Patient centered development and clinical evaluation of an ankle foot orthosis

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Chapter 2

Effects of ankle foot orthoses on body functions and activities in people with floppy paretic ankle muscles: a systematic review

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Abstract

Background People with floppy ankle muscles paresis use ankle foot orthoses to improve their walking ability. Ankle foot orthoses also limit ankle range of motion thereby introducing additional problems. Insight in effects of ankle foot orthoses on body functions and activities in people with floppy paretic ankle muscles aids in clinical decision making and may improve adherence.

Methods Studies published before October 27^{th}, 2014, were searched in Pubmed, Embase, Cinahl, and Cochrane Library. Studies evaluating effects of ankle foot orthoses on body functions and/or activities in people with floppy paretic ankle muscles were included. Studies solely focusing on people with spastic paretic ankle muscles were excluded. Study quality was assessed using a custom-made scale. Body functions and activities were defined according to the International Classification of Functioning, Disability and Health.

Findings Twenty-four studies were included, evaluating 394 participants. Participants were grouped according to paresis type (i) dorsiflexor paresis, (ii) plantar flexor paresis, (iii) both dorsiflexor and plantar flexor paresis. Dorsal, circular, and elastic ankle foot orthoses increased dorsiflexion during swing (by 4-6°, group i). Physical comfort with dorsal ankle foot orthoses was lower than that with circular ankle foot orthoses (groups i and iii). Dorsal ankle foot orthoses increased push-off moment (by 0.2-0.5Nm/kg), increased walking efficiency, and decreased ankle range of motion (by 12-30°, groups ii and iii).

Interpretation People with dorsiflexor paresis benefit more from circular and elastic ankle foot orthoses while people with plantar flexor paresis (and dorsiflexor paresis) benefit more from dorsal ankle foot orthoses.

Keywords Ankle foot orthosis, International classification of functioning Disability and Health, Paretic ankle muscles, Systematic Review

Introduction

A floppy paresis of one or more ankle muscle groups is seen in numerous pathologies such as Charcot Marie Tooth disease[40] and spina bifida[2]. People with a floppy ankle muscles paresis experience problems during walking due to reduced ability to actively plantarflex and/or dorsiflex the ankle. Reduced dorsiflexor strength may result in drop foot, hindering the swing phase of walking[91]. Reduced plantarflexor strength results in the inability to bring the ground reaction force forward during mid-stance, reduced control of the knee flexion moment, and reduced push-off[91]. One way to improve walking is to use an ankle foot orthosis (AFO)[94]. However, AFOs may limit ankle range of motion (ROM)[114], introducing additional problems during activities (such as walking stairs) where more ankle ROM is needed than allowed for by AFOs[98]. People with floppy paretic ankle muscles may benefit more from an AFO that fits the activities and needs that are of importance to them[126].

The 'International Classification of Functioning, Disability and Health' (ICF) on the components 'body functions' and 'activities' can be helpful in evaluating AFO effectiveness[136]. 'Body functions are the physiological and psychological functions of body systems'[136]. 'Activity is the execution of a task or action by an individual'[136]. Especially these two components are important when evaluating effects of AFOs[11]. The component 'participation' was left out of consideration, because a person should be physiologically able to execute an activity first, before this person is able to participate in a life situation[136]. The focus of existing systematic reviews, however, was on body functions[15, 70, 116]. Moreover, these reviews included people based on disease rather than on functioning, while AFOs are prescribed to improve functioning[10]. This is also the reason that floppy paresis should be evaluated separately from spastic paresis of the ankle muscles as the function of an AFO differs between these two paresis types. Flaccidity requires AFOs that compensate for decreased muscle strength, while spasticity requires AFOs that manage spastic muscle activity[10]. Existing systematic reviews did not differentiate between diseases that are characterised by either flaccidity or spasticity[15, 70, 116]. A systematic review evaluating effects of AFOs on body functions and activities in people with a floppy paresis of the ankle muscles is still lacking.

Insight in effects of different types of AFOs on body functions and activities aids in clinical decision making and may improve adherence with AFOs[126]. This study aims to systematically review effects of AFOs on body functions and activities in people with a floppy paresis of the ankle muscles.

Methods

Definitions and data extraction

An AFO was operationalized as a reusable externally applied device used to modify the structural and functional characteristics of the neuromuscular and skeletal system that encompasses the ankle joint and the whole or part of the foot[54]. Functional electrical stimulation devises and shoes encompassing the ankle joint were not considered to be an AFO. The ICF was used to classify outcomes into body functions and activities with corresponding categories[136]. For example, ankle joint moment was classified within the body function 'gait pattern' and gait speed as classified within the activity 'walking'[136]. Specific test findings were classified into the ICF as proposed previously[11]. For example, Berg Balance Scale findings were classified as the activity 'maintaining a body position'[11]. The first author extracted all data from the included studies. Thereafter, the first author classified study findings into ICF categories which were verified by an ICF expert. If disagreement arose which could not be solved by consensus, one co-author (KP) made the final decision.

Systematic literature search

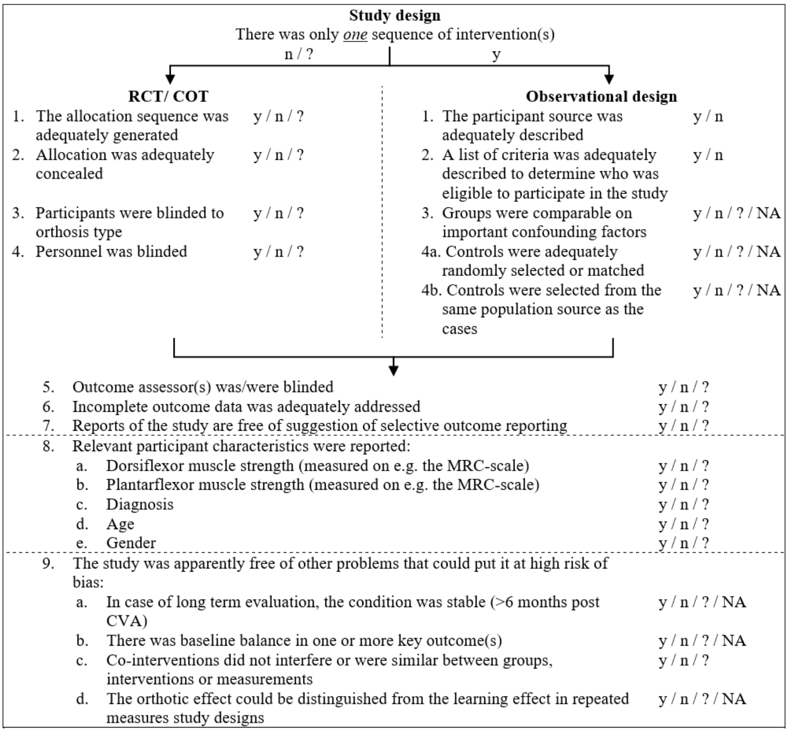
Studies published up to January 3^{rd}, 2013, were systematically searched in four databases (Pubmed, Embase, Cinahl, and Cochrane Library). This search was updated on October 27^{th}, 2014. The complete search strategy specified per database can be found in Appendix 1. In brief, the search strategy consisted of three components that were combined with the Boolean Operator 'AND' (i) AFOs, and (ii) lower extremity body functions and activities, and (iii) people with a floppy paresis of the ankle muscles.Main MESH terms and free text words used in this search were ankle, foot, orthotic devices, orthotics, braces, AFO, gait, locomotion, walking, ambulation, balance*, muscle*, activities of daily living, drop foot, and floppy.

Titles and abstracts were excluded if the study (i) did not evaluate effects of an AFO on lower extremity body functions and/or activities; (ii) did not include patients with a unilateral or bilateral absence or decrease in muscle tone, force, and/or activity of the ankle muscles; (iii) solely focused on (chronic) pain, ankle sprains, lower extremity fractures, lower extremity tendon ruptures or severe malformation of at least one of their lower extremity segments; (iv) solely focused on functional electrical stimulation; (v) solely focused on patients with hypertonia and/or spasticity of their lower extremity muscles (modified Ashworth scale[6] 0 or similar); (vi) solely focused on patients with diabetes; and (vii) included 5 patients or less; (viii)was solely based on qualitative research; and (ix) did not involve a control group, control intervention, or control measurement. Also titles and abstracts were excluded if (x) the AFO was not intended to be used for walking (for example, AFOs solely suitable for sleeping), (xi) patients were wearing knee or hip orthoses besides the AFO, (xii) the paper did not report primary research, and (xiii) the paper was a study protocol, congress, conference, or symposium proceeding. For the full text phase, in addition to the above-mentioned exclusion criteria, the following inclusion criterion was used. In case of pathologies with mainly spasticity (multiple sclerosis, cerebral palsy, cerebral vascular accident, and spinal cord injury), the decrease in ankle muscle strength of the dorsiflexors, plantarflexors, or both,was explicitly stated in the study. Whenever a study included both people with a spastic paresis and people with a floppy paresis and their results could be differentiated then only results of people with a floppy paresis were included. If differentiation was not possible, the study was excluded. No language restrictions were applied.

Two authors (DW and JH) independently assessed titles, followed by abstracts and full texts. In the title phase, if at least one of the authors included a title, it went through to the abstract phase. If no abstract was available, the paper continued to the full text phase. Abstracts and full texts were included when agreement existed between the two assessors. Disagreement was solved in a consensus meeting. Whenever disagreement persisted, a third author (PD) made a final judgement. Inter-rater agreement for each selection phase (titles/abstracts/full texts) was determined by calculating proportion of agreement and Cohen's kappa. After the full texts phase, the reference lists of included studies were assessed for additional studies. The first author selected titles in accordance with the procedure of the primary selection process. Abstracts and full texts were assessed by two authors (DW and JH) according to the same procedure.

Box 1

Quality assessment form

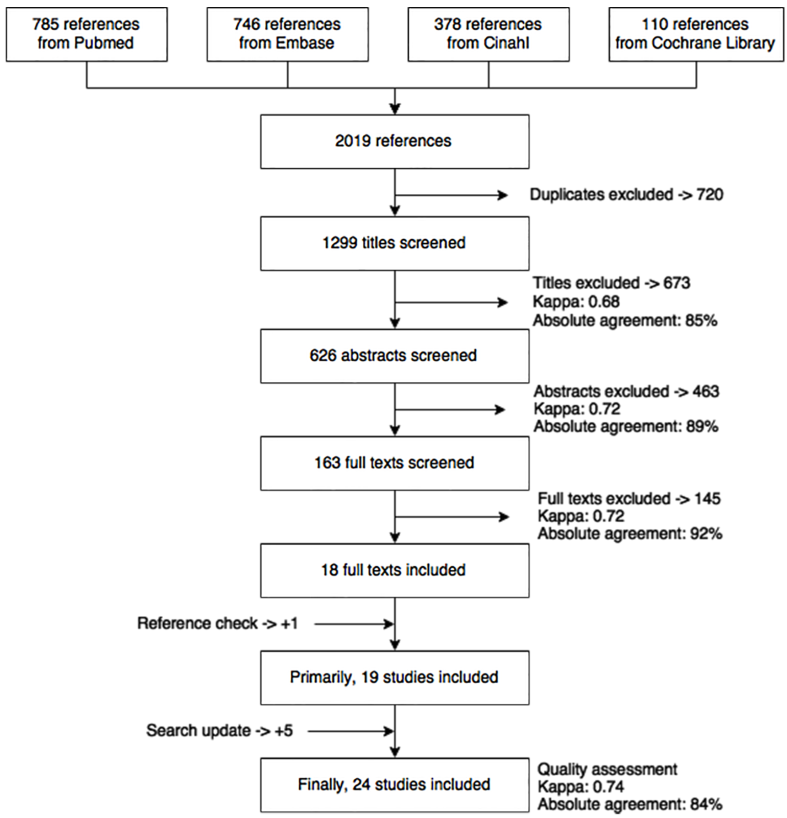


RCT = randomized clinical trial, COT = cross over trial, MRC-scale = medical research council scale. y = yes (low risk of bias), n = no (high risk of bias), ? = unclear (uncertain risk of bias), NA = not applicable. Judgement criteria to score a 'y','n','?' or 'NA' are described in Appendix 2.

Quality assessment

Since both randomized controlled trials (RCT) and observational study designs were eligible, a quality assessment scale was developed to assess the methodological quality of both designs. As a basis, the risk of bias[48] to assess RCTs and cross-over trials (COT) was used. To evaluate eligibility criteria and appropriateness of the population studied in observational study designs, criteria from the PEDro scale[73] and Wales list[131] were combined. A set of additional criteria was added to evaluate completeness of reporting participant characteristics (Box 1). Judgement criteria to score 'not applicable'; 'low risk of bias'; 'high risk of bias'; or 'unclear risk of bias' are described in Appendix 2. Quality scores are summed per criterion and not per study since the latter involves adding weights to criteria[48]. Two authors (DW and JH) independently assessed the quality of included studies, and the same procedure as aforementioned was followed when disagreement arose. The first author determined the level of evidence[74] of all studies included which was verified by one co-author (PD). In short, the three levels of evidence[74] that can be applicable to included studies are level II (well-designed randomized controlled trials), level III (quasi-experimental designs such as non-randomized controlled trials), or level IV evidence (observational designs such as case control and cohort trials[107].

Figure 1
Flowchart



Results

The first search from studies published up to January 3^{rd}, 2013, resulted in 1299 unique titles (Figure 1). Title assessment resulted in the exclusion of 673 titles. In the abstract assessment, 463 abstracts were excluded. Full text evaluation resulted in the exclusion of 145 full texts because (i) the study did not include patients with a unilateral or bilateral absence or decrease in muscle tone, force, or activity of the ankle muscles (n=102); (ii) the paper was a congress, conference, or symposium proceeding (n=13); (iii) the effect of an AFO was not evaluated on lower extremity body functions and/or activities (n=12); (iv) the study was a review (n=8); (v) the sample size was five or less (n=4); (vi) the study solely reported qualitative research (n=3); and (vii) the text was a study protocol (n=3). Initially, 18 studies were included[3, 13, 23, 26, 30, 32, 33, 41, 42, 52, 59, 86, 90, 93, 99, 112, 114, 123]. Reference check resulted in one additional study[31]. Eighteen studies were written in English and one in Turkish. The Turkish study was translated into English by a native speaker and medical terms were verified. The search was updated on October 27th, 2014, and after applying the same inclusion and exclusion criteria, five studies[22, 65, 75, 76, 94] were additionally included, resulting in a final 24 studies that were assessed for their quality.

Study description

To facilitate study comparisons, studies were categorized based on paresis type and the evaluated AFOs were categorised based on the description of the authors (Table 1). Eight studies[26, 31, 32, 33, 65, 75, 76, 99] evaluated people with a dorsiflexor paresis, mostly caused by peroneal nerve palsy. One study[114] evaluated children with spina bifida of which some of them had a plantarflexor paresis while others had both a plantar and a dorsiflexor paresis; therefore, results are reported in two categories. In addition, six studies evaluated people with a plantarflexor paresis, resulting from spina bifida[13, 23, 30, 86, 123] and polio[94]. And another eight studies[3, 22, 41, 42, 52, 59, 90, 93] evaluated people with both a plantar and a dorsiflexor paresis, mostly caused by Charcot Marie Tooth disease. In the remaining study[112], paresis type was unclear. Also after contacting the authors, this study could not be categorized as the study was performed too long ago for the authors to remember paresis type. Five AFO categories were identified: (i) dorsal AFO (no hinge/dorsal/polymer or carbon), (ii) ventral AFO (no hinge/ventral/ polymer or carbon), (iii) hinged AFO (hinge/dorsal/polymer or carbon), (iv) circular AFO (no hinge/circular/silicone or fabric), and (v) elastic AFO (no hinge/ventral string connecting tibia and foot, intended to lift the foot/elastic rubber). In three studies[30, 31, 42], AFOs were not specified. Contacting authors resulted in the categorisation into dorsal AFOs of all three studies.

Quality assessment

'Participant characteristics' were reported in more detail than 'research-specific criteria' (Table 2). Of the 'research-specific criteria' only 'non-selective outcome reporting' was adequately reported in a majority of the studies. While of the 'participant characteristics'; 'dorsiflexor muscle strength'; 'diagnose'; 'age'; and 'gender' were adequately reported in a majority of the studies. Sixteen studies had level III evidence[74]. Fourteen of these studies were cross-over trials[3, 23, 26, 30, 41, 52, 59, 75, 76, 86, 90, 93, 99, 123], and two were randomized controlled trials[32, 33]. In one of these trials[32], the randomization process was not reported, while in the other trial[33], the process was reported but did not result in adequate randomization. Therefore, these studies had level III and not II evidence. Eight studies had level IV evidence[74]. Six of these studies were cohort studies[13, 22, 42, 65, 94, 112] and two were case control trials[31, 114].

Study findings (Table 3)

Three studies[13, 90, 112] were not summarized because findings were unclear or biased. Findings of one study[112] could not be related to paresis type since this was unknown. Another study[13] reported excessive gait deviations without giving criteria for these deviations. In the last study[90], all results were in favor of a ventral AFO;

Table 1
Study methods

Author, year	Paresis type	Level of evidence	Number of participants (females)	Study design	Assessment (interval)	AFO tested (w or w/o shoes or N/A)	Control condition (w or w/o shoes)	Age mean±SD or [range]	Pathology	Paresis side(s)
Geboers et al. 2002a	DF	III	29 (8)	RCT	Follow-up: 6 weeks dorsal AFO use	Dorsal (w)	(w)	51	N/S	UL
Geboers et al. 2002b	DF	III	27 (7)	RCT	Single visit	Dorsal (N/S)	(N/S)	52±16	RP and/or PN	N/S
Menotti et al. 2014b	DF	III	23 (14)	COT	Single visit	Elastic (w) Dorsal (w)	(w)	57±15	†	UL&BL
Ramdharry et al. 2012	DF	III	14 (5)	COT	Single visit	Circular (w) Dorsal (w) Elastic (w)	(w)	38±14	CMT	BL
Farmer et al. 2006	DF	III	8 (4)	COT	Single visit	Circular (w) Dorsal (w)	(w)	35±17	CMT, FSHD, LGMD, MD	UL&BL
Menotti et al. 2014a	DF	III	7 (4)	COT	Single visit	Elastic (w)	(w)	37±11	CMT	N/S
Geboers et al. 2001	DF	IV	24 (8)	CC	Follow-up: 6 weeks dorsal AFO use	Dorsal (w)	(w)	N/S [20-80]	LL, PN	UL
Kutilek et al. 2014	DF	IV	9 (N/S)	CH	Single visit	Elastic (w) Circular (w)	(N/S)	46±15	PN	UL
Vankoski et al. 2000	PF	III	38 (N/S)	COT	Single visit	Dorsal (N/S)	(w/o)	10 [4-18]	SB	UL&BL
Park et al. 1997‡	PF	III	24 (13)	COT	Single visit	Dorsal (N/S) Hinged (N/S)	(w/o)	10±3	SB	BL
Duffy et al. 2000	PF	III	12 (3)	COT	Single visit	Dorsal (w)	(w/o)	11	SB	BL
Galli et al. 2000	PF	III	10 (N/S)	COT	Single visit	N/S (N/S)	(w/o)	9 [7-14]	SB	N/S
Ploeger et al. 2014‡	PF	IV	16 (9)	CH	Follow-up: 1 week dorsal or hinged AFO use	Dorsal (w) Hinged (w)	(w)	56±8	Polio	N/S
Carroll et al. 1982	PF	IV	15 (9)	CH	Single visit	Dorsal (w)	(N/S)	6 [2-11]	SB	BL
Thomson et al. 1999*	PF	IV	N/S 18 legs	CC	Single visit	Dorsal (w)	(w/o)	10	SB	UL&BL
Guillebastre et al. 2011	PF&DF	III	26 (11)	COT	Single visit	Elastic (w) Dorsal (w)	(w & w/o own AFO)	51±16	CMT	BL
Patzkowski et al. 2012	PF&DF	III	18 (0)	COT	Single visit preceded by carbon AFO training (12 weeks)	Ventral (w) Dorsal (w)	(w)	31±8	ATD, CS, fractures, KD, PN, TN	UL&BL
Kizilirmak et al. 2005‡	PF&DF	III	12 (3)	COT	Single visit	Dorsal (w) Hinged (w)	(w/o)	28±9	CES	BL
Bartonek et al. 2002	PF&DF	III	8 (5)	COT	Single visit	Hinged (w)	Hinged KAFO (w)	11±3	SB	BL
Phillips et al. 2012	PF&DF	III	8 (3)	COT	Follow-up: 28 weeks of preferred AFO use. Preceded by each AFO type use (3 weeks) with wash-out in between (1 week)	Circular (w) Dorsal (w)	(w & w/o)	57±14	CMT	BL
Hullin et al. 1992	PF&DF	III	6 (N/S)	COT	Single visit	Dorsal (w & w/o rocker sole)	(w/o)	N/S	SB	N/S
Hachisuka et al. 1997**	PF&DF	IV	22 (N/S)	CH	Single visit	Dorsal (N/S)	(N/S)	46±18	††	BL
Thomson et al. 1999*	PF&DF	IV	N/S 26 legs	CC	Single visit	Dorsal (w)	(w/o)	10	SB	UL&BL
Dufek et al. 2014	PF&DF	IV	8 (3)	CH	Single visit	Dorsal (N/S)	(N/S)	56±10	CMT	BL
Thomas et al. 1989	N/S	IV	7 (4)	CH	Single visit	Dorsal (w)	(N/S)	8 [4-11]	SB	BL

Table is sorted by (i) paresis type (DF/PF/PF&DF), (ii) level of evidence (high-low), (iii) number of participants (high-low), and (iv) author (alphabetically). *Abbreviations* ATD = achilles tendon deficiency, BL = bilateral, CC = case control, CES = cauda equina syndrome, CH = cohort, CMT = Charcot Marie Tooth disease, COT = cross-over trial, CS = compartment syndrome, DF = dorsiflexor, FSHD = fascio-scapulo-humeral dystrophy, KAFO = knee ankle foot orthosis, KD = knee dislocation, LGMD = limb girdle muscular dystrophy, LL = lumbar lesion, MD = myotonic dystrophy, N/S = not specified, OBS = observational design, PF = plantarflexor, PN = peroneal nerve palsy, RCT = randomized controlled trial, RP = radiculopathy, SB = spina bifida, TN = tibial nerve palsy, UL = unilateral, w = with, w/o = without. * The study of Thomson et al. 1999 was split into two participant groups (plantarflexor paresis with and without dorsiflexor paresis). † Amyotrophic lateral sclerosis, cerebral palsy, CMT, encephalomyelitis, FSHD, lateral popliteal nerve injury, MD, multiple sclerosis, myelomeningocele, polio, traumatic brain injury. †† Acute inflammatory demyelinating polyradiculoneuropathy, beriberi, cauda equina syndrome, CMT, distal myopathy with rimmed vacuoles, familial amyloid polyneuropathy, hereditary sensory autonomic neuropathy, lumbosacral spondylotic radiculopathy, myotonic atrophy, MD, peripheral neuropathy, SB, spondylolisthesis, vasculitic neuropathy. ‡ Three studies (Kizilirmak et al. 2005; Park et al. 1997; Ploeger et al. 2014) combined the results of dorsal and hinged AFOs in their study findings. **Hachisuka et al. 1997 described three studies. Only the study on AFO evaluation was included.

Table 2
Quality assessment results

Author, year	Research-specific criteria												PP characteristics					Other bias sources			
	RCT&COT				OBS					General											
	Sequence generation	Allocation concealment	Participants were blinded to orthosis type	Personnel was blinded	Participants source described	Eligibility criteria described	Comparable groups	Controls selected or matched	Control & cases population equal	Blinding of outcome assessor(s)	Incomplete outcome data	Selective outcome reporting	Dorsiflexor muscle strength	Plantarflexor muscle strength	Diagnosis	Age	Gender	Long term evaluation & stable condition	Baseline balance	Similar co-interventions	Orthotic vs. learning effect
Hullin et al. 1992	?	?	n	?						?	y	y	n	n	y	n	n	NA	NA	n	n
Park et al. 1997	?	?	n	?						?	?	y	n	y	y	y	y	NA	NA	?	n
Duffy et al. 2000	?	?	n	?						?	?	y	n	n	y	y	n	NA	NA	n	n
Galli et al. 2000	?	?	n	?						?	?	y	n	n	y	y	n	NA	NA	?	n
Vankoski et al. 2000	?	?	n	?						?	?	y	n	y	y	y	n	NA	?	?	n
Bartonek et al. 2002	n	?	n	?						?	n	y	y	y	y	y	y	NA	?	?	n
Geboers et al. 2002a	?	?	n	?						?	y	y	n	n	n	y	y	?	?	y	y
Geboers et al. 2002b	n	?	n	?						?	n	y	y	n	n	y	y	NA	NA	n	n
Kizilirmak et al. 2005	?	?	n	?			NA			?	?	y	n	n	y	y	y	NA	NA	n	n
Farmer et al. 2006	?	?	n	?						?	y	y	y	n	y	y	y	NA	NA	y	n
Guillebastre et al. 2011	?	?	n	?						?	?	y	y	y	y	y	y	NA	NA	y	n
Patzkowski et al. 2012	?	?	n	n						?	n	y	y	y	y	y	y	NA	NA	n	n
Phillips et al. 2012	?	n	n	y						n	?	y	y	y	y	y	y	?	?	n	n
Ramdharry et al. 2012	?	?	n	?						?	?	y	y	y	y	y	y	NA	NA	y	n
Menotti et al. 2014a	?	?	n	?						?	?	y	y	y	y	y	y	NA	NA	y	n
Menotti et al. 2014b	?	?	n	?						?	?	y	y	y	y	y	y	NA	NA	y	n
Carroll et al. 1982					y	n	NA	NA	NA	n	n	y	n	n	y	y	y	NA	NA	?	n
Thomas et al. 1989					n	n	NA	NA	NA	n	?	y	n	n	y	y	y	NA	NA	?	n
Hachisuka et al. 1997*					y	n	NA	NA	NA	?	n	y	n	n	y	y	y	NA	NA	?	n
Thomson et al. 1999					n	n	NA	n	n	?	y	y	n	n	y	y	n	NA	NA	n	n
Geboers et al. 2001			NA		n	n	y	n	y	?	n	y	y	n	y	y	y	y	y	y	y
Dufek et al. 2014					y	n	NA	NA	NA	?	?	y	y	y	y	y	y	NA	NA	?	n
Ploeger et al. 2014					n	y	NA	NA	NA	?	y	y	y	y	y	y	y	NA	NA	y	n
Kutilek et al. 2014					y	n	NA	NA	NA	?	?	y	n	n	y	y	y	NA	NA	?	n
Adequately reported (nr of y) †	0	0	0	1	4	1	1	0	1	0	5	24	12	11	22	23	19	1	1	8	2
Inadequately reported (nr of n) †	2	1	16	1	4	7	0	2	1	3	6	0	12	13	2	1	5	0	0	7	22
Unclear (nr of ?) †	14	15	0	14	0	0	0	0	0	21	13	0	0	0	0	0	0	2	4	9	0
Total	16	16	16	16	8	8	1	2	2	24	24	24	24	24	24	24	24	3	5	24	24

Table is sorted by (i) study design (RCT and COT/OBS), (ii) year of publication, (iii) author (alphabetically). *Abbreviations* COT = cross-over trial, n = no (high risk of bias), NA = not applicable, nr= number, OBS = observational design, PP = participant, RCT = randomized controlled trial, y = yes (low risk of bias), ? = unknown (uncertain risk of bias).Hachisuka et al. 1997 described three studies. Only the study on AFO evaluation was included. † Judgement criteria to score a ‘y’, ‘n’, ‘?’ or ‘NA’ are described in Appendix 2.

however, these results were more or less artificially created because all participants trained for 12 weeks with the ventral AFO (and not with the other AFOs that were additionally evaluated after the training period).

People with a dorsiflexor paresis

AFO effects on body functions

'Exercise tolerance' (three studies, all level III evidence[33, 75, 76]). Two of these studies[33, 76] evaluated dorsal AFOs compared to walking without AFO. One study[33] found that exercise tolerance increased with dorsal AFOs, while the other study[76] found no difference. In the study[33] that found an effect, 12 of 16 participants perceived walking effort to decrease[(1)].

Two studies[75, 76] evaluated elastic AFOs compared to walking with shoes. Both studies found that exercise tolerance increased with elastic AFOs. More specific, both energy cost(1)[76] and oxygen cost(1)[75] decreased with elastic AFOs.

One study[76] compared dorsal and elastic AFOs and found that energy cost decreased more(1) with elastic AFOs.

'Gait pattern' (one study, level III evidence[99]). Dorsal, elastic, and circular AFOs increased dorsiflexion during swing by 4-6° and none of these AFOs had an effect on maximum plantarflexion moment during push-off compared to walking with shoes[99].

AFO effects on activities

'Ensuring physical comfort' (two studies, both level III evidence[26, 76]. One of these studies compared circular and dorsal AFOs and found that circular AFOs were 2 points more comfortable on a 5-point scale[26]. The other study compared elastic and dorsal AFOs and found that elastic AFOs were more comfortable(1)[76].

'Walking' (five studies, all level III evidence[26, 33, 99, 75, 76]). All of these studies found no effect of dorsal[26, 33, 76, 99], elastic[75, 76, 99], or circular AFOs[26, 99] on comfortable walking speed compared to walking without AFO.

Two studies[26, 99] compared circular and dorsal AFOs. In one study[26], circular AFOs increased comfortable walking speed by 0.13m/s more than dorsal AFOs, while in the other study[99], no difference was found between AFOs.

Two studies[76, 99] compared elastic and dorsal AFOs. In one study[76], elastic AFOs increased comfortable walking speed more(1) than dorsal AFOs, while in the other study[99], no difference was found between AFOs.

People with a plantarflexor paresis

AFO effects on body functions

'Exercise tolerance' (three studies, level III[23, 30] and level IV[94] evidence). Two of these studies[23, 30] found that dorsal AFOs increased exercise tolerance compared to walking without AFO. In these two studies, both oxygen consumption decreased(1)[30] with 0.08ml/kg/m[23] and metabolic index(1) decreased[30]. One study[94] found no effect of dorsal and hinged AFOs on energy efficiency while it did find a decrease in perceived intensity of exertion of 4.5 on a 10-point scale compared to walking with shoes.

'Gait pattern' (three studies, level III[23, 123] and level IV[114] evidence). In all of these studies[23, 114, 123], dorsal AFOs increased maximum plantarflexion moment during push by 0.2-0.5Nm /kg compared to walking without AFO. One study[114]

[(1)] No quantitative data available.

evaluated ankle ROM and found that dorsal AFOs decreased ankle ROM by 12° compared to walking with shoes.

AFO effects on activities

'Walking' (four studies, level III[23, 86] and level IV[94, 114] evidence). Two of these studies[23, 114] evaluated dorsal AFOs and two studies[86, 114] combined results of dorsal- and hinged AFOs. In all four studies, AFOs increased comfortable walking speed compared to walking with shoes. Dorsal AFOs increased comfortable walking speed by 0.13-0.20m/s[23, 114]. Dorsal and hinged AFOs increased comfortable walking speed by 9%(1)[86] and by 0.08m/s[94].

People with both a plantar- and dorsiflexor paresis

AFO effects on body functions

'Exercise tolerance' (two studies, both level III evidence[3, 93]). One of these studies[93] evaluated dorsal and circular AFOs compared to walking without AFO. This study[93] found that both AFOs decreased the values found on the Borg scale of perceived exertion (6-20 scale) by 2.3-2.4 points. The other study[3] evaluated hinged AFOs and compared to knee ankle foot orthoses. This study[3] found a decrease in heart rate of 6 beats per minute with hinged AFOs.

'Gait pattern' (four studies, level III[52, 59] and level IV[22, 114] evidence). Two of these studies[52, 114] evaluated maximum ankle dorsiflexion during stance with dorsal AFOs compared to walking barefoot or rocker sole. Both studies found that dorsal AFOs decreased(1)[52] maximum ankle dorsiflexion by 12° in children[114].

Two studies[22, 114] evaluated maximum plantarflexion moment during push-off with dorsal AFOs compared to walking without AFO. Both studies found an increase(1)[22] with dorsal AFOs by 0.4Nm/kg[114].

Two studies[59, 114] evaluated ankle ROM with dorsal AFOs with and without hinged AFOs compared to walking without shoes. Both studies found that AFOs decreased ankle ROM. Dorsal AFOs decreased ankle ROM by 30° in children[114] and dorsal and hinged AFOs decreased ankle ROM by 22° in adults[59].

AFO effects on activities

'Ensuring physical comfort' (one study, level III evidence[93]). Circular AFOs were 2 points more comfortable on a 7-point Likert scale compared to dorsal AFOs[93].

'Walking' (six studies, level III[3, 41, 52, 93] and level IV[22, 114] evidence). Four of these studies[22, 52, 93, 114] compared walking with dorsal AFOs to walking without AFOs. In all four studies, dorsal AFOs increased comfortable walking speed. Dorsal AFOs increased comfortable walking speed by 0.18m/s[114] and by 12.5%(1)[52] in children and by 0.17m/s[93] and by 0.33 m/s in adults[22]. In the last study[22], this increase in comfortable walking speed with dorsal AFOs was found in six of eight adults, in the other two adults, no change was found.

Two studies compared walking with circular AFOs to participants' own AFO[41] or walking without AFO[93]. None of these studies found a change in comfortable walking speed. These same two studies compared dorsal to circular AFOs. One study[93] found that comfortable walking speed was 0.08m/s higher with dorsal AFOs, while the other study[41] found no difference. One study[3] compared walking with hinged AFO to walking with knee ankle foot orthoses and found no difference.

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(1) No quantitative data available.

Discussion

Twenty-four studies, evaluating 394 participants, were included. A majority (sixteen) of the studies had level III evidence; the other had level IV evidence. Three paresis groups (dorsiflexor, plantarflexor, and plantarflexor with dorsiflexor paresis) were distinguished. People with a dorsiflexor paresis benefit more from circular or elastic AFOs while people with a plantarflexor paresis (both with and without a dorsiflexor paresis) benefit more from dorsal AFOs.

Results from eleven studies (nine level III and two level IV evidence) suggest that AFOs generally improved the body functions 'Exercise tolerance' (five level III evidence studies) and 'Gait pattern' (six studies, four level III and two level IV evidence) in all three paresis groups compared to walking without AFO. AFOs generally also improved the activity 'Walking' (seven studies, four level III and three level IV evidence) in people with a plantarflexor paresis both with and without a dorsiflexor paresis. In all three paresis groups, AFOs in general increased walking efficiency compared to walking without AFO. Elastic AFOs increased walking efficiency in people with a dorsiflexor paresis (two level III evidence studies) and dorsal AFOs increased walking efficiency in people with a plantarflexor paresis both with and without a dorsiflexor paresis (three level III evidence studies). Note that evidence from studies evaluating the effects of ventral AFOs on walking efficiency are lacking. The increase in walking efficiency could partly be the result of the increase in dorsiflexion during swing by 4-6° and consequently a decrease of compensatory hip flexion during swing by 1-4° (evaluated by one level III evidence study), since especially compensatory hip flexion is energetic costly[91]. In people with a plantarflexor paresis (both with and without a dorsiflexor paresis), dorsal AFOs increased plantarflexion moment during push-off (four studies, two level III and two level IV evidence). This increase may explain the clinically relevant[125] increase (>0.10m/s) in comfortable walking speed since plantarflexion moment and gait speed were found to be correlated (r=0.7[22]). Comfortable walking speed only increased in people with a plantarflexor paresis both with and without a dorsiflexor paresis (seven studies, four level III and three level IV evidence) and not in people with a dorsiflexor paresis when using dorsal AFOs (five level III evidence studies). This increase, especially for people with a plantarflexor paresis, supports previous findings that the more severe the plantarflexor paresis, the more benefit from dorsal AFOs[22].

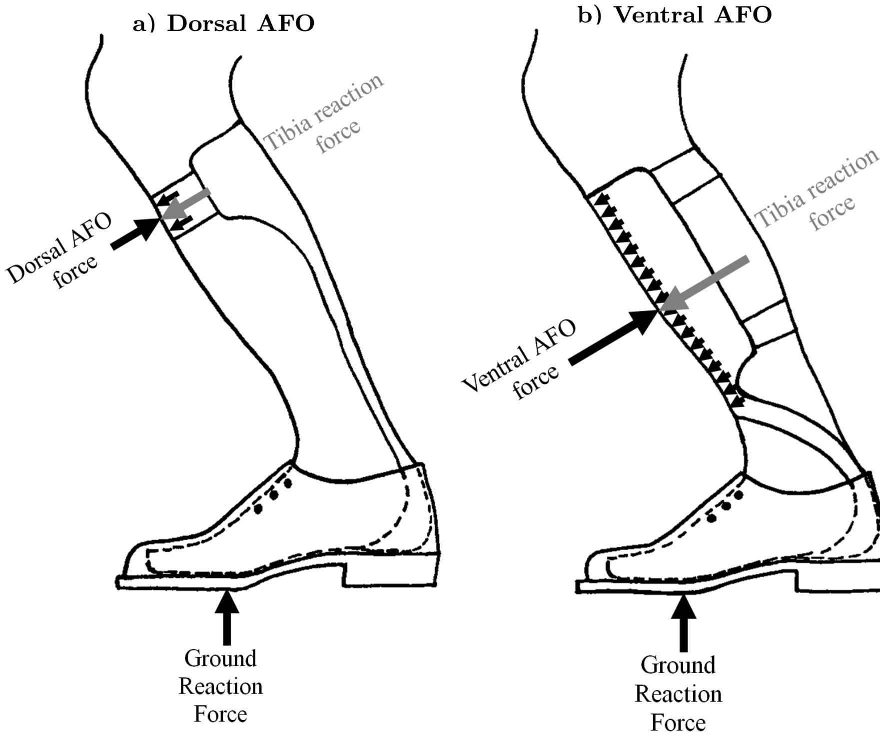
Results from five studies (four level III and one level IV evidence) suggest that AFOs had adverse effects on the body function 'Gait pattern'; more specific ankle ROM (two studies, one level III and one level IV evidence), and the activity 'Ensuring physical comfort' (three level III evidence studies) compared to walking without AFO. Especially, dorsal AFOs decreased ankle ROM to allow a maximum of 2° plantarflexion (two studies, one level III and one level IV evidence) and thereby impeding plantarflexion motion for an appropriate push-off[49]. An appropriate push-off power requires not only a plantarflexion moment (that is about 1.2Nm/kg when walking at 1.18m/s) but also a plantarflexion motion (about 17-20°)[49, 114]. Dorsal AFOs were less comfortable than elastic and circular AFOs (three level III evidence studies), probably as a result of the material used. Dorsal AFOs are made of rigid polymer or carbon, while elastic and circular AFOs are made of more flexible silicone rubber or fabric. Increasing physical comfort may increase adherence to AFO use[126].

Detailed study findings are summarized in Table 3. This overview can aid clinicians, designers of novel AFOs, and researchers. For example, for a person with a dorsiflexor paresis who likes gardening (requiring squats), clinicians can look up what AFO type is most suitable (circular AFOs or elastic AFOs). Designers can develop a list of requirements and compare these requirements to the results found with existing AFOs and norm values. For example, a person with a plantarflexor paresis exerts a maximum plantarflexion moment during push-off of 0.3Nm/kg when walking without AFO[23]. When walking with dorsal AFO, the same person can exert a maximum plantarflexion moment during push-off of 0.9Nm/kg[123]. Theoretically, if a designer evaluates a newly designed AFO and finds moments of 0.6Nm/kg, it would seem an improvement compared to walking without AFO. However, it may not be sufficient to only look at walking without AFO but also look at existing AFOs as norm-values for maximum plantarflexion moments are 1.2Nm/kg[83]. Researchers can identify the gaps in knowledge, looking at all the empty cells in Table 3, which aids in formulating new research questions. For example, when looking at the first line in Table 3, 'What are the effects of circular AFOs on energy cost in people with a dorsiflexor paresis?' Also on the data that are present in Table 3, a remark can be made. For example, two studies[41, 93] evaluated circular AFOs in people with a plantar flexor paresis (both with and without a dorsiflexor paresis). It can be questioned if circular AFOs are appropriate for these people as these AFOs should control knee flexion moment, bring the ground reaction force forward during mid-stance, and assist plantarflexion moment during push-off[8, 91, 10]. Circular AFOs made of silicone or fabric cannot provide such moments[18]. When a material with energy-storing properties (such as carbon) is used, more energy can be returned by the AFO[18]. Especially during late midstance and beginning push-off, the external dorsiflexor moments are large[68] (compared to loading response[68] or swing[140]. Stiff AFOs redirect the ground reaction force to a force on the tibia, through the part of the AFO that connects the footplate to the leg-part of the AFO (Figure 2). Thereby, ankle dorsiflexion is prevented. As a result, the tibia exerts a reaction force on the contact area of the AFO. With dorsal AFOs, this contact area is usually a small band (Figure 2a), and therefore, the tibia reaction force will result in a large and possibly uncomfortable pressure (force per area). Ventral AFOs may be more suitable due to the larger contact area (Figure 2b) and thus lower pressure on the tibia. Unfortunately, the results of the only study evaluating ventral AFOs[90] were not comparable to the other AFO conditions because all participants trained for 12 weeks with the ventral AFO (and not the other AFOs that were also evaluated after the training period). All findings in this study were in favour of the ventral AFO; however, that might be the result of the training period. More studies are needed to evaluate ventral AFOs in people with a plantarflexor paresis (both with and without a dorsiflexor paresis).

Methodological issues and future research

The quality assessment scale used was specially developed for this systematic review, and criteria were used from other often used and validated scales[131, 48, 73]. As this new scale was not validated, comparing results of included studies when using another quality scale may result in differences. Results from the quality assessment showed that research-specific criteria were generally not adequately reported in the included studies (Table 2). In 14 of the 16 randomized controlled and cross-over trials,

Figure 2
Pressure distribution



In AFOs consisting of stiff material and a long footplate, the ground reaction force is redirected by the AFO into a force on the tibia during late mid-stance/beginning push-off. As a result, the tibia exerts a reaction force on the AFO. **a)** A small contact area results in a higher pressure with dorsal AFOs. **b)** Although the moment arm of the tibia reaction force is smaller, resulting in a larger tibia reaction force, the large contact area results in a lower pressure with ventral AFOs.

the sequence generation process was not reported. In the remaining two studies, the sequence generation process was reported, but the process did not result in adequate randomization. This resulted in only level III (and not II) evidence studies. Also, a majority of the observational studies (seven of eight) did not provide a description of both inclusion and exclusion criteria to determine who was eligible to participate in the study. Future studies should report these research characteristics.

Pooling data were impossible due to clinical and methodological heterogeneity. In the control condition, some participants walked barefoot while it is preferred to walk with shoes[16]. Walking with shoes only can already improve gait parameters compared to walking barefoot[16]. Three studies[30, 31, 42] did not specify which AFO type (dorsal/ventral/hinged/circular or elastic) was evaluated, and one study[112] did not specify paresis type of participants. Inadequate reporting hampers interpreting results and makes adequate study comparisons difficult. Future studies should develop a uniform set of outcomes. Also, future studies should report both pre- and post-intervention outcomes to enable pooling.

Grouping participants in paresis type was needed to more accurately evaluate AFO effects, important to each paresis type. Only nine of 24 studies reported both dorsiflexor and plantarflexor muscle strength[3, 22, 41, 75, 76, 90, 93, 94, 99], making grouping according to muscle strength impossible. As an alternative, grouping into paresis type was performed according to the studies' participant description. Future studies should report both dorsiflexor and plantarflexor muscle strength to be able to adequately distinguish paresis groups.

A large variety of AFOs also necessitated the need for grouping. AFOs are preferably grouped according to mechanical properties such as stiffness and neutral ankle angle (angle between shank cover and foot plate) as described in detail in previous literature published in 2011[8]. However, none of the included studies reported all mechanical properties, probably because the majority (15 of 24 studies) was published before 2011 and therefore they may not have been aware of the detail in which the mechanical properties should be described. In this review, AFOs were therefore grouped according to hinge, orientation, and material type. But as variation in thickness, trim line, and footplate influence AFO properties[8], the generalizability of AFO categories is limited. Since the effect of an AFO is directly related to its mechanical properties, future studies should report these properties of the AFOs they evaluate.

Another methodological issue concerned the classification of fall incidents in the ICF. According to the ICF, falling can be classified as the body function 'Sensation of falling'[136], but fall incidents can also be classified as the activity 'Maintaining a body position'[11]. Both classifications raise questions. In the ICF, activities are described as 'the execution of a task or action by an individual'[136]. In our opinion, fall incidents cannot be seen as an activity since this suggests a person intends to fall. Falling may not be an activity, but it is also more than just a sensation. More research is needed to be able to adequately classify fall incidents.

Conclusion

Both beneficial and adverse effects of AFO use were found on body functions and activities. Circular, elastic, and dorsal AFOs increased dorsiflexion during swing and dorsal AFOs increased both plantarflexion moment during push-off and comfortable walking speed. Energy efficiency during walking increased with AFOs (elastic AFOs in people with a dorsiflexor paresis and dorsal AFOs in people with a plantarflexor paresis both with and without a dorsiflexor paresis). Adverse effects of especially dorsal AFOs were noted on ankle ROM and physical comfort. There is a gap in literature concerning the evaluation of ventral AFOs. People with a dorsiflexor paresis benefit more from circular and elastic AFOs while people with a plantarflexor paresis (both with and without a dorsiflexor paresis) benefit more from dorsal AFOs.

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Conflicts of interest

The authors declare no conflicts of interest.

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Table 3

Study findings on effects of AFOs on body functions and activities

(i) People with a dorsiflexor paresis

Author, year	ICF Category (B/A)	Outcome variable	Norm value	Control Condition	Control Data	AFO condition Dorsal (D)	AFO condition Elastic (E)	AFO condition Circular (C)	Significant
Menotti et al. 2014b	Exercise tolerance (B)	Energy cost, comfortable walking speed		w shoes	No change	No change	Decreased		*E‡D↔E
Geboers et al. 2002b		Walking effort, perceived		w or w/o shoes		Decreased in 12 of 16			Unknown
Menotti et al. 2014a		Oxygen cost, comfortable walking speed		w shoes	Unknown		Decreased		*
Ramdharry et al. 2012	Gait pattern (B)	Ankle DF, swing		w shoes		6° increase	5° increase	4° increase	*DEC
Ramdharry et al. 2012		Ankle PF moment MAX, stance	1.2±0.3Nm/kg	w shoes		No change	No change	No change	NS
Ramdharry et al. 2012		Ankle PF power total, stance		w shoes		Decreased	No change	No change	*D‡C↔D
Ramdharry et al. 2012		Contralateral knee extension, stance		w shoes		No change	No change	No change	NS
Ramdharry et al. 2012		Hip abduction MAX, swing		w shoes		No change	No change	No change	NS
Kutilek et al. 2014		Hip inclination angle (right correlated to left angles)		N/S	57[47;58]°		(i) 58[49;60]° (ii) 56[53;64]°	55[53;59]°	*E(ii)
Ramdharry et al. 2012		Hip flexion MAX, swing		w shoes		1° decrease	2° decrease	4° decrease	*DEC
Ramdharry et al. 2012		Hip moment MAX, stance		w shoes		No change	No change	No change	NS
Kutilek et al. 2014		Hip ROM gait symmetry index (non-paretic/paretic)		N/S	0.7[0.6;0.7]		(i) 0.8[0.4;0.8] (ii) 0.7[0.4;0.9]	0.8[0.6;0.9]	NS
Ramdharry et al. 2012		Hip total power, stance		w shoes		No change	No change	No change	NS
Ramdharry et al. 2012		Pelvic ROM frontal plane, swing		w shoes		No change	No change	No change	NS
Geboers et al. 2001	Muscle power (B)	Ankle DF torque restoration, T0-T6		w shoes	17±15% increase	9±12% increase			NS
Geboers et al. 2002a		Total electromyographic activity, GC T0-T6		w shoes		No change			NS
Geboers et al. 2002a		Total musle reaction, GC T0-T6		w shoes		No change			NS
Geboers et al. 2002a		Extensor digitorum longus activity, GC	With dorsal AFO	w shoes		Decreased			*
Geboers et al. 2002a		Extensor digitorum longus activity at 15%GC	With dorsal AFO	w shoes		No change			NS
Geboers et al. 2002a		Gastrocnemius activity, GC	With dorsal AFO	w shoes		No change			NS
Geboers et al. 2002a		Peroneus longus activity, GC	With dorsal AFO	w shoes		No change			NS
Geboers et al. 2002a		Soleus activity, GC	With dorsal AFO	w shoes		No change			NS
Geboers et al. 2002a		Tibialis anterior activity, GC	With dorsal AFO	w shoes		7% decrease			*
Geboers et al. 2002a		Tibialis anterior activity at 15%GC	With dorsal AFO	w shoes		No change			NS

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Table 3 (*continued*)

(i) People with a dorsiflexor paresis

Author, year	ICF	Outcome variable	Norm value	Control		AFO condition			Significant
	Category (B/A)			Condition	Data	Dorsal (D)	Elastic (E)	Circular (C)	
Geboers et al. 2002b	Climbing (A)	Stair walking, perceived		w or w/o shoes		No change			Unknown
Geboers et al. 2002b		Stair walking and level walking, perceived		w or w/o shoes		No change			NS
Farmer et al. 2006		Stair and slope walking ability, perceived		w shoes		Decreased in 2 of 8		Decreased in 2 of 8	Unknown
Farmer et al. 2006	Donning footwear (A)	Donning ability, perceived		w shoes		Decreased in 3 of 8		Decreased in 1 of 8	Unknown
Farmer et al. 2006	Ensuring physical comfort (A)	Comfort (1-5 = worst perceived)		w shoes	1.8±1.1	4.1±0.9		2.1±0.4	Unknown
Menotti et al. 2014b		Comfort (0-100 = best perceived)		w shoes		Decreased	Increased		‡
Farmer et al. 2006	Maintaining a standing position (A)	Stability (5-1 = best perceived)		w shoes	2.8±0.8	3.8±1.4		1.4±0.6	Unknown
Farmer et al. 2006		Standing ability, perceived		w shoes		Decreased in 1 of 8		Decreased in 1 of 8	Unknown
Geboers et al. 2002b	Squatting (A)	Squatting ability, perceived		w or w/o shoes		Decreased			Unknown
Geboers et al. 2002b	Walking (A)	6 minute walking test		w or w/o shoes		No change			NS
Menotti et al. 2014a¶		Cadence, comfortable		w shoes	104±12spm		110±13spm		NS
Menotti et al. 2014b				w shoes	85±19spm	82±18spm	86±18spm		NS
Ramdharry et al. 2012				w shoes		No change	No change	No change	NS
Menotti et al. 2014a¶		Cadence, MAX		w shoes	117±12spm		117±24spm		NS
Menotti et al. 2014a¶		Cadence, MIN		w shoes	92±7spm		92±11spm		NS
Farmer et al. 2006		Walking performance, perceived		w shoes		Increased		Increased	Unknown
Geboers et al. 2002b				w or w/o shoes		Increased in 12 of 16			Unknown
Farmer et al. 2006		Walking speed, comfortable	1.30±0.20m/s	w shoes	1.17±0.19m/s	1.02±0.19m/s		1.15±0.19m/s	‡
Geboers et al. 2002b				w or w/o shoes		No change			Unknown
Menotti et al. 2014a		Walking speed, comfortable		w shoes	1.03±0.19m/s		0.99±0.16m/s		NS
Menotti et al. 2014b				w shoes	No change	No change	Increased		‡
Ramdharry et al. 2012				w shoes		No change	No change	No change	NS
Geboers et al. 2002b		Walking speed, MAX		w or w/o shoes		No change			NS
Menotti et al. 2014a				w shoes	1.30±0.18m/s		1.32±0.16m/s		NS
Menotti et al. 2014a		Walking speed, MIN		w shoes	0.82±0.12m/s		0.78±0.12m/s		NS
Menotti et al. 2014a		Step length, comfortable		w shoes	0.59±0.06m		0.59±0.06m		NS
Menotti et al. 2014b				w shoes	No change	No change	Increased		*
Ramdharry et al. 2012				w shoes		No change	No change	No change	NS
Menotti et al. 2014a		Step length, MAX		w shoes	0.66±0.06m		0.68±0.06m		NS
Menotti et al. 2014a		Step length, MIN		w shoes	0.53±0.05m		0.52±0.04m		NS
Ramdharry et al. 2012		Support time, double support		w shoes		No change	No change	No change	NS

(ii) People with a plantarflexor paresis

Author, year	ICF	Outcome variable	Norm value	Control		AFO condition		Significant
	Category (B/A)			Condition	Data	Dorsal	Dorsal+Hinged	
Ploeger et al. 2014	Exercise tolerance (B)	Energy efficiency, comfortable walking speed	3.3±0.3J/kg/min	w shoes	5.2±1.7J/kg/min		4.8±1.2J/kg/min	NS
Ploeger et al. 2014		Intensity of exertion (0-10 = best perceived)		w shoes	3.0[2.0;5.0]		7.5[6.0;8.0]	*
Duffy et al. 2000		Oxygen cost, comfortable walking speed		w shoes	0.41±?ml/kg/m	0.33±?ml/kg/m		*
Galli et al. 2000			Normal	w or w/o shoes	Increased per min	Less increased per min		†*
Galli et al. 2000		Metabolic index	Normal	w or w/o shoes	Increased	Less increased		†*
Thomson et al. 1999	Gait pattern (B)	Ankle DF, initial contact	0±6°	w shoes	2±4°	3±5°		NS
Vankoski et al. 2000(i)§		Ankle DF, GC		w or w/o shoes	16±6°	11±6°		*
Vankoski et al. 2000(ii)§				w or w/o shoes	12±5°	14±7°		*
Ploeger et al. 2014		Ankle DF MAX, mid-stance	10±2°	w shoes	5±7°		2±8°	*
Thomson et al. 1999		Ankle DF MAX, stance	14±3°	w shoes	23±6°	14±6°		*
Vankoski et al. 2000(i)§				w or w/o shoes	29±8°	20±8°		*
Vankoski et al. 2000(ii)§				w or w/o shoes	24±5°	24±8°		NS
Ploeger et al. 2014		Ankle DF MAX, terminal stance	14±2°	w shoes	19±6°		14±7°	*
Thomson et al. 1999		Ankle DF MAX timing, stance	36±8%GC	w shoes	50±4%GC	49±4%GC		NS
Ploeger et al. 2014		Ankle PF moment, mid-stance	0.4±0.1Nm/kg	w shoes	0.2±0.2Nm/kg		0.1±0.3Nm/kg	NS
Vankoski et al. 2000(i)§		Ankle PF moment, push-off		w or w/o shoes	0.3±0.2Nm/kg	0.4±0.2Nm/kg		*
Vankoski et al. 2000(ii)§				w or w/o shoes	0.2±0.1Nm/kg	0.4±0.1Nm/kg		*
Thomson et al. 1999		Ankle PF moment MAX, push-off	1.2±0.3Nm/kg	w shoes	0.6±0.3Nm/kg	0.8±0.2Nm/kg		*
Vankoski et al. 2000(i)§				w or w/o shoes	0.6±0.3Nm/kg	0.8±0.2Nm/kg		*
Vankoski et al. 2000(ii)§				w or w/o shoes	0.4±0.2Nm/kg	0.9±0.3Nm/kg		*
Duffy et al. 2000¶				w shoes	0.3±?Nm/kg	0.7±?Nm/kg		*
Vankoski et al. 2000(i)§		Ankle PF moment MAX timing, stance		w or w/o shoes	0.4±0.2s	0.5±0.1s		NS
Vankoski et al. 2000(ii)§				w or w/o shoes	0.4±0.0s	0.5±0.1s		NS
Duffy et al. 2000		Ankle PF power MAX, push-off	3.5±1.2W/kg	w shoes	0.5±?W/kg	1.3±?W/kg		*
Thomson et al. 1999				w shoes	1±0.7W/kg	0.8±0.4W/kg		NS
Ploeger et al. 2014			4.8±1.1W/kg	w shoes	1.5±0.8W/kg		1.1±0.7W/kg	*
Ploeger et al. 2014		Ankle PF power MAX timing, push-off	55±1%GC	w shoes	55[53;57]%GC		56[54;57]%GC	NS

(continued on next page)

Table 3 (*continued*)

(ii) People with a plantarflexor paresis

Author, year	ICF Category (B/A)	Outcome variable	Norm value	Control Condition	Control Data	AFO condition Dorsal	AFO condition Dorsal+Hinged	Significant
Thomson et al. 1999	Gait pattern (B)	Ankle PF MAX, swing	17±7°	w shoes	2±4°	-1±5°		NS
Thomson et al. 1999		Ankle PF MAX timing, swing	63±2%GC	w shoes	88±14%GC	81±10%GC		NS
Thomson et al. 1999		Ankle ROM sagittal plane, GC	32±7°	w shoes	28±5°	16±5°		*
Ploeger et al. 2014		COP progression, mid-stance	95±15mm	w shoes	29±26mm		48±29mm	*
Thomson et al. 1999		Foot progression, stance	12±12°toes out	w shoes	8±19°toes out	4±17° toes in		*
Duffy et al. 2000		Hip extension MAX, stance		w shoes	9±?°	9±?°		NS
Duffy et al. 2000		Hip angle at initial contact		w shoes	51±?°	55±?°		*
Duffy et al. 2000		Hip ROM frontal plane, GC		w shoes	21±?°	19±?°		NS
Duffy et al. 2000		Hip ROM sagittal plane, GC		w or w/o shoes		Decreased		*
Ploeger et al. 2014		Heel off timing, GC	37±4%GC	w shoes	50±3%GC		44±8%GC	*
Thomson et al. 1999		Knee abduction, stance	1±3°	w shoes	1±3°	0±3°		NS
Duffy et al. 2000		Knee angle, initial contact	8±5°	w shoes	23±?°	21±?°		NS
Thomson et al. 1999				w shoes	15±8°	9±8°		*
Park et al. 1997		Knee flexion, stance	15±5°	w or w/o shoes	26±12°		17±11°	*
Thomson et al. 1999				w shoes	20±8°	15±10°		*
Vankoski et al. 2000(i)§				w or w/o shoes	27±13°	18±11°		*
Vankoski et al. 2000(ii)§				w or w/o shoes	23±8°	17±8°		NS
Duffy et al. 2000		Knee flexion MIN, stance		w shoes	16±?°	16±?°		NS
Ploeger et al. 2014		Knee flexion MAX, mid-stance	-7±4°	w shoes	-11±8°		-9±7°	*
Vankoski et al. 2000(i)§		Knee flexion MAX, stance		w or w/o shoes	44±12°	44±9°		NS
Vankoski et al. 2000(ii)§				w or w/o shoes	38±9°	38±9°		NS
Ploeger et al. 2014		Knee flexion MAX, terminal stance	-1±3°	w shoes	-9±7°		-4±8°	*
Thomson et al. 1999		Knee flexion MAX, swing	65±6°	w shoes	53±8°	60±17°		*
Duffy et al. 2000				w shoes	58±?°	62±?°		NS
Thomson et al. 1999		Knee flexion MAX timing, swing	71±2%GC	w shoes	76±4%GC	73±4%GC		*
Thomson et al. 1999		Knee moment frontal plane, stance	0.2±0.1Nm/kg	w shoes	0.1±0.1Nm/kg	0.1±0Nm/kg		NS
Ploeger et al. 2014		Knee moment internal extension, mid-stance	0.3±0.2Nm/kg	w shoes	0.3±0.2Nm/kg		0.1±0.2Nm/kg	NS
Park et al. 1997		Knee moment internal extension, stance	0.1±0.1Nm/kg	w or w/o shoes	0.4±0.2Nm/kg		0.3±0.2 Nm/kg	*
Vankoski et al. 2000(i)§				w or w/o shoes	0.4±0.2Nm/kg	0.3±0.2Nm/kg		*
Vankoski et al. 2000(ii)§				w or w/o shoes	0.3±0.1Nm/kg	0.2±0.1Nm/kg		NS
Thomson et al. 1999				w shoes	0.3±0.2Nm/kg	0.2±0.2Nm/kg		*

Ploeger et al. 2014	Gait pattern (B)	Knee moment internal extension, terminal stance	-0.2±0.1Nm/kg	w shoes	0.2±0.2Nm/kg		0.1±0.2Nm/kg	NS
Vankoski et al. 2000(i)§		Knee moment MAX internal extension, stance		w or w/o shoes	0.8±0.4Nm/kg	0.6±0.3Nm/kg		*
Vankoski et al. 2000(ii)§				w or w/o shoes	0.6±0.1Nm/kg	0.5±0.2Nm/kg		NS
Galli et al. 2000		Knee ROM sagittal plane, GC	62±6°	w or w/o shoes		No change		NS
Thomson et al. 1999				w shoes	43±9°	56±13°		*
Park et al. 1997				w or w/o shoes	66±?°		43±?°	Unknown
Thomson et al. 1999		Knee ROM transverse plane, stance	11±5°	w shoes	15±6°	23±9°		*
Galli et al. 2000		Pelvic ROM frontal plane, GC	Normal	w or w/o shoes	Increased	Less increased		*
Duffy et al. 2000		Pelvic ROM sagittal plane, GC		w shoes	14±?°	15±?°		NS
Galli et al. 2000			Normal	w or w/o shoes	Increased	Less increased		Unknown
Duffy et al. 2000		Pelvic ROM transverse plane, GC		w shoes	38±?°	37±?°		NS
Galli et al. 2000			Normal	w or w/o shoes	Increased	Less increased		*
Park et al. 1997		Toe off timing, GC	58±1%GC	w or w/o shoes	64±?%GC		63±?%GC	NS
Ploeger et al. 2014			61±1%GC	w shoes	61[58;63]		61[60;63]	NS
Thomson et al. 1999			58±1%GC	w shoes	63±21%GC	61±4%GC		NS
Galli et al. 2000		Upright standing angles, perceived		w or w/o shoes	More different	Less different		Unknown
Ploeger et al. 2014	Sensation of falling (B)	Fear of falling (0-10 = best perceived)		w shoes	4.5[2.3;6.8]		7.5[5.3;9.0]	NS
Park et al. 1997	Muscle power (B)	Gluteus maximus activity onset, GC	27%GC	w or w/o shoes	90±7%GC		10±5%GC	NS
Park et al. 1997		Gluteus maximus activity offset, GC	26%GC	w or w/o shoes	39±12%GC		38±11%GC	NS
Park et al. 1997		Gluteus medius activity onset, GC	93%GC	w or w/o shoes	84±14%GC		83±16%GC	NS
Park et al. 1997		Gluteus medius activity offset, GC	37%GC	w or w/o shoes	42±12%GC		42±13%GC	NS
Park et al. 1997		Hamstrings activity onset, GC	81-83%GC	w or w/o shoes	84±7%GC		82±8%GC	NS
Park et al. 1997		Hamstrings activity offset, GC	23-31%GC	w or w/o shoes	35±16%GC		33±16%GC	NS
Park et al. 1997		Rectus femoris activity onset, GC	52%GC	w or w/o shoes	62±5%GC		59±6%GC	*
Park et al. 1997		Rectus femoris activity second onset, GC	95%GC	w or w/o shoes	88±8%GC		89±5%GC	NS
Park et al. 1997		Rectus femoris activity offset, GC	14%GC	w or w/o shoes	43±11%GC		33±13 %GC	*
Park et al. 1997		Rectus femoris activity second offset, GC	67%GC	w or w/o shoes	76±7%GC		75±6%GC	NS

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Table 3 (*continued*)

(ii) People with a plantarflexor paresis

Author, year	ICF Category (B/A)	Outcome variable	Norm value	Control Condition	Control Data	AFO condition Dorsal	AFO condition Dorsal+Hinged	Significant
Ploeger et al. 2014	Climbing (A)	Stair walking safety (0-10 = best perceived)		w shoes	6.0[4.3;8.0]		7.0[4.5;8.0]	NS
Thomson et al. 1999	Walking (A)	Cadence, comfortable	128±12spm	w shoes	124±14spm	117±8spm		*
Duffy et al. 2000				w shoes	116±?spm	116±?spm		NS
Ploeger et al. 2014		Walking distance, MAX in 6 minutes	537±36m	w shoes	362±67m		392±61m	*
Ploeger et al. 2014		Walking, overall satisfaction (0-100=best perceived)		w shoes	20[14;50]		78[67;91]	*
Ploeger et al. 2014		Walking performance, perceived		w shoes	4.0[2.0-6.0]		8.0[7.0-8.8]	*
Ploeger et al. 2014		Walking safety, perceived		w shoes	4.0[3.0-6.0]		8.0[7.0-8.8]	*
Ploeger et al. 2014		Walking safety on uneven surface (0-10 = best perceived)		w shoes	3.0[2.0;4.8]		6.0[3.3;7.0]	NS
Duffy et al. 2000		Walking speed, comfortable	1.18±0.13m/s	w shoes	0.83±?m/s	0.97±?m/s		*
Duffy et al. 2000				w shoes	0.86±?m/s	1.06±?m/s		*
Park et al. 1997			100%	N/S	73.9±12.6%		83.3±15.6%	*
Ploeger et al. 2014			1.49±0.10m/s	w shoes	1.01±0.18m/s		1.09±0.17m/s	*
Thomson et al. 1999			1.18±0.13m/s	w shoes	0.88±0.21m/s	1.01±0.16m/s		*
Ploeger et al. 2014		Walking stability, perceived		w shoes	4.0[3.0-5.0]		8.0[7.0-8.0]	*
Duffy et al. 2000		Step length, comfortable	0.56±0.08m	w shoes	0.45±?m	0.54±?m		*
Thomson et al. 1999				w shoes	0.43±0.09m	0.52±0.08m		*
Ploeger et al. 2014‖			0.66±0.08m	w shoes	0.60±0.21m		0.64±0.19m	*
Duffy et al. 2000		Support time, double support		w shoes	0.32±?s	0.28±?s		*
Duffy et al. 2000		Support time, single support		w shoes	0.37±?s	0.38±?s		NS

(iii) People with both a plantar- and dorsiflexor paresis

Author, year	ICF Category (B/A)	Outcome variable	Norm value	Control Condition	Control Data	AFO condition Dorsal	AFO condition Hinged	AFO condition Circular	AFO condition Dorsal+ Hinged	Significant
Phillips et al. 2012	Exercise tolerance (B)	Borg scale (6-20 scale)		w&w/o shoes	10.8 (95%CI5.4;16.2)	8.4 (95%CI3.7;13.0)		8.5 (95%CI2.5;14.5)		Unknown
Bartonek et al. 2002		Heart rate, comfortable walking speed		KAFO	140±19bpm		134±20bpm			*
Kizilirmak et al. 2005	Gait pattern (B)	Ankle DF, initial contact	0±6°	w/o shoes	-2±9°				2±6°	*
Thomson et al. 1999				w/o shoes	4±4°	-8±9°				NS
Kizilirmak et al. 2005		Ankle DF, toe off		w/o shoes	1±15°				11±10°	*
Hullin et al. 1992		Ankle DF MAX, stance	14±3°	w&w/o RS		Decreased				Unknown
Thomson et al. 1999				w/o shoes	25±7°	13±4°				*
Thomson et al. 1999		Ankle DF MAX timing, stance	36±8%GC	w/o shoes	50±11%GC	47±6%GC				NS

Dufek et al. 2014	Gait pattern (B)	Ankle DF moment MAX, loading response		w or w/o shoes	Increased in 5 of 8			*
					Decreased in 1 of 8			*
					No change in 2 of 8			NS
Kizilirmak et al. 2005		Ankle PF MAX, swing	17±7°	w/o shoes 23±19°			2±9°	*
Thomson et al. 1999				w/o shoes 16±12°	0±4°			*
Thomson et al. 1999		Ankle PF MAX timing, swing	63±2%GC	w/o shoes 85±12%GC	81±12%GC			NS
Dufek et al. 2014		Ankle PF moment MAX, push-off		w or w/o shoes	Increased in 6 of 8			*
					No change in 2 of 8			NS
Thomson et al. 1999			1.2±0.3Nm/kg	w/o shoes 0.5±0.3Nm/kg	0.9±0.2Nm/kg			*
Dufek et al. 2014		Ankle PF power generation MAX, loading response		w or w/o shoes	Increased in 7 of 8			*
					No change in 1 of 8			NS
Dufek et al. 2014		Ankle PF power generation MAX, push-off		w or w/o shoes	0.6±0.6W/kg increase in 5 of 8			*
					Decreased in 1 of 8			*
					No change in 2 of 8			NS
Thomson et al. 1999			3.5±1.2W/kg	w/o shoes 0.9±0.8W/kg	0.7±0.3W/kg			NS
Kizilirmak et al. 2005		Ankle ROM sagittal plane, GC	32±7°	w/o shoes 42±16°			20±6°	*
Thomson et al. 1999				w/o shoes 43±14°	13±5°			*
Hullin et al. 1992		COP progression, stance		w&w/o RS None at single stance	Rapid to end AFO			Unknown
Thomson et al. 1999		Foot progression, stance	12±12°toes out	w/o shoes 18±17°toes out	12±17°toes out			*
Hullin et al. 1992		Heel lift, single stance, observed		w&w/o RS None	None			Unknown
Guillebastre et al. 2011		Heel on-off		N/S AFO	No change	No change		NS
Kizilirmak et al. 2005		Hip flexion MAX, stance		w/o shoes 46±14°			39±9°	*
Kizilirmak et al. 2005		Hip flexion MAX, swing		w/o shoes 3±14°			1±14°	NS
Dufek et al. 2014		Hip flexion moment MAX, loading response		w or w/o shoes	Increased in 5 of 8			*
					Decreased in 2 of 8			*
					No change in 1 of 8			NS
Dufek et al. 2014		Hip flexion moment MAX, push-off		w or w/o shoes	Increased in 4 of 8			*
					Decreased in 1 of 8			*
					No change in 3 of 8			NS
Dufek et al. 2014		Hip power generation MAX, loading response		w or w/o shoes	Increased in 4 of 8			*
					No change in 4 of 8			NS
Dufek et al. 2014		Hip power absorption MAX, push-off		w or w/o shoes	Increased in 3 of 8			*
					Decreased in 1 of 8			*
					No change in 4 of 8			NS
Kizilirmak et al. 2005		Hip ROM sagittal plane, GC		w/o shoes 45±1°			6±8°	*
Thomson et al. 1999		Knee abduction, stance	1±3°	w/o shoes 2±5°	1±6°			NS
Hullin et al. 1992		Knee flexion, stance	15±5°	w&w/o RS	Decreased			Unknown
Thomson et al. 1999				w/o shoes 26±10°	21±11°			NS
Kizilirmak et al. 2005		Knee flexion, initial contact	8±5°	w/o shoes -6±7°			-4±5°	NS
Thomson et al. 1999				w/o shoes 18±12°	14±11°			NS
Kizilirmak et al. 2005		Knee flexion MAX, stance		w/o shoes -7±8°			-7±6°	NS
Kizilirmak et al. 2005		Knee flexion MAX, 10% stance		w/o shoes -5±6°			1±6°	*

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Table 3 (*continued*)

(iii) People with both a plantar- and dorsiflexor paresis

Author, year	ICF Category (B/A)	Outcome variable	Norm value	Control Condition	Control Data	AFO condition Dorsal	Hinged	Circular	Dorsal+ Hinged	Significant
Kizilirmak et al. 2005	Gait pattern (B)	Knee flexion MAX, swing	65±6°	w/o shoes	38±17°				34±14°	NS
Thomson et al. 1999				w/o shoes	58±17°	57±9°				NS
Thomson et al. 1999		Knee flexion MAX timing, swing	71±2%GC	w/o shoes	79±6%GC	75±4%GC				*
Thomson et al. 1999		Knee flexion moment frontal plane, push-off	0.2±0.1Nm/kg	w/o shoes	0.0±0.1Nm/kg	0.0±0.1Nm/kg				NS
Thomson et al. 1999		Knee flexion moment, push-off	0.1±0.1Nm/kg	w/o shoes	0.4±0.2Nm/kg	0.1±0.1Nm/kg				*
Dufek et al. 2014		Knee flexion moment MAX, loading response		w or w/o shoes		Increased in 1 of 8				*
						Decreased in 5 of 8				*
						No change in 2 of 8				NS
Dufek et al. 2014		Knee flexion moment MAX, push-off		w or w/o shoes		Increased in 5 of 8				*
						Decreased in 2 of 8				*
						No change in 1 of 8				NS
Hullin et al. 1992				w&w/o RS		Decreased				Unknown
Dufek et al. 2014		Knee power generation MAX, loading response		w or w/o shoes		Increased in 5 of 8				*
						Decreased in 1 of 8				*
						No change in 2 of 8				NS
Dufek et al. 2014		Knee power generation MAX, push-off		w or w/o shoes		Increased in 4 of 8				*
						Decreased in 1 of 8				*
						No change in 3 of 8				NS
Kizilirmak et al. 2005		Knee ROM sagittal plane, GC	62±6°	w/o shoes	50±16°				-5±6°	*
Thomson et al. 1999				w/o shoes	46±12°	49±13°				NS
Thomson et al. 1999		Knee ROM transverse plane, stance	11±5°	w/o shoes	22±9°	28±12°				*
Kizilirmak et al. 2005		Pelvic ROM frontal plane, GC		w/o shoes	18±6°				16±6°	*
Kizilirmak et al. 2005		Pelvic ROM sagittal plane, GC		w/o shoes	14±7°				15±7°	NS
Kizilirmak et al. 2005		Pelvic ROM transversal plane, GC		w/o shoes	39±13°				34±14°	NS
Hullin et al. 1992		Push-off force MAX		w&w/o RS	<100%BW	>100%BW				Unknown
Thomson et al. 1999		Toe off timing	58±1%GC	w/o shoes	65±6%GC	62±2%GC				NS
Phillips et al. 2012	Sensation of falling (B)	Falls reported		w&w/o shoes		0 in 7 of 8 & 1 in 1 of 8		0 in 8 of 8		Unknown
Phillips et al. 2012	Doffing footwear (A)	Doffing ability (1-7 = best perceived)		w&w/o shoes		<u>6.0</u>[5.0;6.0]		<u>5.0</u>[3.0;6.0]		NS
Phillips et al. 2012	Donning footwear (A)	Donning ability (1-7 = best perceived)		w&w/o shoes		<u>4.0</u>[3.0;5.0]		<u>5.0</u>[4.0;6.0]		NS

Phillips et al. 2012	Ensuring physical comfort (A)	Comfort (1-7 = best perceived)		w&w/o shoes		3.0[2.0;4.0]	5.0[5.0;6.0]	‡
Phillips et al. 2012		Discomfort skin (1-7 = best perceived)		w&w/o shoes		3.0[1.8;4.0]	5.5[4.0;7.0]	‡
Phillips et al. 2012	Maintaining a standing position (A)	Berg balance score (0-56 = best)		w&w/o shoes	46[36;49]	48[41;50]	45[36;48]	NS
Guillebastre et al. 2011		COP area		N/S AFO		Decreased	No change	*D
Hachisuka et al. 1997				w or w/o shoes		Decreased in 7 of 16		*
						No change in 9 of 16		NS
Guillebastre et al. 2011		COP amplitude anterioposterior		N/S AFO		No change	No change	NS
Guillebastre et al. 2011		COP amplitude mediolateral		N/S AFO		No change	No change	NS
Guillebastre et al. 2011		COP frequency anterioposterior		N/S AFO		No change	No change	NS
Guillebastre et al. 2011		COP frequency mediolateral		N/S AFO		No change	No change	NS
Hachisuka et al. 1997		Standing ability, perceived		w or w/o shoes		Increased		Unknown
Phillips et al. 2012	Moving around in different locations (A)	Activity goals met		w&w/o shoes		42.5[30.8;64.0]	50.0[39.5;59.5]	NS
Phillips et al. 2012		Nottingham extended ADL score		w&w/o shoes		No change	No change	NS
Dufek et al. 2014	Walking (A)	Cadence, comfortable		w or w/o shoes	55±10spm in 6 of 8	72±13spm in 6 of 8		*
					67±0spm in 2 of 8	69±0spm in 2 of 8		NS
Kizilirmak et al. 2005				w/o shoes	45±16spm		57±19spm	*
Phillips et al. 2012				w&w/o shoes	88[78;96]spm	96[93;103]spm	96[90;105]spm	NS
Thomson et al. 1999			128±12spm	w/o shoes	107±29spm	118±17spm		*
Phillips et al. 2012			100±?%	w&w/o shoes	83[68-90]%	91[81-95]%	89[84-96]%	NS
Phillips et al. 2012		Stance time		w&w/o shoes	0.92[0.85;1.02]s	0.83[0.76;0.87]s	0.83[0.74;0.91]s	NS
Phillips et al. 2012			60%GC	w&w/o shoes	67[65;68]%GC	65[62;67]%GC	65[63;67]%GC	*
Dufek et al. 2014		Step length, comfortable		w or w/o shoes	0.54±0.05m	0.67±0.08m		Unknown
Guillebastre et al. 2011				N/S AFO		Increased	Increased	*
Kizilirmak et al. 2005				w/o shoes	0.33±0.11m		0.41±0.19m	*
Phillips et al. 2012‖				w&w/o shoes	0.49[0.44;0.60]m	0.58[0.48;0.73]m	0.53[0.48;0.73]m	Unknown
Thomson et al. 1999			0.56±0.08m	w/o shoes	0.43±0.09m	0.48±0.10m		*
Phillips et al. 2012			100±?%	w&w/o shoes	73[71;79]%	84[72;97]%	78[76;90]%	Unknown
Guillebastre et al. 2011		Step time		N/S AFO		No change	No change	NS
Phillips et al. 2012‖				w&w/o shoes	0.69[0.63;0.77]s	0.63[0.58;0.65]s	0.62[0.58;0.67]s	NS
Phillips et al. 2012			100±?%	w&w/o shoes	117[107;142]%	106[100;119]%	107[100;117]%	NS

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Table 3 (*continued*)

(iii) People with both a plantar- and dorsiflexor paresis

Author, year	ICF Category (B/A)	Outcome variable	Norm value	Control Condition	Control Data	AFO condition Dorsal	AFO condition Hinged	AFO condition Circular	AFO condition Dorsal+ Hinged	Significant
Dufek et al. 2014		Support time, double support		w or w/o shoes		4.3±1.7% decrease in 5 of 8				*
						No change in 3 of 8				NS
Kizilirmak et al. 2005		Support time, single support		w/o shoes	0.7±0.1s				0.6±0.1s	*
Phillips et al. 2012		Swing time		w&w/o shoes	0.44[0.40;0.52]s	0.44[0.43;0.47]s		0.43[0.39;0.47]s		NS
Phillips et al. 2012			40%GC	w&w/o shoes	33[32;36]%GC	35[33;38]%GC		35[33;37]%GC		*
Phillips et al. 2012		Swing velocity		w&w/o shoes	1.96[1.48;2.09]m/s	2.32[1.84;2.61]m/s		2.12[1.87;2.55]m/s		Unknown
Phillips et al. 2012	Walking (A)	Timed walk on surfaces		w&w/o shoes	57.8[44.7;62.4]s	44.8[37.7;55.1]s		47.9[35.6;51.2]s		NS
Bartonek et al. 2002		Walking distance, MAX		KAFO	67.1±26.1m		65.8±25.9m			NS
Bartonek et al. 2002		Walking speed, comfortable	1.18±0.13m/s	KAFO	0.89±0.26m/s		0.82±0.26m/s			NS
Hullin et al. 1992				w&w/o RS	100±?%	112.5±3.5%				Unknown
Thomson et al. 1999				w/o shoes	0.78±0.28m/s	0.96±0.22m/s				*
Dufek et al. 2014			1.30±0.20m/s	w or w/o shoes	0.84±0.11m/s in 6 of 8	1.17±0.22m/s in 6 of 8				*
					1.07±0.05m/s in 2 of 8	1.10±0.02m/s in 2 of 8				NS
Guillebastre et al. 2011				N/S AFO		No change		No change		NS
Phillips et al. 2012				w&w/o shoes	0.79[0.56;0.84]m/s	0.96[0.75;1.18]m/s		0.88[0.71;1.12]m/s		Unknown
Phillips et al. 2012			100±?%	w&w/o shoes	58[47;63]%	72[54;85]%		58[47;63]%		Unknown
Kizilirmak et al. 2005		Walking speed, MAX		w/o shoes	0.26±0.17m/s				0.62±0.58m/s	*

Table is alphabetically sorted by (i) ICF category (Body Functions first, Activities second), (ii) outcome variable, (iii) author. Mean or median values are displayed±SD or [interquartile range] or (confidence interval) or unknown (±?). Empty fields indicate no data available. *Abbreviations*: A = activity component, ADL = activities of daily living, AFO = ankle foot orthosis, bpm = beats per minute, B = Body Functions component, BW = body weight, C = circular AFO, CI = confidence interval, COP = centre of pressure, D = dorsal AFO, DF = dorsiflexion, E = elastic AFO, GC = gait cycle, H = hinged AFO, ICF = International Classification of Functioning, Disability and Health, KAFO = knee ankle foot orthosis, kg = kilogram, m = meter, MAX = maximum, MIN = minimum, min = minute, ml = millilitre, Nm = Newton times meter, NS = not significant, N/S = not specified, PF = plantarflexion, ROM = range of motion, RS = rocker sole, s = seconds, spm = steps per minute, W = Watt, w = with, w/o = without. * Significant difference ($p \leq 0.05$) between control and AFO condition. † Significant difference ($p \leq 0.05$) between norm value and AFO condition. ‡ Significant difference ($p \leq 0.05$) between AFO conditions. §Vankoski et al. 2000 consisted of two subgroups (i) people with a thigh-foot angle <15° and (ii) people with a thigh-foot angle ≥20°. ‖ Stride (length/time) was converted into step (length/time) by dividing by 2. ¶ -Duffy et al. 2000, ankle plantarflexion moment was assumed to be expressed in Nm *per kg* and not Nm. -Menotti et al. 2014a, cadence was assumed to be expressed in steps per *minute* and not steps per second.

Appendix 1

Search strategy

#	Text type	Pubmed Search word	Pubmed Hits	Embase Search word	Embase Hits	Cinahl Search word	Cinahl Hits	Cochrane Library Search word	Cochrane Library Hits
1	Mesh	"Orthotic Devices" [Mesh:NoExp] OR "Braces" [Mesh] OR "Splints" [Mesh]	15660	"orthosis" /de OR "brace" /exp OR "splint" /exp	10700	MH "Orthoses" OR MH "Splints"	4639	"Orthotic Devices" [Mesh: NoExp] OR "Braces" [Mesh] OR "Splints" [Mesh]	1025
2	Free text	Orthotic* [tiab] OR Orthosis [tiab] OR Orthoses [tiab] OR Brace* [tiab] OR Robotic* [tiab] OR Exoskelet* [tiab] OR Splint [tiab] OR Splints [tiab] OR Splinting [tiab] OR AFO [tiab]	28875	orthotic*:ti,ab OR orthosis:ti,ab OR orthoses:ti,ab OR brace*:ti,ab OR robotic*:ti,ab OR exoskelet*:ti,ab or splint:ti,ab OR splints:ti,ab OR Splinting:ti,ab OR AFO:ti,ab	27114	TI (Orthotic* OR Orthosis OR Orthoses OR Brace* OR Robotic* OR Exoskelet* OR Splint OR Splints OR Splinting OR AFO) OR AB (Orthotic* OR Orthosis OR Orthoses OR Brace* OR Robotic* OR Exoskelet* OR Splint OR Splints OR Splinting OR AFO)	6358	Orthotic*:ti,ab OR Orthosis:ti,ab OR Orthoses:ti,ab OR Brace*:ti,ab OR Robotic*:ti,ab OR Exoskelet*:ti,ab OR Splint:ti,ab OR Splints:ti,ab OR Splinting:ti,ab OR AFO:ti,ab	1869
3		#1 OR #2	36611	#1 OR #2	31877	#1 OR #2	8489	#1 OR #2	2210
4	Mesh	"Foot" [Mesh:NoExp] OR "Ankle" [Mesh] OR "Ankle Joint" [Mesh] OR "Lower Extremity" [Mesh:NoExp]	37982	"foot" /de OR "ankle" /exp OR "leg" /de OR "ankle foot orthosi" /exp	47732	MH "Foot" OR MH "Ankle" OR MH "Ankle Joint" OR MH "Lower Extremity"	10265	"Foot" [Mesh:NoExp] OR "Ankle" [Mesh] OR "Ankle Joint" [Mesh] OR "Lower Extremity" [Mesh:NoExp]	1595
5	Free text	Foot [tiab] OR Ankle [tiab] OR "Lower limb" [tiab] OR "Lower extremity" [tiab] OR Feet [tiab] OR AFO [tiab]	126019	"lower extremity":ti,ab OR "lower limb":ti,ab OR foot:ti,ab OR ankle:ti,ab OR Feet:ti,ab OR AFO:ti,ab	122317	TI("lower extremity" OR "lower limb" OR foot OR ankle OR Feet OR AFO) OR AB ("lower extremity" OR "lower limb" OR foot OR ankle OR Feet OR AFO)	26180	Foot:ti,ab OR Ankle:ti,ab OR "Lower limb":ti,ab OR "Lower extremity":ti,ab OR Feet:ti,ab OR AFO:ti,ab	9255
6		#4 OR #5	139609	#4 OR #5	143098	#4 OR #5	29476	#4 OR #5	9559
7		#3 AND #6	4243	#3 AND #6	4303	#3 AND #6	1938	#3 AND #6	552
8	Mesh	"Gait" [Mesh] OR "Locomotion" [Mesh:NoExp] OR "Walking" [Mesh] OR "Movement" [Mesh:NoExp] OR "Posture" [Mesh] OR "Postural Balance" [Mesh] OR "Motor Activity" [Mesh] OR "Activities of Daily Living" [Mesh] OR "Gait Disorders, Neurologic" [Mesh] OR "Movement disorders" [Mesh:noexp] OR "Muscle, Skeletal" [Mesh:noexp]	421270	"gait" /exp OR "locomotion" /de OR "walking" /exp OR "movement (physiology)" /de OR "body posture" /exp OR "body equilibrium" /exp OR "motor activity" /exp OR "daily life activity" /exp OR "gait disorder" /exp OR "motor dysfunction" /de OR "walking difficulty" /exp OR "skeletal muscle" /de OR "skeletal muscle" /exp	540837	MH "Gait+" OR MH "Locomotion" OR MH "Walking+" OR MH "Movement+" OR MH "Posture" OR MH "Balance, Postural" OR MH "Motor Activity+" OR MH "Activities of Daily Living+" OR MH "Gait Disorders, Neurologic+" OR MH "Movement disorders" OR MH "Muscle, Skeletal"	80426	"Gait" [Mesh] OR "Locomotion" [Mesh:NoExp] OR "Walking" [Mesh] OR "Movement" [Mesh:NoExp] OR "Posture" [Mesh] OR "Postural Balance" [Mesh] OR "Motor Activity" [Mesh] OR "Activities of Daily Living" [Mesh] OR "Gait Disorders, Neurologic" [Mesh] OR "Movement disorders" [Mesh] OR "Muscle, Skeletal" [Mesh]	27936

(continued on next page)

9	Free text	Gait[tiab] OR Ambulat*[tiab] OR locomotion[tiab] OR Walk[tiab] OR Walking[tiab] OR mobility[tiab] OR "stair climbing" [tiab] OR Posture[tiab] OR Balanc*[tiab] OR "Activities of Daily Living" [tiab] OR "Movement" [tiab] OR Muscle*[tiab] OR "Physical function" [tiab] OR "Physical functioning" [tiab]	1020822	gait:ti,ab OR Ambulat*:ti,ab OR Locomotion:ti,ab OR Walk:ti,ab OR Walking:ti,ab OR Mobility:ti,ab OR (Stair AND climbing):ti,ab OR Posture:ti,ab OR Balanc*:ti,ab OR (Activities AND Daily AND Living):ti,ab OR Movement:ti,ab OR Muscle*:ti,ab OR "Physical function":ti,ab OR "Physical functioning":ti,ab	949112	TI(Gait OR Ambulat* OR Locomotion OR Walk OR Walking OR Mobility OR "Stair climbing" OR Posture OR Balanc* OR "Activities of Daily Living" OR Movement OR Muscle* OR "Physical function" OR "Physical functioning") OR AB (Gait OR Ambulat* OR Locomotion OR Walk OR Walking OR Mobility OR "Stair climbing" OR Posture OR Balanc* OR "Activities of Daily Living" OR Movement OR Muscle* OR "Physical function" OR "Physical functioning")	102705	Gait:ti,ab OR Ambulat*:ti,ab OR locomotion:ti,ab OR Walk:ti,ab OR Walking:ti,ab OR mobility:ti,ab OR "stair climbing":ti,ab OR Posture:ti,ab OR Balanc*:ti,ab OR "Activities of Daily Living":ti,ab OR Movement:ti,ab OR Muscle*:ti,ab OR "Physical function":ti,ab OR "Physical functioning":ti,ab	50119
10		#8 OR #9	1261152	#8 OR #9	1268521	#8 OR #9	150777	#8 OR #9	65142
11		#7 AND #10	2545	#7 AND #10	2509	#7 AND #10	1177	#7 AND #10	344
12	Mesh	"Paresis" [Mesh] OR "Paralysis" [Mesh:noexp] OR "Muscle Hypotonia" [Mesh] OR "Muscle Weakness" [Mesh] OR "Muscular Atrophy" [Mesh] OR "Hemiplegia" [Mesh] OR "Paraplegia" [Mesh] OR "Quadriplegia" [Mesh] OR "Leprosy" [Mesh] OR "Spinal Dysraphism" [Mesh] OR "Meningomyelocele" [Mesh] OR "Meningocele" [Mesh] OR "Peroneal Neuropathies" [Mesh] OR "Sciatic Neuropathy" [Mesh:noexp] OR "Hereditary Sensory and Motor Neuropathy" [Mesh:noexp] OR "Charcot-Marie-Tooth Disease" [Mesh:noexp] OR "Peripheral Nerve Injuries" [Mesh] OR "Peripheral Nervous System Diseases" [Mesh] OR "Peripheral Nervous System Neoplasms" [Mesh] OR "Polyneuropathies" [Mesh:noexp] OR "Poliomyelitis" [Mesh] OR "Amyotrophic Lateral Sclerosis" [Mesh] OR "Stroke" [Mesh:noexp] OR "Spinal Cord Injuries" [Mesh] OR "Spinal Cord Compression"	352113	"paresis" /exp OR "paralysis" /de OR "muscle hypotonia" /de OR "cataplexy" /exp OR "hypotonic hyporesponsive episode" /exp OR "infantile hypotonia" /exp OR "muscle atonia" /exp OR "flaccid paralysis" /exp OR "muscle weakness" /de OR "limb weakness" /exp OR "muscle atrophy" /exp OR "hemiplegia" /exp OR "monoplegia" /exp OR "paraplegia" /exp OR "quadriplegia" /exp OR "leprosy" /exp OR "spinal dysraphism" /exp OR "meningomyelocele" /exp OR "meningocele" /exp OR "peroneal neuropathy" /exp OR "sciatic neuropathy" /exp OR "hereditary motor sensory neuropathy" /exp OR "peripheral nerve injury" /de OR "peripheral neuropathy" /de OR "peripheral nerve tumor" /de OR "poliomyelitis" /exp OR "amyotrophic lateral sclerosis" /exp OR "stroke patient" /exp OR "cerebrovascular accident" /exp OR "spinal cord injury"	404324	MH "Paralysis" OR MH "Muscle Hypotonia+" OR MH "Muscle Weakness" OR MH "Muscular Atrophy" OR MH "Hemiplegia" OR MH "Paraplegia" OR MH "Quadriplegia" OR MH "Leprosy" OR MH "Spina Bifida" OR MH "Peroneal Nerve" OR MH "Mononeuropathies" OR MH "Nerve Compression Syndromes" OR MH "Sciatic Nerve" OR MH "Neuropathies, Hereditary Motor and Sensory" OR MH "Charcot-Marie-Tooth Disease" OR MH "Peripheral Nervous System Diseases" OR MH "Peripheral Nervous System Neoplasms" OR MH "Polyneuropathies" OR MH "Poliomyelitis+" OR MH "Amyotrophic Lateral Sclerosis" OR MH "Stroke" OR MH "Stroke Patients" OR MH "Cerebrovascular Disorders" OR MH "Spinal Cord Injuries" OR MH "Spinal Injuries" OR MH "Spinal Cord Compression" OR MH "Multiple Sclerosis" OR MH "Neuromuscular Manifestations"	65451	"Paresis" [Mesh] OR "Paralysis" [Mesh:noexp] OR "Muscle Hypotonia" [Mesh] OR "Muscle Weakness" [Mesh] OR "Muscular Atrophy" [Mesh] OR "Hemiplegia" [Mesh] OR "Paraplegia" [Mesh] OR "Quadriplegia" [Mesh] OR "Leprosy" [Mesh] OR "Spinal Dysraphism" [Mesh] OR "Meningomyelocele" [Mesh] OR "Meningocele" [Mesh] OR "Peroneal Neuropathies" [Mesh] OR "Sciatic Neuropathy" [Mesh:noexp] OR "Hereditary Sensory and Motor Neuropathy" [Mesh:noexp] OR "Charcot-Marie-Tooth Disease" [Mesh:noexp] OR "Peripheral Nerve Injuries" [Mesh] OR "Peripheral Nervous System Diseases" [Mesh] OR "Peripheral Nervous System Neoplasms" [Mesh] OR "Polyneuropathies" [Mesh:noexp] OR "Poliomyelitis" [Mesh] OR "Amyotrophic Lateral Sclerosis" [Mesh] OR "Stroke" [Mesh:noexp] OR "Spinal Cord Injuries" [Mesh] OR	7513

		[Mesh] OR “Multiple Sclerosis” [Mesh:noexp] OR “Multiple Sclerosis, Chronic Progressive” [Mesh] OR “Multiple Sclerosis, Relapsing-Remitting” [Mesh] OR “Neuromuscular Diseases” [Mesh:noexp]		/exp OR “spinal cord compression” /exp OR “multiple sclerosis” /exp OR “neuromuscular disease” /de				“Spinal Cord Compression” [Mesh] OR “Multiple Sclerosis” [Mesh:noexp] OR “Multiple Sclerosis, Chronic Progressive” [Mesh] OR “Multiple Sclerosis, Relapsing-Remitting” [Mesh] OR “Neuromuscular Diseases” [Mesh:noexp]	
13	Free text	Paresis [tiab] OR Paraparesis [tiab] OR Paretic [tiab] OR Paralysis [tiab] OR Palsy [tiab] OR Palsies [tiab] OR Paralyses [tiab] OR Hypoton* [tiab] OR floppy [tiab] OR Flaccid [tiab] OR “Muscle Weakness” [tiab] OR Atrophy [tiab] OR Atrophic [tiab] OR “footdrop” [tiab] OR “foot drop” [tiab] OR “drop foot” [tiab] OR “dropfoot” [tiab] OR “dropped foot” [tiab] OR Hemipleg* [tiab] OR Monopleg* [tiab] OR Parapleg*[tiab] OR Quadripleg* [tiab] OR Tetrapleg* [tiab] OR Leprosy [tiab] OR “Spinal Dysraphism” [tiab] OR Meningomyelocele [tiab] OR Meningocele [tiab] OR Myeloschisis [tiab] OR “Spina bifida” [tiab] OR “Peroneal Neuropathies” [tiab] OR “Peroneal Neuropathy” [tiab] OR “Sciatic Neuropathy” [tiab] OR “Sciatic Neuropathies” [tiab] OR “Hereditary Sensory and Motor Neuropathy” [tiab] OR HSMN [tiab] OR “Charcot Marie Tooth Disease” [tiab] OR “Peripheral Nerve Injuries” [tiab] OR “Peripheral Nerve Injury” [tiab] OR “Peripheral Nervous System Diseases” [tiab] OR “Peripheral Nervous System Disease” [tiab] OR “peripheral neuropathy” [tiab] OR “peripheral neuropathies” [tiab] OR “Peripheral Nervous System Neoplasms” [tiab]	622621	Paraparesis :ti,ab OR Paresis :ti,ab OR Paretic :ti,ab OR Paralysis :ti,ab OR Palsy :ti,ab OR Palsies :ti,ab OR Paralyses :ti,ab OR Hypoton* :ti,ab OR floppy :ti,ab OR Flaccid :ti,ab OR “Muscle Weakness” :ti,ab OR Atrophy :ti,ab OR Atrophic :ti,ab OR footdrop :ti,ab OR “foot drop” :ti,ab OR “drop foot” :ti,ab OR “dropfoot” :ti,ab OR “dropped foot” :ti,ab OR Hemipleg* :ti,ab OR monopleg* :ti,ab OR Parapleg* :ti,ab OR Quadripleg* :ti,ab OR Tetrapleg* :ti,ab OR Leprosy :ti,ab OR “Spinal Dysraphism” :ti,ab OR Meningomyelocele :ti,ab OR Meningocele :ti,ab OR Myeloschisis :ti,ab OR “Spina bifida” :ti,ab OR “Peroneal Neuropathies” :ti,ab OR “Peroneal Neuropathy” :ti,ab OR “Sciatic Neuropathy” :ti,ab OR “Sciatic Neuropathies” :ti,ab OR “Hereditary Sensory and Motor Neuropathy” :ti,ab OR HSMN:ti,ab OR “Charcot Marie Tooth Disease” :ti,ab OR “Peripheral Nerve Injuries” :ti,ab OR “Peripheral Nerve Injury” :ti,ab OR “Peripheral Nervous System Diseases” :ti,ab OR “Peripheral Nervous System Disease” :ti,ab OR “peripheral neuropathy” :ti,ab OR “peripheral neuropathies” :ti,ab OR “Peripheral Nervous System Neoplasms” :ti,ab	646559	TI (Paraparesis OR Paresis OR Paretic OR Paralysis OR Palsy OR Palsies OR Paralyses OR Hypoton* OR floppy OR Flaccid OR “Muscle Weakness” OR Atrophy OR Atrophic OR footdrop OR “foot drop” OR “drop foot” OR dropfoot OR “dropped foot” OR Hemipleg* OR monopleg* OR Parapleg* OR Quadripleg* OR Tetrapleg* OR Leprosy OR “Spinal Dysraphism” OR Meningomyelocele OR Meningocele OR Myeloschisis OR “Spina bifida” OR “Peroneal Neuropathies” OR “Peroneal Neuropathy” OR “Sciatic Neuropathy” OR “Sciatic Neuropathies” OR “Hereditary Sensory and Motor Neuropathy” OR HSMN OR “Charcot Marie Tooth Disease” OR “Peripheral Nerve Injuries” OR “Peripheral Nerve Injury” OR “Peripheral Nervous System Diseases” OR “Peripheral Nervous System Disease” OR “peripheral neuropathy” OR “peripheral neuropathies” OR “Peripheral Nervous System Neoplasms” OR “Peripheral Nervous System Neoplasm” OR “peripheral nerve tumor” OR “peripheral nerve tumors” OR Polyneuropathies OR Polyneuropathy OR Polio* OR “Amyotrophic Lateral Sclerosis” OR ALS OR Stroke OR “Cerebrovascular accident” OR CVA OR “Spinal Cord Injuries” OR	69845	Paraparesis :ti,ab OR Paresis :ti,ab OR Paretic :ti,ab OR Paralysis :ti,ab OR Palsy :ti,ab OR Palsies:ti,ab OR Paralyses :ti,ab OR Hypoton* :ti,ab OR floppy :ti,ab OR Flaccid:ti,ab OR “Muscle Weakness” :ti,ab OR Atrophy :ti,ab OR Atrophic :ti,ab OR footdrop :ti,ab OR “foot drop” :ti,ab OR “drop foot” :ti,ab OR dropfoot :ti,ab OR “dropped foot” :ti,ab OR Hemipleg* :ti,ab OR Monopleg* :ti,ab OR Parapleg* :ti,ab OR Quadripleg* :ti,ab OR Tetrapleg* :ti,ab OR Leprosy :ti,ab OR “Spinal Dysraphism” :ti,ab OR Meningomyelocele :ti,ab OR Meningocele:ti,ab OR Myeloschisis :ti,ab OR “Spina bifida” :ti,ab OR “Peroneal Neuropathies” :ti,ab OR “Peroneal Neuropathy” :ti,ab OR “Sciatic Neuropathy” :ti,ab OR “Sciatic Neuropathies” :ti,ab OR “Hereditary Sensory and Motor Neuropathy” :ti,ab OR HSMN :ti,ab OR “Charcot Marie Tooth Disease” :ti,ab OR “Peripheral Nerve Injuries” :ti,ab OR “Peripheral Nerve Injury” :ti,ab OR “Peripheral Nervous System Diseases” :ti,ab OR “Peripheral Nervous System Disease” :ti,ab OR “peripheral neuropathy” :ti,ab OR “peripheral neuropathies” :ti,ab OR “Peripheral Nervous System Neoplasms” :ti,ab OR “Peripheral Nervous System Neoplasm” :ti,ab OR	30758

(continued on next page)

OR “Peripheral Nervous System Neoplasm” [tiab] OR “peripheral nerve tumor” [tiab] OR “peripheral nerve tumors” [tiab] OR Polyneuropathies[tiab] OR Polyneuropathy[tiab] OR Polio*[tiab] OR “Amyotrophic Lateral Sclerosis” [tiab] OR ALS [tiab] OR Stroke [tiab] OR “Cerebrovascular accident” [tiab] OR CVA [tiab] OR “Spinal Cord Injuries” [tiab] OR “Spinal Cord Injury” [tiab] OR “Spinal Cord Compression” [tiab] OR “Spinal Cord Compressions” [tiab] OR “Multiple Sclerosis” [tiab] OR MS [tiab] OR “Neuromuscular diseases” [tiab] OR “Neuromuscular disease” [tiab]	“peripheral nerve tumor” :ti,ab OR “peripheral nerve tumors” :ti,ab OR Polyneuropathies :ti,ab OR Polyneuropathy :ti,ab OR Polio* :ti,ab OR “Amyotrophic Lateral Sclerosis” :ti,ab OR ALS :ti,ab OR Stroke :ti,ab OR “Cerebrovascular accident” :ti,ab OR CVA :ti,ab OR “Spinal Cord Injuries” :ti,ab OR “Spinal Cord Injury” :ti,ab OR “Spinal Cord Compression” :ti,ab OR “Spinal Cord Compressions” :ti,ab OR “Multiple Sclerosis” :ti,ab OR MS :ti,ab OR “Neuromuscular diseases” :ti,ab OR “Neuromuscular disease” :ti,ab	“Spinal Cord Injury” OR “Spinal Cord Compression” OR “Spinal Cord Compressions” OR “Multiple Sclerosis” OR MS OR “Neuromuscular diseases” OR “Neuromuscular disease” OR AB Paraparesis OR Paresis OR Paretic OR Paralysis OR Palsy OR Palsies OR Paralyses OR Hypoton* OR floppy OR Flaccid OR “Muscle Weakness” OR Atrophy OR Atrophic OR foot-drop OR “foot drop” OR “drop foot” OR dropfoot OR “dropped foot” OR Hemipleg* OR monopleg* OR Parapleg* OR Quadripleg* OR Tetrapleg* OR Leprosy OR “Spinal Dysraphism” OR Meningomyelocele OR Meningocele OR Myeloschisis OR “Spina bifida” OR “Peroneal Neuropathies” OR “Peroneal Neuropathy” OR “Sciatic Neuropathy” OR “Sciatic Neuropathies” OR “Hereditary Sensory and Motor Neuropathy” OR HSMN OR “Charcot Marie Tooth Disease” OR “Peripheral Nerve Injuries” OR “Peripheral Nerve Injury” OR “Peripheral Nervous System Diseases” OR “Peripheral Nervous System Disease” OR “peripheral neuropathy” OR “peripheral neuropathies” OR “Peripheral Nervous System Neoplasms” OR “Peripheral Nervous System Neoplasm” OR “peripheral nerve tumor” OR “peripheral nerve tumors” OR Polyneuropathies OR Polyneuropathy OR Polio* OR “Amyotrophic Lateral Sclerosis” OR ALS OR Stroke OR “Cerebrovascular accident” OR CVA OR “Spinal Cord Injuries” OR “Spinal Cord Injury” OR “Spinal Cord Compression” OR “Spinal Cord Compressions” OR “Multiple Sclerosis” OR MS OR “Neuromuscular diseases” OR “Neuromuscular disease”	OR “Peripheral Nervous System Neoplasm” :ti,ab OR “peripheral nerve tumor” :ti,ab OR “peripheral nerve tumors” :ti,ab OR “polyneuropathy”/de OR Polyneuropathies:ti,ab OR Polyneuropathy:ti,ab OR Polio*:ti,ab OR “amyotrophic lateral sclerosis” :ti,ab OR ALS:ti,ab OR Stroke:ti,ab OR “cerebrovascular accident” :ti,ab OR CVA:ti,ab OR “Spinal Cord Injuries” :ti,ab OR “Spinal Cord Injury” :ti,ab OR “Spinal Cord Compression” :ti,ab OR “Spinal Cord Compressions” :ti,ab OR “Multiple Sclerosis” :ti,ab OR MS:ti,ab OR “Neuromuscular diseases” :ti,ab OR “Neuromuscular disease” :ti,ab

14	#12 OR #13	784394	#12 OR #13	786994	#12 OR #13	94134	#12 OR #13	31863
15	#11 AND #14	1005	#11 AND #14	1089	#11 AND #14	402	#11 AND #14	126
16	"Case Reports" [Publication Type] OR "Review" [Publication Type] OR "Meta-Analysis" [Publication Type] OR "Editorial" [Publication Type] OR "Letter" [Publication Type] OR "Addresses" [Publication Type] OR "Bibliography" [Publication Type] OR "Biography" [Publication Type] OR "Comment" [Publication Type] OR "Interview" [Publication Type] OR "News" [Publication Type] OR "Newspaper Article" [Publication Type]	4622848	"case report" /exp OR "review" /exp OR "systematic review" /exp OR "meta analysis" /exp OR "abstract report" /exp OR "book" /exp OR "conference paper" /exp OR "editorial" /exp OR "erratum" /exp OR "letter" /exp OR "note" /exp OR "short survey" /exp	5002452	MH "Case Studies" OR MH "Literature Review+" OR MH "Systematic Review" OR MH "Meta Analysis" OR MH "Interviews+" OR MH "Biographies+" OR MH "Diaries" OR MH "News" OR MH "Catalogs" OR MH "Book Reviews" OR MH "Blogs" OR MH "Almanacs"		"Case Reports" [Publication Type] OR "Review" [Publication Type] OR "Meta-Analysis" [Publication Type] OR "Cochrane Reviews" OR "Other Reviews"	140
17	#15 NOT #16	785	#15 NOT #16	746	#15 NOT #16	378	#15 NOT #16	110
	Combined				**1302** (included duplicates 2019)			

2

2

Appendix 2

Quality assessment elaboration

Randomized Controlled Trials & Cross Over Trials				Observational designs				
*	yes	no	unknown	*	yes	no	unknown	not applicable
1	Adequate random components: - Referring to a random number table - Using a computer random number generator - Coin tossing - Shuffling cards/envelopes - Throwing dice - Drawing of lots - Minimisation	Non-random components: - Odd or even date of birth - Date or day of admission - Hospital or clinic record number - Judgement of the clinician - Participants' preference - Laboratory test results - Availability of the intervention	Insufficient information about the sequence generation process	1	The institute/ place where participants were recruited was specified	The institute/ place where participants were recruited was not specified	-	-
2	- Central allocation (including telephone, web-based and pharmacy-controlled randomization). - Sequentially numbered drug containers of identical appearance. - Sequentially numbered, opaque, sealed envelopes.	- Open random allocation schedule (e.g. list of random numbers) - Assignment envelopes without appropriate safeguards (e.g. unsealed/ non-opaque) - Alternation of rotation - Date of birth - Case record number	Insufficient information. This is usually the case if the method of concealment is not described or not described in sufficient detail to allow a definite judgement. (when envelopes were used but it is unclear whether these were numbered, opaque & sealed)	2	Inclusion AND exclusion criteria were specified	- Only inclusion criteria were specified - Only exclusion criteria were specified - Neither inclusion criteria nor exclusion criteria were specified	-	-
3 - 5	- No blinding, but the review authors judge that outcome (measurement) are not likely to be influenced by lack of blinding. - Blinding is ensured, and it is unlikely that the blinding could have been broken - Either participants or some key study personnel were not blinded, but outcome assessment was blinded and the non-blinding of others is unlikely to introduce bias	- No blinding or incomplete blinding, and the outcome (measurement) is likely to be influenced by lack of blinding - Participants and key personnel blinding attempted but likely that blinding to been broken - Either participants or some key study personnel were not blinded, and the non-blinding of others is likely to introduce bias	Insufficient information. The study did not address this outcome	3	Groups were comparable on ≤ 2 of the following confounders: - Diagnosis - Muscle tone/force/ activity - Age - Gender - Anthropometric data	Groups were comparable on less than 2 confounders: - Diagnosis - Muscle tone/force/ activity - Age -Gender - Anthropometric data	Insufficient information	No groups
				4a	Adequate random selection: (or similar) - Referring to a random number table - Using a random number generator - Coin tossing - Shuffling cards/envelopes - Throwing dice - Drawing of lots - Minimisation -Matching on at least 2 of: - Age - Gender - Anthropometric data	- No adequate random method used -Matching on less than 2 components	Insufficient information	No controls
				4b	Selection from the same population was explicitly stated	Not stated or stated that the population was different	Insufficient information	No controls

	All study designs			
*	**yes**	**no**	**unknown**	**not applicable**
6	- No missing outcome data - Reasons for missing outcome data unlikely to be related to true outcome - Missing outcome data balanced in numbers across intervention groups, with similar reasons for missing data across groups - For dichotomous outcome data, the proportion of missing outcomes compared with observed event risk not enough to have a clinically relevant impact on the intervention effect estimate - For continuous outcome data, plausible effect size (difference in means or standardized difference in means) among missing outcomes not enough to have a clinically relevant impact on observed effect size - Missing data have been imputed using appropriate methods	- Reason for missing outcome data likely to be related to true outcome, with either imbalance in numbers or reasons for missing data across intervention groups - For dichotomous outcome data, the proportion of missing outcomes compared with observed event risk enough to induce clinically relevant bias in intervention effect estimate - For continuous outcome data, plausible effect size (difference in means or standardized difference in means) among missing outcomes enough to induce clinically relevant bias in observed effect size - 'As-treated' analysis done with substantial departure of the intervention received from that assigned at randomization; - Potentially inappropriate application of simple imputation	- Insufficient information - The study did not address this outcome - No information in the results section and no information on the number of evaluations in the tables	-
7	- The study protocol is available and all of the study's pre-specified (primary and secondary) outcomes that are of interest in the review have been reported in the pre-specified way - The study protocol is not available but it is clear that the published reports include all expected outcomes, including those that were pre-specified (convincing text of this nature may be uncommon)	- Not all of the study's pre-specified primary outcomes have been reported; - One or more primary outcomes reported using measurements, analysis methods or subsets of the data (e.g. subscales) that were not pre-specified - One or more reported primary outcomes were not pre-specified (unless clear justification for their reporting is provided, such as an unexpected adverse effect); - One or more outcomes of interest in the review are reported incompletely so that they cannot be entered in a meta-analysis; - Results for a key outcome that would be expected to have been reported were not.	Insufficient information	-
8a & 8b	- Mean strength with or without standard deviation and/or range - Individual strengths - Median strength and standard deviation or range	- Only a threshold was provided. - Patients were divided into two groups (e.g. low and high muscle strength) - No information on strength	Other combinations	-
9a	Long term follow up & stable condition	Long term follow up & no stable condition	Long term follow up & unknown condition	No long term follow up
9b	Baseline balance	Baseline imbalance	Unknown baseline data	No groups
9c	- No co-interventions - Similar co-interventions such as: - Shoes - Crutches or walking aids - Medicines	Unequal co-interventions	Unknown co-interventions	-
9d	More than 1 measurement per condition was reported	Only 1 measurement per condition was reported	Insufficient information	No repeated measures

* Criteria 1 to 9 can be found in Box 1.