediately after measurements, she was fitted with new prostheses which had the same type but new silicone liners, the socket shape was a copy of the old one, so the only difference was in the prosthetic feet – the new prostheses had hydraulic prosthetic ankles (Echelon foot from Blatchford). She received two weeks of physiotherapy training with the new prostheses. Functional training combined training of gait and daily activities. At the beginning, gait endurance and velocity on flat surfaces was trained; uneven surfaces, stairs and ramps followed. After two weeks of training, we performed the second measurement (T2), after which she was discharged home. The last measurement was performed three months after discharge (T3).

Clinical tests

The 6-minute walk test (6MWT) is a generic timed test used to assess aerobic capacity and endurance, and to monitor prosthetic walking performance (13). It was performed according to the guidelines (14); the turnaround points were marked with cones. Verbal encouragement was standardised; the distance walked in 6 min was recorded in meters.

The 10-metre walk test (10MWT) was conducted on a 14 m walking path. The measurement started when the participant crossed the 2 m mark and stopped when she crossed the 12 m mark (15). The participant was instructed to walk as fast as possible but safely without running. Two consecutive trials were performed with fast speed, and the mean speed was calculated as the outcome (16).

The L Test is as modification of the Timed Up and Go test (17). It is named after the L-shaped walking path. The time of an individual to stand up from a chair, walk for 3 m in a straight line, turn left for 90° at the first cone, walk 7 m in a straight line, turn for 180° at the second cone, walk back along the same path and sit down on the chair was measured with a manual stopwatch (in seconds, to the first decimal point). The participant was instructed to walk as fast as she was safely able to. Following the test demonstration by the therapist and one practice trial, two consecutive trials were measured with a 2minuste break between them. The mean was calculated as the outcome (18).

Table 1: *Timetable of performed tests and outcome measures.*
Tabela 1: *Časovnica opravljenih testov in merjenj izida.*

Test / outcome measure Test / mera izida		T1 – at admission with the old prostheses T1 – ob sprejemu s starima protezama	T2 – after 2 weeks of training with the new prostheses T2 – po dveh tednih vadbe z novima protezama	T3 – after 3 months of use at home T3 – po treh mesecih uporabe doma
Structured interview / Strukturirani intervju		x		x
Clinical tests / Klinični testi				
6-minute walk test (m)		x	x	x
10-metre walk test (m/s)		x	x	x
L-test (s)		x	x	x
One leg standing test (on prosthesis) (s)	left	x	x	x
	right	x	x	x
AMPPRO-Bilateral		x	x	x
PROMs / Vprašalniki				
PMQ 2.0		x		x
ABC		x		x
WAS		x		x
Numeric pain rating scale walking downhill		x		x
Kinesiologic measurements / Kineziološke meritve				
Flat 0.3 m/s		x	x	x
Flat 0.6 m/s		x	x	x
Uphill 0.3 m/s		x	x	x
Uphill 0.6 m/s		x	x	x
Downhill 0.3 m/s		x	x	x

Legend: AMPPRO – Amputee Mobility Predictor, PROMs – patient reported outcome measures, PMQ – Prosthetic Mobility Questionnaire, ABC - Activities-specific Balance Confidence Scale, WAS - Walking Aid Scale.

The one-leg stance test is described as a method of quantifying static balance ability. It is a valid measure and is useful in explaining other variables of importance such as frailty and self-sufficiency in activities of daily living, gait performance and fall status (19, 20). Test was performed with eyes open and hands placed on the hips. Participant had to stand unassisted on one leg - prosthesis, timed from the time the other foot leaved the ground till when the foot touched the ground again or the arms left the hips. The best time of five trials was used as a result (21).

Patient reported outcome measures (PROMs)

She filled in the Prosthetic Mobility Questionnaire (PMQ) 2.0 (22, 23), the Activity-specific Balance Confidence (ABC) scale (24, 25), and the Walking Aid Scale (WAS) (26), all in the validated Slovene versions (23, 25, 26). Pain was assessed using the Numeric Pain Rating Scale (27).

The PMQ 2.0 is a Rasch-validated self-report 12-item questionnaire that examines different tasks of varying difficulty related to mobility in people with lower-limb loss (22, 23). The common stem of the items is “Over the past week, please rate your ability to do the following activities when using your prosthesis”. Each item is rated with a 5-response option scale (0, unable; 1, high difficulty; 2, moderate difficulty; 3, little difficulty; 4, no problems). In PMQ 2.0, all 12 PMQ items of the original version (22) are assessed, but the global score is calculated on 10 of them, using only the worst performance in each couple of locally-dependent items, representing the same task performed in two opposite directions (up/down stairs; up/down hill). Raw scores range from 0 to 40, with higher scores indicating better prosthetic mobility.

The ABC (24) is a self-report 16-item questionnaire that asks people to score their perceived level of balance confidence when performing various indoor and outdoor activities of daily living. The common stem of the questions is: “How confident are you that you can maintain your balance and remain steady when you...”. We use the original scoring (0= No confidence; 100 = Complete confidence). The WAS quantifies the need for walking aids in four activities of increasing difficulty (walking indoors; walking on sidewalk and streets; walking up and down a steep hill; walking for up to 2 hours) on a 5level ordinal scale: 0 – no walking aids; 1 – one cane or crutch; 2 – two canes or crutches; 3 – walker or rollator; 4 – unable to perform the activity. The sum of the four scores is taken as the total score, with higher values indicating a greater need for walking aids (26).

Numeric Pain Rating scale (27) is an 11-point scale scored from zero (no pain) to 10 (the most intense pain imaginable). Patients verbally select a value that is the most in line with the intensity of pain they have experienced in the last 24 hours.

Kinesiological measurements

Kinematic data were captured using the Optitrack motion analysis system (Prime 13W, NaturalPoint Inc., US). Plug-in gait lower-body model with 16 reflective markers attached to the subject was used to calculate hip, knee and ankle angles, as well as step length, width and time. The subject walked on a custom-designed wide instrumented treadmill with force transducers (K3D120, ME Systeme GmbH, DE) placed underneath, from which ground reaction forces (GRF) and centre of pressure (COP) were obtained. Sampling frequency was 120 Hz for kinematic and 200 Hz for kinetic data. Uphill and downhill measurements were recorded on a sloped treadmill with the slope angle of 8.5 degrees (15 %). The subject walked uphill, downhill and on a flat positioned treadmill as outlined in Table 1, with each measurement lasting for approximately three minutes, from which 50 gait cycles were extracted on average. Kinematic and kinetic signals were segmented into strides (defined between two consecutive heel strikes of the same leg) for calculation of mean values and standard deviation. Spatio-temporal data on step length, width and time were statistically analysed using one-way ANOVA separately for each leg.

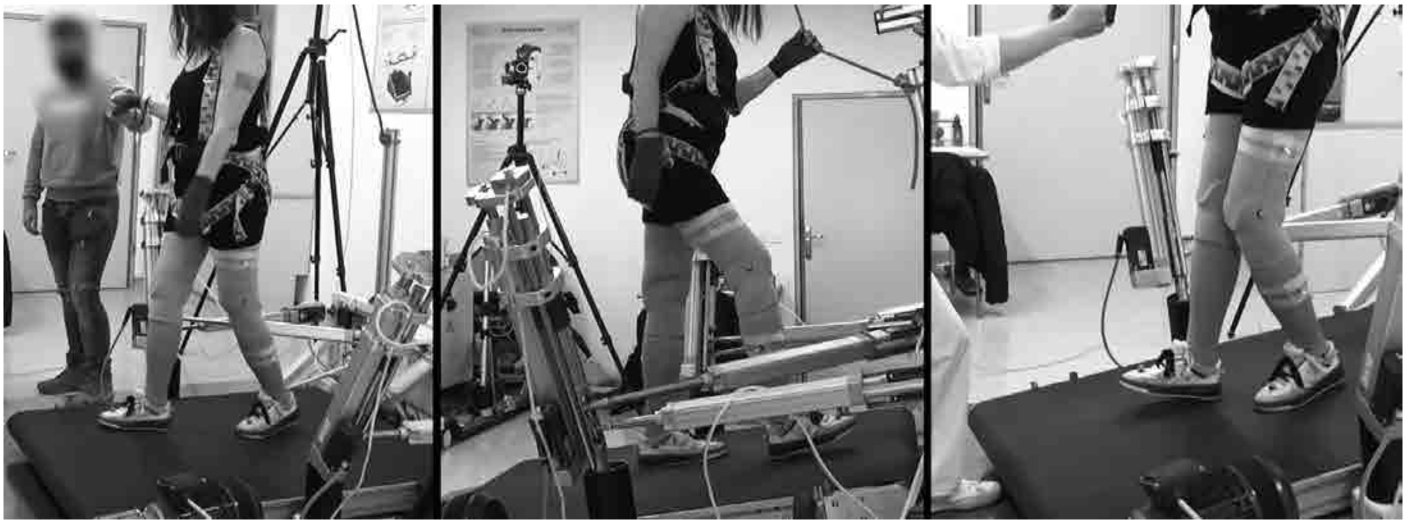

Figure 1: *Bilateral transtibial amputee walking on a flat, uphill-sloped and downhill-sloped instrumented treadmill.*

Slika 1: *Oseba po obojestranski transtibialni amputaciji hodi po ravnem, navkreber in navzdol po tekočem traku, opremljenem z merilnimi napravami.*

In addition, post hoc multiple comparison tests were performed using Bonferroni correction. For safety, the patient was wearing a harness (Figure 1). In spite of the harness, while walking uphill she was holding a rope (Figure 1), and while walking downhill the hand of a physiotherapist (Figure 1, Table 2).

The study was approved by the Research Ethics Committee of the University Rehabilitation Institute, Republic of Slovenia (035-1/2021-1/2-2).

RESULTS

The results of the structured interview, clinical tests and PROMs are summarised in Table 3. The subject was wearing new prostheses the whole day and walked with them approximately 2000 steps more that with the old prostheses. For half an hour, she was also able to walk without a stick or any additional walking aids. Otherwise, she was using one cane. She also walked with a cane

Table 2: *Additional support while walking on treadmill.*
Tabela 2: *Dodatna opora pri hoji na tekočem traku.*

Surface and speed Površina in hitrost	T1 – at admission with the old prostheses T1 – ob sprejemu s starima protezama	T2 – after 2 weeks of training with the new prostheses T2 – po dveh tednih vadbe z novima protezama	T3 – after 3 months of use at home T3 – po treh mesecih uporabe doma
Flat 0.3 m/s	Nothing	2 hands	1 hand
Flat 0.6 m/s	1 hand	2 hands	1 hand
Uphill 0.3 m/s	2 hands	1 hand	1 hand
Uphill 0.6 m/s	2 hands	1 hand	1 hand
Downhill 0.3 m/s	2 hands	2 hands	2 hands

Table 3: *Results of the interview, clinical tests and PROMs.*
Tabela 3: *Rezultati intervjuja in kliničnih testov ter dosežki na vprašalnikih.*

Test / outcome measure Test / mera izida		T1 – at admission with the old prostheses T1 – ob sprejemu s starima protezama	T2 – after 2 weeks of training with the new prostheses T2 – po dveh tednih vadbe z novima protezama	T3 – after 3 months of use at home T3 – po treh mesecih uporabe doma
Structured interview / Strukturirani intervju				
Daily time of wearing prosthesis		Whole day		Whole day
Time able to walk without any aid (min)		15		30
Self-reported daily walking (no. of steps)		10.000		12.000
Clinical tests / Klinični testi				
6-minute walk test (m)		350	360	390
10-metre walk test – fast speed (m/s)		1.08	1.17	1.16
L-test (s)		29.1	28.1	28.5
One leg standing test (on prosthesis) (s)	left		0	0
	right		0	0
AMPPRO- Bilateral		40	40	43
PROMs / Vprašalniki				
PMQ 2.0 (0 – 40)		21		28
ABC (%)		37		69
WAS (0 – 20)		9		5
Numeric pain rating scale walking downhill		7		0

Legend: AMPPRO – Amputee Mobility Predictor, PROMs – patient reported outcome measures, PMQ – Prosthetic Mobility Questionnaire, ABC - Activities-specific Balance Confidence Scale, WAS - Walking Aid Scale.

Table 4: *Spatio-temporal data from kinesiological measurements.*
Tabela 4: *Prostorsko-časovni podatki kinezioloških meritev.*

Spatio-temporal data mean (SD)/ Prostorsko-časovni podatki povprečje (SO)		T1 – at admission with the old prostheses/ T1 – ob sprejemu s starima protezama	T2 – after 2 weeks of training with the new prostheses/ T2 – po dveh tednih vadbe z novima protezama	T3 – after 3 months of use at home/ T3 – po treh mesecih uporabe doma
Flat 0.3 m/s / Ravna površina 0,3 m/s				
Step length (m)	L	0.26 (0.03)	0.27 (0.03)	0.32 (0.03)**##
	R	0.26 (0.03)	0.26 (0.04)	0.28 (0.04)*
Step width (m)	L	0.19 (0.02)	0.16 (0.03)**	0.14 (0.02)**##
	R	0.19 (0.02)	0.16 (0.02)**	0.14 (0.02)**##
Step time (s)	L	0.86 (0.05)	0.89 (0.09)	1.01 (0.07)**##
	R	0.88 (0.07)	0.87 (0.09)	0.98 (0.09)**##
Flat 0.6 m/s / Ravna površina 0,6 m/s				
Step length (m)	L	0.44 (0.02)	0.42 (0.03)**	0.45 (0.02)##
	R	0.45 (0.03)	0.47 (0.02)*	0.44 (0.03)##
Step width (m)	L	0.11 (0.02)	0.12 (0.02)	0.11 (0.02)
	R	0.11 (0.02)	0.12 (0.02)	0.11 (0.02)
Step time (s)	L	0.71 (0.03)	0.72 (0.04)	0.73 (0.03)
	R	0.78 (0.04)	0.76 (0.04)	0.75 (0.03)*
Uphill 0.3 m/s / Navkreber 0,3 m/s				
Step length (m)	L	0.41 (0.02)	0.33 (0.03)**	0.38 (0.02)**##
	R	0.38 (0.03)	0.34 (0.02)**	0.39 (0.02)##
Step width (m)	L	0.09 (0.02)	0.12 (0.02)**	0.11 (0.01)*##
	R	0.09 (0.01)	0.12 (0.02)**	0.11 (0.01)**##
Step time (s)	L	1.30 (0.07)	1.10 (0.06)**	1.31 (0.08)##
	R	1.35 (0.07)	1.15 (0.06)**	1.26 (0.07)**##
Uphill 0.6 m/s / Navkreber 0,6 m/s				
Step length (m)	L	0.55 (0.02)	0.48 (0.02)**	0.51 (0.02)**##
	R	0.52 (0.02)	0.51 (0.02)	0.50 (0.02)**#
Step width (m)	L	0.08 (0.01)	0.11 (0.02)**	0.11 (0.01)**
	R	0.08 (0.01)	0.11 (0.02)**	0.11 (0.01)**
Step time (s)	L	0.86 (0.02)	0.80 (0.03)**	0.82 (0.02)**##
	R	0.91 (0.03)	0.86 (0.03)**	0.86 (0.03)**
Downhill 0.3 m/s / Navzdol 0,3 m/s				
Step length (m)	L	0.28 (0.03)	0.26 (0.04)**	0.26 (0.03)**
	R	0.26 (0.03)	0.26 (0.04)	0.28 (0.03)**##
Step width (m)	L	0.15 (0.03)	0.16 (0.03)	0.15 (0.02)
	R	0.15 (0.02)	0.16 (0.02)*	0.15 (0.02)
Step time (s)	L	0.92 (0.08)	0.89 (0.07)	0.94 (0.08)##
	R	0.89 (0.08)	0.82 (0.10)**	0.86 (0.07)#

Legend: L – left; R – right; SD – standard deviation
Legenda: L - levo; R - desno; SD - standardni odklon
Note: * ($p < 0.05$) and ** ($p < 0.01$) indicate a statistically significant difference compared to T1; # ($p < 0.05$) and ## ($p < 0.01$) indicate a statistically significant difference between T2 and T3.
Opomba: * ($p < 0,05$) in ** ($p < 0,01$) označuje statistično značilno razliko v primerjavi s T1; # ($p < 0,05$) in ## ($p < 0,01$) označuje statistično značilno razliko med T2 in T3.

during the 6MWT. While walking down she had no more pain in her stumps. On the Numeric Pain Rating Scale, she assessed pain while walking downhill as seven for the old and as zero for the new prostheses.

The main findings from the spatio-temporal results are significant narrowing of step width and consequently slight prolongation of step length and step duration at slow flat walking (0.3 m/s). When walking uphill at both speeds (0.3 and 0.6 m/s), we observed significant step widening between old and new prostheses. Flat walking at 0.6 m/s and downhill walking (0.3 m/s) showed no significant differences between using old and new prostheses (Table 4). There was also no difference in the need for additional support (Table 2).

DISCUSSION

While the patient reported subjective improvement on all questions of structured interview and PROMs, we did not measure any objective improvement with clinical tests and with kinesiology we observed only very small, probably clinically not important differences.

To our knowledge, there is neither minimal detectable change (MDC) nor minimal clinically important difference (MCID) estimated either for the number of steps walked per day or for the Walking Aids Scale. However, both measures indicated a tendency of improvement. There are also no MDC or MCID estimates for pain in people with limb loss, but for all other populations the MCID is between 1.0 and 2.2 (27). The difference of 7 points reported by our patient is therefore a clinically important improvement. This decrease in pain is probably due to greater range of motion of hydraulic prosthetic feet, especially plantar flexion, because while walking on a flat surface she did not have any pain even with the old prostheses.

For ABC, there is also no MDC or MCID estimated for people with limb loss. For patients with Parkinson disease, MDC is 13 (28); the difference in our patient was much higher. The cut point for risk of falling for non-specific population and people with vestibular problems is 67 % and for those with Parkinson disease it is 69 % (28). Our patient had a huge improvement on ABC score and moved from the area of high risk for falling to the cut point. This does not mean that she cannot fall using the new prostheses, but the risk of falling is much lower with hydraulic prosthetic feet and with that also risk for further injuries.

MCID for PMQ 2.0 is 8 points (29), while our patient reported an improvement of 7 points. That is certainly an improvement in self-reported mobility, because MDC for PMQ 2.0 is 5 points (29), which is just below the clinical importance.

The difference of 40 metres on the 6-minute walk test is probably not clinically important. MCID estimates vary from 34.4 m (30) for stroke patients up to 147.5 m for patients at least two years after unilateral lower limb amputation (30). For most disabilities, the MCID is around 50 metres (13).

The difference in walking speed of 0.08 m/s may represent a small clinically relevant change, as the MCID is 0.05 m/s for older adults and 0.06 m/s for stroke patients (31). We found no data for people with limb loss, not even unilateral. The difference is smaller than any reported clinically substantial difference, which is at least 0.13 m/s (31).

The difference of one second on the L Test is in the range of the measurement error. In outpatient experienced prosthesis users, the MCID of the L Test was 4.5 s (32) and the minimal detectable change (MDC) ranged from 2.2 to 3.2 s (33). The difference of 3 points on the AMPPRO is also in the range of measurement error, as the MDC for AMPPRO is 3.4 points (31).

Compared to walking speed of subjects with bilateral transtibial amputation (34), we decided for slow and very slow walking speeds on the treadmill. The reason for such decision was that we did our measurement on treadmill and not during over-ground walking as was the case in a comparable study (34). Compared to their results, our slow walking speed was very slow, while our fast-walking speed was still slow. We also did not find any study measuring walking parameters while walking up and downhill.

The differences observed in spatio-temporal parameters were small, so probably clinically not important. To our knowledge, there are no MDC or MCID estimates for spatio-temporal walking parameters.

While walking on flat treadmill at speed of 0.6 m/s, step width was similar to that of healthy subjects (34) and much narrower than in other subjects after bilateral transtibial amputation (34). That might suggest improved balance and confidence during walking with hydraulic prosthetic feet. The reason might also be increased additional support during the second measurement. While walking uphill, all measured differences were very small, much smaller than standard deviations estimated in a comparable study (34). While walking uphill at both walking speeds, our subject used the longest and the narrowest steps of all three conditions. The additional support that she needed while walking uphill decreased from two to one hand already at the first measurement with hydraulic prosthetic feet. That might suggest higher confidence when walking uphill and even better confidence when walking with hydraulic prosthetic feet.

When walking downhill, the patient was able to walk at 0.3m/s only, so this was the most difficult condition for her. Even after using hydraulic prosthetic feet for three months, she still needed additional support with both hands.

In spite of a carefully prepared protocol, our study has several limitations. The main limitation is that we did not anticipate that the patient might need additional support while walking, and consequently we allowed her various forms of support in different conditions and at different measurement times. Furthermore, the study was performed on one patient only. We do not have many highly active patients with bilateral transtibial amputation, so for us a study on a larger number of subjects would be very difficult to perform. We did also not take into account some other aspects where we might have found some changes, such as energy expenditure and cognitive demand, but our primary focus was the ability to walk downhill, which was also the major problem of our patient while using the old prostheses. On the other hand, our study demonstrated that the acclimatisation period to different prosthetic feet might be even longer than two weeks.

CONCLUSION

While the patient reported subjective improvement on all questions of the structured interview and on the PROMs, we did not measure any objective improvement with clinical tests and with kinesiology, we observed only very small, probably clinically not important differences. It is not possible to generalise our results to other subjects after bilateral transtibial amputation.

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