Data Article

Inter-participant variability data in loading applied on osseointegrated implant by transtibial bone-anchored prostheses during daily activities

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ABSTRACT

The data in this paper are related to the research article entitled "Loading applied on osseointegrated implant by transtibial bone-anchored prostheses during daily activities: Preliminary characterization of prosthetic feet" (Frossard et al., 2019: Accepted). This article contains the individual and grouped loading characteristics applied on transtibial osseointegrated implant generated while walking with bone-anchored prostheses including prosthetic feet with different index of anthropomorphicity. Inter-participant variability was presented for (A) the spatio-temporal characteristics, (B) the loading boundaries and (C) the loading local extremum during walking, ascending and descending ramp and stairs. These initial inter-participant variability benchmark datasets are critical to improve the efficacy and safety of prosthetic components for transtibial prostheses as well as the design of future automated algorithms and clinical trials. Online repository contains the files: https://doi.org/10.17632/vhc6sf7ngy.1.

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Specifications Table

Subject area	Biomechanics
More specific subject area	Gait analysis of individuals using lower limb prosthesis
Type of data	Figure, table
How data was acquired	Three participants walked consecutively with two instrumented transtibial bone-anchored prostheses including their own prosthetic feet and Free-Flow foot. Loading profile was recorded by a state-of-the-art portable kinetic system (iPecLab, RTC Inc, US) including a multi-axis transducer attached to osseointegrated fixation.
Data format	Raw and Analyzed
Experimental factors	All loading data were time-normalized from 0 to 100% during the support phase
Experimental features	Participants were asked to perform up to five trials of level walking in straight-line, ascending and descending ramp and stairs at self-selected comfortable pace with transtibial bone-anchored prostheses fitted with connector, a transducer attached with pyramidal adaptors, a pylon, either their own or Free-Flow prosthetic foot.
Data source location	Brisbane, Australia, Queensland University of Technology
Data accessibility	Data is with this article. Transparency data associated with this article can be found in the online version at https://doi.org/10.17632/vhc6sf7ngy.1
Related research article	Frossard, L., B. Leech, and M. Pitkin, Loading applied on osseointegrated implant by transtibial bone-anchored prostheses during daily activities: Preliminary characterization of prosthetic feet. Accepted [1].

Value of the Data

- The individual data collected for the first time includes the three forces and moments applied on osseointegrated fixation that where generated while walking with transtibial bone-anchored prostheses including prosthetic feet with different index of anthropomorphicity. This information provides valuable insight into inter-participant variability in variables characterizing load profile.
- The individual loading data presented here constitutes an initial benchmark of spatio-temporal characteristics as well as loading boundaries and local extremum on the anteroposterior, mediolateral and long axes of the implant during walking, ascending and descending ramp and stairs with transtibial bone-anchored prostheses. This baseline information could be used in future meta-analyses or comparative studies involving other cohorts of individuals fitted with transtibial bone-anchored or socket-suspended prostheses, respectively.
- The inter-participant variability of loading characteristics, more particularly, the range of the loading applied can be used as mechanical constrain input in finite element models. This will be enhancing reflectiveness of the models and, subsequently, improve design efficacy and safety of prosthetic components and osseointegrated implants parts.
- The inter-participant variability of loading characteristics is critical to assist the design of algorithms capable to characterize in real-time the load profile applied on a residuum during daily activities. This will greatly facilitate processing of large ecological datasets relying on embedded load cell to measure directly forces and moments applied on residuum.
- The inter-participant variability of loading characteristics provided here can educate the design of subsequent clinical trials testing effect of particular intervention (e.g., effect of choice and alignment of prosthetic components). For instance, the ranges of differences between the usual and Free-Flow feet can informed the sample size required to achieve sufficient statistical power during analytical planning stage.

1. Data

Inter-participant variability of alignment and position of the tri-axial transducer (iPecLab, RTC, US) in relation to the ankle joint embedded in the instrumented transtibial bone-anchored prosthesis fitted with Free-Flow Foot is illustrated in Fig. 1.

The individual and grouped spatio-temporal characteristics including cadence, duration of gait cycle and support phase while using usual (i.e., P1: RUSH, P2: Trias, P3: Triton) and Free-Flow (Ohio Willow Wood) feet during walking, ascending and descending ramp and stairs are presented in Tables 1, 4, 7, 10 and 13, respectively.

The individual and grouped loading boundaries including minimum and maximum of magnitude of forces, expressed in %BW and N, and moments, expressed in %BWm and Nm, applied on the anteroposterior, mediolateral and long axes of the implant fitted with usual and Free-Flow feet during walking, ascending and descending ramp and stairs are presented in Tables 2, 5, 8, 11 and 14, respectively.

The individual and grouped mean and standard deviation of individual onset, expressed in percentage of support phase, and magnitude of the local extrema of forces in %BW and moments in %BWm applied on the anteroposterior, mediolateral and long axes of the implant fitted with usual and Free-Flow feet during walking, ascending and descending ramp and stairs are presented in Tables 3, 6, 9, 12 and 15, respectively.

1.1. Alignment

The information about the alignment is provided in Fig. 1.

Fig. 1. Inter-participant variability of alignment and position of the tri-axial transducer (iPecLab, RTC, US) in relation to the ankle joint embedded in the instrumented transtibial bone-anchored prosthesis fitted with Free-Flow Foot (Ohio Willow Wood).

1.2. Level walking

The spatio-temporal characteristics, loading boundaries as well as onset and magnitude of up to three local extremum during walking are presented in Tables 1–3.

Table 1
Mean and standard deviation of spatio-temporal characteristics including cadence, duration of gait cycle and support phase while using usual and Free-Flow feet during walking.

		P1		P2		P3		All	
USU									
Cadence	(Strides/min)	46	−	57	−	46	−	50 ± 7	L
Gait cycle	(s)	1.30 ± 0.06	L	1.05 ± 0.06	L	1.31 ± 0.07	L	1.24 ± 0.13	L
Support	(%GC)	61 ± 2	L	63 ± 4	L	66 ± 3	L	64 ± 3	L
FFF									
Cadence	(Strides/min)	46	−	56	−	44	−	49 ± 6	L
Gait cycle	(s)	1.31 ± 0.05	L	1.07 ± 0.05	L	1.37 ± 0.07	L	1.30 ± 0.13	L
Support	(%GC)	61 ± 3	L	64 ± 2	L	65 ± 2	L	64 ± 3	L

Note: P1, P2, P3: Individual participants, USU: usual feet, FFF: Free-Flow feet, H: High PV, L: Low PV.

Table 2
Loading boundaries including minimum and maximum magnitude of forces and moments applied on the three anatomical axes of the implant fitted prosthesis including usual and Free-Flow feet during walking.

		P1		P2		P3		All	
		Min	Max	Min	Max	Min	Max	Min	Max
USU									
F AP	(%BW)	−10.07	32.23	−4.42	39.05	−16.00	17.28	−16.00	39.05
F ML	(%BW)	−0.97	14.21	−8.00	7.40	−3.34	9.29	−8.00	14.21
F LG	(%BW)	−2.64	105.49	−12.02	110.87	−10.88	108.01	−12.02	110.87
M AP	(%BWm)	−1.83	0.80	−1.21	0.62	−1.91	0.61	−1.91	0.80
M ML	(%BWm)	−2.45	9.78	−3.01	8.66	−2.61	8.17	−3.01	9.78
M LG	(%BWm)	−0.80	0.82	−0.38	0.79	−0.46	0.60	−0.80	0.82
F AP	(N)	−107.75	344.96	−35.32	312.22	−90.71	97.96	−107.75	344.96
F ML	(N)	−10.38	152.15	−63.93	59.16	−18.95	52.64	−63.93	152.15
F LG	(N)	−28.31	1,129.25	−96.08	886.40	−61.66	612.21	−96.08	1,129.25
M AP	(Nm)	−19.60	8.56	−9.66	4.99	−10.85	3.46	−19.60	8.56
M ML	(Nm)	−26.23	104.64	−24.04	69.22	−14.82	46.29	−26.23	104.64
M LG	(Nm)	−8.52	8.75	−3.06	6.29	−2.60	3.42	−8.52	8.75
FFF									
F AP	(%BW)	−7.48	27.52	−4.51	41.20	−13.16	18.94	−13.16	41.20
F ML	(%BW)	−2.81	14.25	−8.29	5.70	−3.78	9.53	−8.29	14.25
F LG	(%BW)	−23.52	101.95	−12.53	102.50	−5.54	106.84	−23.52	106.84
M AP	(%BWm)	−1.49	0.53	−0.65	1.11	−1.77	0.84	−1.77	1.11
M ML	(%BWm)	−2.05	6.75	−3.23	8.08	−2.26	8.22	−3.23	8.22
M LG	(%BWm)	−0.54	0.55	−0.41	0.69	−0.40	0.59	−0.54	0.69
F AP	(N)	−80.06	294.61	−36.05	329.36	−74.58	107.35	−80.06	329.36
F ML	(N)	−30.08	152.52	−66.25	45.56	−21.44	54.00	−66.25	152.52
F LG	(N)	−251.75	1,091.39	−100.19	819.50	−31.43	605.60	−251.75	1,091.39
M AP	(Nm)	−15.92	5.72	−5.20	8.91	−10.02	4.76	−15.92	8.91
M ML	(Nm)	−21.98	72.23	−25.82	64.64	−12.79	46.60	−25.82	72.23
M LG	(Nm)	−5.83	5.86	−3.25	5.49	−2.24	3.35	−5.83	5.86

Note: P1, P2, P3: Individual participants, Min: minimum magnitude, Max: maximum magnitude, F: force expressed in %BW and N, M: moments expressed in %BWm and Nm, USU: usual feet, FFF: Free-Flow feet, H: High PV, L: Low PV, AP: Anteroposterior axis, ML: Mediolateral axis, LG: long axis.

Table 3
Mean and standard deviation of onset in percentage of support phase and magnitude of up to three local extremum of forces and moments applied on the three anatomical axes of the implant fitted prosthesis including usual and Free-Flow feet during walking.

	P1		P2		P3		All	
USU								
Onset								
F_{AP1}	9.85 ± 3.67	H	5.42 ± 3.01	H	17.09 ± 5.64	H	12.99 ± 6.97	H
F_{AP2}	84.38 ± 3.57	L	78.63 ± 12.94	L	84.84 ± 3.31	L	83.23 ± 7.42	L
F_{ML1}	64.46 ± 20.35	H	33.32 ± 9.38	H	35.36 ± 6.84	L	39.77 ± 15.47	H
F_{LG1}	31.23 ± 7.88	H	36.84 ± 16.14	H	49.69 ± 19.22	H	43.40 ± 18.57	H
M_{AP1}	91.54 ± 4.35	L	90.37 ± 24.83	H	96.13 ± 3.58	L	93.94 ± 12.79	L
M_{ML1}	12.46 ± 5.43	H	14.47 ± 6.91	H	12.64 ± 2.29	L	13.06 ± 4.43	H
M_{ML2}	83.00 ± 6.35	L	80.00 ± 7.31	L	72.93 ± 4.55	L	76.38 ± 6.99	L
Magnitude								
F_{AP1}	−7.70 ± 2.17	H	−2.42 ± 1.31	H	−13.26 ± 1.28	L	−9.65 ± 4.85	H
F_{AP2}	28.62 ± 2.49	L	36.70 ± 2.24	L	13.99 ± 1.53	L	22.07 ± 10.15	H
F_{ML1}	12.41 ± 1.16	L	5.16 ± 1.63	H	8.30 ± 0.62	L	8.22 ± 2.53	H
F_{LG1}	96.49 ± 3.90	L	102.04 ± 5.14	L	103.65 ± 2.46	L	102.05 ± 4.36	L
M_{AP1}	0.68 ± 0.12	L	0.02 ± 0.13	H	−0.01 ± 0.06	H	0.11 ± 0.27	H
M_{ML1}	−2.05 ± 0.38	L	−2.46 ± 0.52	H	−1.79 ± 0.35	L	−2.00 ± 0.49	H
M_{ML2}	9.25 ± 0.38	L	8.22 ± 0.31	L	7.44 ± 0.41	L	7.94 ± 0.78	L
FFF								
Onset								
F_{AP1}	13.11 ± 7.10	H	3.79 ± 3.31	H	19.92 ± 8.53	H	15.11 ± 9.62	H
F_{AP2}	79.50 ± 5.29	L	78.14 ± 6.50	L	81.46 ± 3.27	L	80.09 ± 5.68	L
F_{ML1}	73.00 ± 6.90	L	36.29 ± 25.20	H	33.56 ± 5.06	L	43.41 ± 20.85	H
F_{LG1}	55.39 ± 24.94	H	45.29 ± 22.11	H	40.52 ± 14.54	H	45.68 ± 19.78	H
M_{AP1}	94.06 ± 4.11	L	45.50 ± 23.49	H	97.42 ± 3.94	L	72.30 ± 20.02	H
M_{ML1}	13.56 ± 3.90	H	9.07 ± 3.05	H	11.56 ± 2.71	H	11.50 ± 3.68	H
M_{ML2}	83.67 ± 5.10	L	74.21 ± 7.78	L	74.76 ± 3.78	L	76.95 ± 7.00	L
Magnitude								
F_{AP1}	−5.56 ± 1.68	H	−1.14 ± 1.36	H	−10.65 ± 1.14	L	−7.49 ± 3.92	H
F_{AP2}	23.69 ± 3.67	L	38.53 ± 1.31	L	16.68 ± 1.31	L	22.87 ± 8.69	H
F_{ML1}	12.39 ± 1.21	L	3.58 ± 0.78	H	8.31 ± 0.55	L	8.23 ± 3.20	H
F_{LG1}	97.47 ± 2.49	L	94.62 ± 4.97	L	102.68 ± 1.73	L	99.69 ± 4.60	L
M_{AP1}	0.31 ± 0.10	H	0.37 ± 0.20	H	−0.04 ± 0.08	H	0.90 ± 0.56	H
M_{ML1}	−1.50 ± 0.27	L	−1.76 ± 0.56	H	−1.69 ± 0.29	L	−1.63 ± 0.37	H
M_{ML2}	6.31 ± 0.34	L	7.62 ± 0.33	L	7.45 ± 0.55	L	7.19 ± 0.70	L

Note: P1, P2, P3: Individual participants, F: force expressed in %BW, M: moments expressed in %BWm, USU: usual feet, FFF: Free-Flow feet, H: High PV, L: Low PV, AP: Anteroposterior axis, ML: Mediolateral axis, LG: long axis.

Table 4
Mean and standard deviation of spatio-temporal characteristics including cadence, duration of gait cycle and support phase while using usual and Free-Flow feet during ascending ramp. P2 performed only one trial with usual leg and was not reported here.

		P1		P2		P3		All	
USU									
Cadence	(Strides/min)	40	–	–	–	30	–	40 ± 10	H
Gait cycle	(s)	1.50 ± 0.06	L	–	–	1.99 ± 0.19	L	1.77 ± 0.32	L
Support	(%GC)	62 ± 3	L	–	–	69 ± 2	L	66 ± 4	L
FFF									
Cadence	(Strides/min)	38	–	46	–	33	–	39 ± 7	L
Gait cycle	(s)	1.59 ± 0.12	L	1.29 ± 0.10	L	1.84 ± 0.13	L	1.59 ± 0.25	L
Support	(%GC)	62 ± 2	L	66 ± 4	L	69 ± 3	L	65 ± 4	L

Note: P1, P2, P3: Individual participants, USU: usual feet, FFF: Free-Flow feet, H: High PV, L: Low PV.

Table 5

Loading boundaries including minimum and maximum magnitude of forces and moments applied on the three anatomical axes of the implant fitted prosthesis including usual and Free-Flow feet during ascending ramp.

		P1		P2		P3		All	
		Min	Max	Min	Max	Min	Max	Min	Max
FFF									
F AP	(%BW)	−0.80	34.94	0.16	48.35	−9.53	16.48	−9.53	48.35
F ML	(%BW)	−1.94	13.83	−4.35	4.76	−3.16	5.79	−4.35	13.83
F LG	(%BW)	−5.52	103.09	−3.60	99.41	−6.49	109.26	−6.49	109.26
M AP	(%BWm)	−1.00	0.44	−0.34	0.46	−2.05	0.34	−2.05	0.46
M ML	(%BWm)	−0.31	9.61	−0.81	9.61	−0.23	12.02	−0.81	12.02
M LG	(%BWm)	−0.22	1.08	−0.55	0.42	−0.09	0.42	−0.55	1.08
F AP	(N)	−8.57	373.98	1.31	386.60	−54.04	93.42	−54.04	386.60
F ML	(N)	−20.81	148.01	−34.75	38.06	−17.89	32.83	−34.75	148.01
F LG	(N)	−59.06	1,103.56	−28.76	794.76	−36.77	619.33	−59.06	1,103.56
M AP	(Nm)	−10.68	4.75	−2.75	3.66	−11.63	1.93	−11.63	4.75
M ML	(Nm)	−3.36	102.87	−6.46	76.85	−1.31	68.13	−6.46	102.87
M LG	(Nm)	−2.31	11.56	−4.37	3.35	−0.52	2.40	−4.37	11.56
USU									
F AP	(%BW)	0.09	39.79	2.94	34.02	−11.72	12.36	−11.72	39.79
F ML	(%BW)	−0.32	11.99	−4.03	1.77	−1.88	7.33	−4.03	11.99
F LG	(%BW)	−1.79	103.65	−3.00	101.61	−10.71	110.13	−10.71	110.13
M AP	(%BWm)	−0.16	0.78	−0.72	0.05	−1.51	0.24	−1.51	0.78
M ML	(%BWm)	−0.73	13.17	−0.38	10.53	−0.38	10.78	−0.73	13.17
M LG	(%BWm)	−0.18	0.87	−0.63	0.00	−0.18	0.63	−0.63	0.87
F AP	(N)	0.91	425.92	23.47	271.98	−66.42	70.04	−66.42	425.92
F ML	(N)	−3.40	128.35	−32.19	14.16	−10.68	41.57	−32.19	128.35
F LG	(N)	−19.16	1,109.52	−24.01	812.36	−60.73	624.22	−60.73	1,109.52
M AP	(Nm)	−1.71	8.37	−5.76	0.37	−8.54	1.37	−8.54	8.37
M ML	(Nm)	−7.85	140.95	−3.06	84.20	−2.15	61.10	−7.85	140.95
M LG	(Nm)	−1.98	9.33	−5.01	0.01	−1.03	3.55	−5.01	9.33
All									
F AP	(%BW)	−0.80	39.79	0.16	48.35	−11.72	16.48	−11.72	48.35
F ML	(%BW)	−1.94	13.83	−4.35	4.76	−3.16	7.33	−4.35	13.83
F LG	(%BW)	−5.52	103.65	−3.60	101.61	−10.71	110.13	−10.71	110.13
M AP	(%BWm)	−1.00	0.78	−0.72	0.46	−2.05	0.34	−2.05	0.78
M ML	(%BWm)	−0.73	13.17	−0.81	10.53	−0.38	12.02	−0.81	13.17
M LG	(%BWm)	−0.22	1.08	−0.63	0.42	−0.18	0.63	−0.63	1.08
F AP	(N)	−8.57	425.92	1.31	386.60	−66.42	93.42	−66.42	425.92
F ML	(N)	−20.81	148.01	−34.75	38.06	−17.89	41.57	−34.75	148.01
F LG	(N)	−59.06	1,109.52	−28.76	812.36	−60.73	624.22	−60.73	1,109.52
M AP	(Nm)	−10.68	8.37	−5.76	3.66	−11.63	1.93	−11.63	8.37
M ML	(Nm)	−7.85	140.95	−6.46	84.20	−2.15	68.13	−7.85	140.95
M LG	(Nm)	−2.31	11.56	−5.01	3.35	−1.03	3.55	−5.01	11.56

Note: P1, P2, P3: Individual participants, Min: minimum magnitude, Max: maximum magnitude, F: force expressed in %BW and N, M: moments expressed in %BWm and Nm, USU: usual feet, FFF: Free-Flow feet, H: High PV, L: Low PV, AP: Anteroposterior axis, ML: Mediolateral axis, LG: long axis.

Table 6

Mean and standard deviation of onset in percentage of support phase and magnitude of up to three local extremum of forces and moments applied on the three anatomical axes of the implant fitted prosthesis including usual and Free-Flow feet during ascending ramp. H: High PV, L: Low PV. NOTE: P2 performed only one trial with USU leg and was not reported here.

	P1		P2		P3		All	
USU								
Onset								
F $_{AP1}$	58.83 ± 23.02	H	−		84.70 ± 3.30	L	75.12 ± 18.13	H
F $_{ML1}$	46.67 ± 18.65	H	−		29.20 ± 11.45	H	35.82 ± 15.94	H
F $_{LG1}$	48.00 ± 25.80	H	−		65.20 ± 16.12	H	59.65 ± 20.91	H
M $_{AP1}$	81.17 ± 29.46	H	−		73.10 ± 8.28	L	73.82 ± 20.38	H

Table 6 (*continued*)

	P1		P2		P3		All	
M $_{ML1}$	1.33 ± 0.52	H	–		4.50 ± 2.32	H	3.24 ± 2.36	H
M $_{ML2}$	82.17 ± 3.25	L	–		69.60 ± 12.01	L	74.29 ± 11.02	L
M $_{LG1}$	67.40 ± 15.84	H	–		65.70 ± 9.71	L	68.82 ± 13.65	L
Magnitude								
F $_{AP1}$	38.44 ± 1.59	L	–		10.65 ± 1.14	L	21.83 ± 13.87	H
F $_{ML1}$	11.03 ± 0.83	L	–		5.20 ± 1.11	H	7.06 ± 3.27	H
F $_{LG1}$	95.93 ± 5.17	L	–		102.45 ± 5.43	L	100.10 ± 5.92	L
M $_{AP1}$	−0.08 ± 0.06	H	–		−1.40 ± 0.09	L	−0.90 ± 0.65	H
M $_{ML1}$	−0.01 ± 0.46	H	–		−0.24 ± 0.10	H	−0.10 ± 0.35	H
M $_{ML2}$	11.93 ± 0.97	L	–		10.47 ± 0.16	L	10.99 ± 0.91	L
M $_{LG1}$	0.80 ± 0.15	L	–		0.47 ± 0.08	L	0.55 ± 0.22	H
FFF								
Onset								
F $_{AP1}$	72.71 ± 16.82	H	40.40 ± 5.50	L	82.67 ± 3.93	L	67.06 ± 20.49	H
F $_{ML1}$	50.43 ± 16.99	H	47.80 ± 4.92	L	22.50 ± 7.31	H	40.39 ± 17.14	H
F $_{LG1}$	54.57 ± 23.28	H	66.20 ± 19.47	H	70.50 ± 3.21	L	63.11 ± 18.32	H
M $_{AP1}$	65.14 ± 20.28	H	49.80 ± 4.32	L	74.67 ± 2.58	L	64.06 ± 15.86	H
M $_{ML1}$	1.71 ± 0.49	H	2.40 ± 0.55	H	4.50 ± 1.38	H	2.83 ± 1.50	H
M $_{ML2}$	76.29 ± 7.89	L	80.20 ± 1.79	L	73.17 ± 3.31	L	76.33 ± 5.82	L
M $_{LG1}$	65.29 ± 12.72	L	67.60 ± 18.47	H	72.83 ± 2.79	L	68.44 ± 12.28	L
Magnitude								
F $_{AP1}$	29.40 ± 1.81	L	42.61 ± 3.90	L	14.98 ± 1.10	L	28.26 ± 11.33	H
F $_{ML1}$	11.90 ± 1.42	L	3.68 ± 0.97	H	4.63 ± 0.75	L	7.19 ± 4.02	H
F $_{LG1}$	98.74 ± 4.18	L	96.31 ± 2.16	L	105.14 ± 4.25	L	100.20 ± 5.15	L
M $_{AP1}$	−0.74 ± 0.19	H	−0.26 ± 0.08	H	−1.96 ± 0.09	L	−1.01 ± 0.73	H
M $_{ML1}$	0.07 ± 0.21	H	0.01 ± 0.18	H	−0.13 ± 0.10	H	−0.01 ± 0.18	H
M $_{ML2}$	8.97 ± 0.46	L	8.84 ± 0.56	L	11.75 ± 0.23	L	9.86 ± 1.44	L
M $_{LG1}$	0.85 ± 0.15	L	0.21 ± 0.14	H	0.36 ± 0.05	L	0.51 ± 0.31	H

Note: P1, P2, P3: Individual participants, F: force expressed in %BW, M: moments expressed in %BWm, USU: usual feet, FFF: Free-Flow feet, H: High PV, L: Low PV, AP: Anteroposterior axis, ML: Mediolateral axis, LG: long axis.

Table 7
Mean and standard deviation of spatio-temporal characteristics including cadence, duration of gait cycle and support phase while using usual and Free-Flow feet during descending ramp.

		P1		P2		P3		All	
USU									
Cadence	(Strides/min)	44	–	52	–	46	–	47 ± 4	L
Gait cycle	(s)	1.36 ± 0.08	L	1.15 ± 0.04	L	1.32 ± 0.14	L	1.31 ± 0.13	L
Support	(%GC)	63 ± 4	L	60 ± 3	L	68 ± 4	L	65 ± 5	L
FFF									
Cadence	(Strides/min)	42	–	52	–	50	–	48 ± 5	L
Gait cycle	(s)	1.43 ± 0.09	L	1.16 ± 0.06	L	1.21 ± 0.07	L	1.26 ± 0.13	L
Support	(%GC)	61 ± 3	L	62 ± 3	L	63 ± 3	L	62 ± 3	L

Note: P1, P2, P3: Individual participants, USU: usual feet, FFF: Free-Flow feet, H: High PV, L: Low PV.

Table 8
Loading boundaries including minimum and maximum magnitude of forces and moments applied on the three anatomical axes of the implant fitted prosthesis including usual and Free-Flow feet during descending ramp.

		P1		P2		P3		All	
		Min	Max	Min	Max	Min	Max	Min	Max
USU									
F AP	(%BW)	−20.05	23.80	−6.23	47.95	−18.74	11.76	−20.05	47.95
F ML	(%BW)	−0.93	12.50	−5.88	6.43	−2.59	9.16	−5.88	12.50

Table 8 (*continued*)

		P1		P2		P3		All	
		Min	Max	Min	Max	Min	Max	Min	Max
F LG	(%BW)	−4.27	109.30	−21.92	86.82	−6.53	105.63	−21.92	109.30
M AP	(%BWm)	−2.20	0.45	−0.44	0.32	−1.60	0.35	−2.20	0.45
M ML	(%BWm)	−4.25	3.99	−2.57	5.23	−4.02	0.63	−4.25	5.23
M LG	(%BWm)	−0.66	0.40	−0.32	0.52	−0.31	0.28	−0.66	0.52
F AP	(N)	−214.58	254.78	−49.78	383.37	−106.20	66.69	−214.58	383.37
F ML	(N)	−9.95	133.76	−46.99	51.37	−14.69	51.93	−46.99	133.76
F LG	(N)	−45.72	1,170.03	−175.22	694.12	−36.99	598.72	−175.22	1,170.03
M AP	(Nm)	−23.54	4.79	−3.54	2.57	−9.06	1.98	−23.54	4.79
M ML	(Nm)	−45.49	42.68	−20.53	41.82	−22.79	3.58	−45.49	42.68
M LG	(Nm)	−7.01	4.26	−2.54	4.18	−1.74	1.59	−7.01	4.26
FFF									
F AP	(%BW)	−12.80	25.16	−6.23	47.95	−14.66	6.53	−14.66	47.95
F ML	(%BW)	−1.47	14.05	−5.88	6.43	−1.37	7.76	−5.88	14.05
F LG	(%BW)	−1.84	110.12	−21.92	86.82	−3.33	108.99	−21.92	110.12
M AP	(%BWm)	−1.89	0.33	−0.44	0.32	−0.79	0.34	−1.89	0.34
M ML	(%BWm)	−3.60	4.93	−2.57	5.23	−3.72	0.27	−3.72	5.23
M LG	(%BWm)	−0.55	0.62	−0.32	0.52	−0.31	0.29	−0.55	0.62
F AP	(N)	−137.04	269.30	−49.78	383.37	−83.09	37.02	−137.04	383.37
F ML	(N)	−15.73	150.37	−46.99	51.37	−7.74	43.99	−46.99	150.37
F LG	(N)	−19.74	1,178.84	−175.22	694.12	−18.89	617.80	−175.22	1,178.84
M AP	(Nm)	−20.19	3.53	−3.54	2.57	−4.50	1.93	−20.19	3.53
M ML	(Nm)	−38.48	52.78	−20.53	41.82	−21.09	1.55	−38.48	52.78
M LG	(Nm)	−5.86	6.69	−2.54	4.18	−1.74	1.66	−5.86	6.69

Note: P1, P2, P3: Individual participants, Min: minimum magnitude, Max: maximum magnitude, F: force expressed in %BW and N, M: moments expressed in %BWm and Nm, USU: usual feet, FFF: Free-Flow feet, H: High PV, L: Low PV, AP: Anteroposterior axis, ML: Mediolateral axis, LG: long axis.

Table 9
Mean and standard deviation of onset in percentage of support phase and magnitude of up to three local extremum of forces and moments applied on the three anatomical axes of the implant fitted prosthesis including usual and Free-Flow feet descending ramp.

	P1		P2		P3		All	
USU								
Onset								
F $_{AP1}$	24.89 ± 9.52	H	6.00 ± 3.56	H	39.00 ± 12.08	H	29.04 ± 15.60	H
F $_{ML1}$	73.56 ± 10.37	L	69.00 ± 23.15	H	58.00 ± 14.32	H	65.08 ± 15.86	H
F $_{LG1}$	49.22 ± 13.22	H	54.50 ± 14.46	H	54.54 ± 14.40	H	52.69 ± 13.68	H
M $_{AP1}$	51.89 ± 17.34	H	68.75 ± 34.22	H	60.31 ± 14.23	H	58.69 ± 19.18	H
M $_{ML1}$	35.78 ± 12.42	H	19.25 ± 7.68	H	64.46 ± 10.46	L	47.58 ± 20.87	H
M $_{ML2}$	89.89 ± 2.76	L	67.00 ± 14.72	H	96.31 ± 2.87	L	89.58 ± 11.73	L
M $_{LG1}$	91.22 ± 5.61	L	71.50 ± 34.89	H	89.92 ± 7.22	L	87.54 ± 15.17	L
Magnitude								
F $_{AP1}$	−13.36 ± 3.12	H	−2.81 ± 2.49	H	−17.00 ± 1.13	L	−13.56 ± 5.40	H
F $_{ML1}$	10.80 ± 1.13	L	4.64 ± 1.44	H	6.84 ± 1.02	L	7.87 ± 2.54	H
F $_{LG1}$	103.20 ± 4.96	L	71.50 ± 15.28	H	103.12 ± 2.57	L	98.28 ± 13.22	L
M $_{AP1}$	−1.93 ± 0.18	L	−0.33 ± 0.08	H	−1.22 ± 0.17	L	−1.33 ± 0.57	H
M $_{ML1}$	−4.04 ± 0.24	L	−2.28 ± 0.21	L	−3.56 ± 0.23	L	−3.53 ± 0.63	L
M $_{ML2}$	3.35 ± 0.57	L	4.72 ± 0.43	L	0.06 ± 0.29	H	1.91 ± 1.99	H
M $_{LG1}$	0.22 ± 0.12	H	0.34 ± 0.07	H	0.19 ± 0.06	H	0.22 ± 0.10	H
FFF								
Onset								
F $_{AP1}$	26.50 ± 16.44	H	6.00 ± 3.56	H	24.20 ± 9.17	H	20.09 ± 13.20	H
F $_{ML1}$	70.30 ± 8.00	L	69.00 ± 23.15	H	38.07 ± 9.02	H	61.77 ± 23.19	H
F $_{LG1}$	34.80 ± 14.97	H	54.50 ± 14.46	H	45.33 ± 21.36	H	46.43 ± 19.88	H
M $_{AP1}$	48.80 ± 16.95	H	68.75 ± 34.22	H	52.67 ± 17.88	H	63.89 ± 25.10	H
M $_{ML1}$	25.20 ± 9.41	H	19.25 ± 7.68	H	33.20 ± 10.61	H	26.51 ± 10.93	H
M $_{ML2}$	93.40 ± 5.30	L	67.00 ± 14.72	H	96.07 ± 3.17	L	88.17 ± 11.81	L

Table 9 (*continued*)

	P1		P2		P3		All	
M $_{LG1}$	89.50 ± 4.03	L	71.50 ± 34.89	H	87.80 ± 7.78	L	87.43 ± 11.84	L
Magnitude								
F $_{AP1}$	−9.10 ± 3.02	H	−2.81 ± 2.49	H	−13.80 ± 0.75	L	−9.03 ± 5.34	H
F $_{ML1}$	11.39 ± 1.43	H	4.64 ± 1.44	H	6.80 ± 0.56	L	7.09 ± 3.25	H
F $_{LG1}$	103.82 ± 4.83	L	71.50 ± 15.28	H	103.42 ± 2.45	L	98.26 ± 9.74	L
M $_{AP1}$	−1.70 ± 0.25	L	−0.33 ± 0.08	H	−0.72 ± 0.07	L	−0.81 ± 0.65	H
M $_{ML1}$	−2.80 ± 0.84	H	−2.28 ± 0.21	L	−3.19 ± 0.32	L	−2.61 ± 0.88	H
M $_{ML2}$	1.59 ± 1.51	H	4.72 ± 0.43	L	−0.10 ± 0.15	H	1.46 ± 1.82	H
M $_{LG1}$	0.22 ± 0.19	H	0.34 ± 0.07	H	0.21 ± 0.05	H	0.26 ± 0.14	H

Note: P1, P2, P3: Individual participants, F: force expressed in %BW, M: moments expressed in %BWm, USU: usual feet, FFF: Free-Flow feet, H: High PV, L: Low PV, AP: Anteroposterior axis, ML: Mediolateral axis, LG: long axis.

1.3. Ascending ramp

The spatio-temporal characteristics, loading boundaries as well as onset and magnitude of up to three local extremum during ascending ramp are presented in Tables 4−6.

Table 10
Mean and standard deviation of spatio-temporal characteristics including cadence, duration of gait cycle and support phase while using usual and Free-Flow feet during ascending stairs.

		P1		P2		P3		All	
USU									
Cadence	(Strides/min)	34	−	42	−	25	−	34 ± 9	H
Gait cycle	(s)	1.76 ± 0.11	L	1.42 ± 0.05	L	2.42 ± 0.20	L	1.94 ± 0.44	H
Support	(%GC)	56 ± 3	L	59 ± 1	L	61 ± 3	L	59 ± 3	L
FFF									
Cadence	(Strides/min)	33	−	44	−	25	−	34 ± 9	H
Gait cycle	(s)	1.81 ± 0.06	L	1.36 ± 0.04	L	2.35 ± 0.13	L	1.70 ± 0.43	H
Support	(%GC)	55 ± 2	L	65 ± 5	L	50 ± 8	L	59 ± 8	L

Note: P1, P2, P3: Individual participants, USU: usual feet, FFF: Free-Flow feet, H: High PV, L: Low PV.

Table 11
Loading boundaries including minimum and maximum magnitude of forces and moments applied on the three anatomical axes of the implant fitted prosthesis including usual and Free-Flow feet during ascending stairs.

		P1		P2		P3		All	
		Min	Max	Min	Max	Min	Max	Min	Max
USU									
F AP	(%BW)	−0.26	42.13	−2.88	37.90	−14.95	14.81	−14.95	42.13
F ML	(%BW)	−1.12	15.20	−4.85	8.25	−3.22	6.93	−4.85	15.20
F LG	(%BW)	−1.34	105.93	−4.28	99.29	−20.92	100.12	−20.92	105.93
M AP	(%BWm)	−0.36	0.89	−0.84	0.56	−0.69	1.39	−0.84	1.39
M ML	(%BWm)	−0.24	10.46	−0.69	7.29	−0.70	7.45	−0.70	10.46
M LG	(%BWm)	−0.25	0.89	−1.01	0.74	−0.55	0.09	−1.01	0.89
F AP	(N)	−2.74	450.96	−23.13	303.87	−84.77	83.93	−84.77	450.96
F ML	(N)	−12.03	162.73	−38.89	66.12	−18.26	39.29	−38.89	162.73
F LG	(N)	−14.32	1,133.99	−34.35	796.14	−118.59	567.52	−118.59	1,133.99
M AP	(Nm)	−3.89	9.55	−6.76	4.53	−3.93	7.90	−6.76	9.55
M ML	(Nm)	−2.52	111.94	−5.53	58.43	−3.94	42.21	−5.53	111.94
M LG	(Nm)	−2.63	9.50	−8.13	5.96	−3.10	0.51	−8.13	9.50
FFF									
F AP	(%BW)	−0.74	29.02	−1.50	39.02	−14.21	12.31	−14.21	39.02
F ML	(%BW)	−0.04	13.43	−4.58	8.23	−2.78	6.05	−4.58	13.43
F LG	(%BW)	−0.45	106.63	−3.49	103.29	−3.04	106.28	−3.49	106.63
M AP	(%BWm)	−0.78	0.41	−0.42	1.31	−1.14	1.16	−1.14	1.31
M ML	(%BWm)	−0.07	7.59	−0.55	7.58	−0.72	3.51	−0.72	7.59

Table 11 (continued)

		P1		P2		P3		All	
		Min	Max	Min	Max	Min	Max	Min	Max
M LG	(%BWm)	−0.68	0.38	−0.75	1.19	−0.50	0.17	−0.75	1.19
F AP	(N)	−7.97	310.65	−11.99	312.89	−80.55	69.76	−80.55	312.89
F ML	(N)	−0.43	143.76	−36.75	65.97	−15.77	34.28	−36.75	143.76
F LG	(N)	−4.85	1,141.42	−28.02	828.23	−17.25	602.43	−28.02	1,141.42
M AP	(Nm)	−8.37	4.41	−3.34	10.49	−6.44	6.60	−8.37	10.49
M ML	(Nm)	−0.71	81.29	−4.39	60.74	−4.10	19.90	−4.39	81.29
M LG	(Nm)	−7.32	4.12	−6.04	9.54	−2.84	0.95	−7.32	9.54

Note: P1, P2, P3: Individual participants, Min: minimum magnitude, Max: maximum magnitude, F: force expressed in %BW and N, M: moments expressed in %BWm and Nm, USU: usual feet, FFF: Free-Flow feet, H: High PV, L: Low PV, AP: Anteroposterior axis, ML: Mediolateral axis, LG: long axis.

Table 12

Mean and standard deviation of onset in percentage of support phase and magnitude of up to three local extremum of forces and moments applied on the three anatomical axes of the implant fitted prosthesis including usual and Free-Flow feet during ascending stairs.

	P1		P2		P3		All	
USU								
Onset								
F $_{AP1}$	72.40 ± 25.13	H	24.67 ± 7.09	H	19.20 ± 7.56	H	40.92 ± 30.22	H
F $_{ML1}$	41.80 ± 25.82	H	27.67 ± 4.51	L	40.00 ± 18.23	H	37.85 ± 19.26	H
F $_{LG1}$	82.00 ± 4.69	L	65.33 ± 28.88	H	75.40 ± 5.68	L	75.62 ± 14.16	L
M $_{AP1}$	72.60 ± 33.32	H	100.00 ± 0.00	L	76.60 ± 5.50	L	80.46 ± 22.53	H
M $_{ML1}$	2.00 ± 0.00	L	6.00 ± 4.00	H	13.20 ± 15.48	H	7.23 ± 10.45	H
M $_{ML2}$	83.40 ± 3.97	L	76.67 ± 11.02	L	81.80 ± 4.09	L	81.23 ± 6.19	L
M $_{LG1}$	8.00 ± 6.00	H	7.33 ± 4.16	H	27.00 ± 7.48	H	15.15 ± 11.34	H
M $_{LG2}$	57.20 ± 21.58	H	55.00 ± 26.29	H	94.80 ± 3.03	L	71.15 ± 25.55	H
Magnitude								
F $_{AP1}$	35.72 ± 4.55	L	36.35 ± 2.60	L	13.27 ± 1.29	L	27.23 ± 11.86	H
F $_{ML1}$	13.90 ± 1.51	L	6.37 ± 2.13	H	6.16 ± 0.60	L	9.18 ± 4.09	H
F $_{LG1}$	99.33 ± 5.12	L	93.83 ± 6.90	L	97.96 ± 2.72	L	97.53 ± 4.90	L
M $_{AP1}$	0.53 ± 0.18	H	−0.09 ± 0.12	H	1.28 ± 0.07	L	0.68 ± 0.57	H
M $_{ML1}$	0.16 ± 0.32	H	0.11 ± 0.69	H	−0.15 ± 0.42	H	0.03 ± 0.44	H
M $_{ML2}$	9.93 ± 0.42	L	6.96 ± 0.44	L	6.41 ± 1.21	L	7.89 ± 1.85	H
M $_{LG1}$	−0.06 ± 0.11	H	−0.58 ± 0.38	H	−0.47 ± 0.07	L	−0.34 ± 0.29	H
M $_{LG2}$	0.68 ± 0.17	H	0.55 ± 0.24	H	0.04 ± 0.04	H	0.41 ± 0.34	H
FFF								
Onset								
F $_{AP1}$	82.25 ± 0.96	L	37.00 ± 17.23	H	43.40 ± 32.04	H	48.83 ± 26.96	H
F $_{ML1}$	31.75 ± 12.28	H	42.67 ± 21.14	H	46.80 ± 12.13	H	41.39 ± 17.40	H
F $_{LG1}$	69.75 ± 24.51	H	76.78 ± 4.18	L	63.20 ± 18.74	H	71.44 ± 15.25	H
M $_{AP1}$	75.75 ± 37.35	H	49.33 ± 23.59	H	67.00 ± 26.57	H	60.11 ± 28.41	H
M $_{ML1}$	2.00 ± 0.00	L	1.44 ± 0.53	H	16.80 ± 18.94	H	5.83 ± 11.56	H
M $_{ML2}$	83.75 ± 0.50	L	77.78 ± 3.99	L	82.40 ± 2.30	L	80.39 ± 4.03	L
M $_{LG1}$	28.50 ± 3.11	L	18.22 ± 8.03	H	44.00 ± 19.66	H	27.67 ± 15.77	H
M $_{LG2}$	72.50 ± 14.93	H	73.89 ± 11.15	L	87.00 ± 27.42	H	77.22 ± 17.72	H
Magnitude								
F $_{AP1}$	26.97 ± 1.49	L	36.07 ± 2.08	L	9.19 ± 3.91	H	26.58 ± 11.95	H
F $_{ML1}$	12.93 ± 0.42	L	5.38 ± 1.70	H	5.71 ± 0.43	L	7.15 ± 3.40	H
F $_{LG1}$	102.67 ± 3.79	L	97.36 ± 3.87	L	97.21 ± 5.79	L	98.50 ± 4.77	L
M $_{AP1}$	0.01 ± 0.16	H	0.86 ± 0.29	H	0.84 ± 0.35	H	0.66 ± 0.45	H
M $_{ML1}$	0.08 ± 0.11	H	−0.05 ± 0.09	H	−0.34 ± 0.37	H	−0.10 ± 0.25	H
M $_{ML2}$	7.26 ± 0.30	L	6.45 ± 0.86	L	3.19 ± 0.33	L	5.72 ± 1.76	H
M $_{LG1}$	−0.38 ± 0.23	H	−0.53 ± 0.13	H	−0.34 ± 0.16	H	−0.44 ± 0.18	H
M $_{LG2}$	0.30 ± 0.10	H	0.68 ± 0.34	H	0.12 ± 0.04	H	0.44 ± 0.35	H

Note: P1, P2, P3: Individual participants, F: force expressed in %BW, M: moments expressed in %BWm, USU: usual feet, FFF: Free-Flow feet, H: High PV, L: Low PV, AP: Anteroposterior axis, ML: Mediolateral axis, LG: long axis.

1.4. Descending ramp

The spatio-temporal characteristics, loading boundaries as well as onset and magnitude of up to three local extremum during descending ramp are presented in Tables 7–9.

1.5. Ascending stairs

The spatio-temporal characteristics, loading boundaries as well as onset and magnitude of up to three local extremum during ascending stairs are presented in Tables 10–12.

Table 13
Mean and standard deviation of spatio-temporal characteristics including cadence, duration of gait cycle and support phase while using usual and Free-Flow feet during descending stairs.

		P1		P2		P3		All	
USU									
Cadence	(Strides/min)	20	–	23	–	15	–	19 ± 4	H
Gait cycle	(s)	1.53 ± 0.13	L	1.31 ± 0.02	L	1.99 ± 0.19	L	1.78 ± 0.32	L
Support	(%GC)	62 ± 4	L	54 ± 2	L	69 ± 2	L	65 ± 6	L
FFF									
Cadence	(Strides/min)	21	–	23	–	16	–	20 ± 3	L
Gait cycle	(s)	1.42 ± 0.11	L	1.32 ± 0.05	L	1.84 ± 0.13	L	1.54 ± 0.26	L
Support	(%GC)	60 ± 3	L	60 ± 4	L	69 ± 3	L	63 ± 5	L

Note: P1, P2, P3: Individual participants, USU: usual feet, FFF: Free-Flow feet, H: High PV, L: Low PV.

Table 14
Loading boundaries including minimum and maximum magnitude of forces and moments applied on the three anatomical axes of the implant fitted prosthesis including usual and Free-Flow feet during descending stairs.

		P1		P2		P3		All	
		Min	Max	Min	Max	Min	Max	Min	Max
USU									
F AP	(%BW)	−3.20	29.11	−0.42	32.57	−16.98	7.87	−16.98	32.57
F ML	(%BW)	−1.67	16.73	−9.36	5.53	−2.29	6.87	−9.36	16.73
F LG	(%BW)	0.00	100.00	−4.70	105.28	−10.65	112.07	−10.65	112.07
M AP	(%BWm)	−0.84	0.68	−0.82	0.44	−1.53	0.29	−1.53	0.68
M ML	(%BWm)	−0.74	8.03	−0.70	6.88	−2.36	2.46	−2.36	8.03
M LG	(%BWm)	−0.53	1.18	−0.76	0.05	−0.18	0.77	−0.76	1.18
F AP	(N)	−34.25	311.56	−3.32	260.38	−96.25	44.62	−96.25	311.56
F ML	(N)	−17.84	179.10	−74.84	44.24	−12.96	38.96	−74.84	179.10
F LG	(N)	0.01	1,070.45	−37.59	841.72	−60.35	635.24	−60.35	1,070.45
M AP	(Nm)	−9.01	7.30	−6.53	3.52	−8.69	1.65	−9.01	7.30
M ML	(Nm)	−7.90	85.95	−5.57	54.99	−13.37	13.92	−13.37	85.95
M LG	(Nm)	−5.71	12.59	−6.10	0.42	−1.02	4.39	−6.10	12.59
FFF									
F AP	(%BW)	−3.60	29.36	−0.39	38.54	−11.42	6.28	−11.42	38.54
F ML	(%BW)	−0.21	15.81	−8.97	4.70	−1.96	7.20	−8.97	15.81
F LG	(%BW)	0.88	100.37	−13.43	104.80	−2.19	106.85	−13.43	106.85
M AP	(%BWm)	−1.47	0.21	−0.30	1.38	−1.11	0.19	−1.47	1.38
M ML	(%BWm)	−0.47	6.29	−1.18	6.49	−1.23	2.17	−1.23	6.49
M LG	(%BWm)	−0.61	0.90	−0.97	0.10	−0.58	0.54	−0.97	0.90
F AP	(N)	−38.58	314.31	−3.12	308.10	−64.72	35.62	−64.72	314.31
F ML	(N)	−2.25	169.28	−71.68	37.56	−11.11	40.80	−71.68	169.28
F LG	(N)	9.46	1,074.47	−107.35	837.88	−12.43	605.67	−107.35	1,074.47
M AP	(Nm)	−15.72	2.22	−2.37	11.01	−6.32	1.09	−15.72	11.01
M ML	(Nm)	−5.04	67.35	−9.42	51.93	−6.96	12.28	−9.42	67.35
M LG	(Nm)	−6.57	9.67	−7.76	0.77	−3.26	3.06	−7.76	9.67

Note: P1, P2, P3: Individual participants, Min: minimum magnitude, Max: maximum magnitude, F: force expressed in %BW and N, M: moments expressed in %BWm and Nm, USU: usual feet, FFF: Free-Flow feet, H: High PV, L: Low PV, AP: Anteroposterior axis, ML: Mediolateral axis, LG: long axis.

Table 15

Mean and standard deviation of onset in percentage of support phase and magnitude of up to three local extremum of forces and moments applied on the three anatomical axes of the implant fitted prosthesis including usual and Free-Flow feet during descending stairs.

	P1		P2		P3		All	
USU								
Onset								
F $_{AP1}$	64.60 ± 6.69	L	66.50 ± 3.54	L	87.10 ± 5.20	L	78.06 ± 12.31	L
F $_{ML1}$	57.80 ± 15.45	H	24.50 ± 2.12	L	55.80 ± 11.17	H	52.71 ± 15.61	H
F $_{LG1}$	42.40 ± 12.20	H	30.50 ± 28.99	H	42.00 ± 18.18	H	40.76 ± 17.05	H
M $_{AP1}$	51.80 ± 40.79	H	7.00 ± 0.00	L	10.00 ± 23.22	H	52.65 ± 29.61	H
M $_{ML1}$	64.80 ± 4.92	L	55.50 ± 4.95	L	81.40 ± 10.62	L	73.47 ± 13.20	L
Magnitude								
F $_{AP1}$	25.01 ± 2.61	L	30.18 ± 2.85	L	4.90 ± 1.97	H	13.78 ± 11.24	H
F $_{ML1}$	13.36 ± 2.67	H	4.30 ± 1.75	H	5.88 ± 0.64	L	7.89 ± 3.96	H
F $_{LG1}$	92.02 ± 6.70	L	95.08 ± 7.25	L	105.46 ± 6.07	L	100.25 ± 8.78	L
M $_{AP1}$	0.42 ± 0.19	H	0.38 ± 0.08	H	0.12 ± 0.10	H	0.99 ± 0.52	H
M $_{ML1}$	6.91 ± 0.94	L	6.19 ± 0.97	L	1.51 ± 0.57	H	3.65 ± 2.73	H
FFF								
Onset								
F $_{AP1}$	73.67 ± 8.43	L	62.80 ± 10.06	L	85.88 ± 6.29	L	71.00 ± 15.40	H
F $_{ML1}$	66.83 ± 15.65	H	32.40 ± 18.46	H	51.13 ± 16.61	H	51.16 ± 20.75	H
F $_{LG1}$	41.00 ± 13.48	H	23.80 ± 18.54	H	54.63 ± 20.44	H	42.21 ± 21.27	H
M $_{AP1}$	36.00 ± 45.55	H	7.80 ± 1.30	L	18.88 ± 32.89	H	34.21 ± 35.11	H
M $_{ML1}$	72.67 ± 8.45	L	53.20 ± 5.02	L	80.25 ± 9.63	L	70.74 ± 13.73	L
Magnitude								
F $_{AP1}$	25.83 ± 3.10	L	32.90 ± 4.97	L	4.88 ± 1.92	H	19.31 ± 12.45	H
F $_{ML1}$	13.63 ± 2.07	L	3.75 ± 0.71	L	5.86 ± 0.94	L	7.76 ± 4.38	H
F $_{LG1}$	97.78 ± 3.23	L	91.50 ± 16.43	L	102.20 ± 2.40	L	97.92 ± 9.24	L
M $_{AP1}$	0.05 ± 0.09	H	1.20 ± 0.21	L	0.13 ± 0.06	H	0.68 ± 0.55	H
M $_{ML1}$	5.55 ± 0.55	L	5.56 ± 1.03	L	1.82 ± 0.28	L	3.98 ± 1.98	H

Note: P1, P2, P3: Individual participants, F: force expressed in %BW, M: moments expressed in %BWm, USU: usual feet, FFF: Free-Flow feet, H: High PV, L: Low PV, AP: Anteroposterior axis, ML: Mediolateral axis, LG: long axis.

1.6. Descending stairs

The spatio-temporal characteristics, loading boundaries as well as onset and magnitude of up to three local extremum during descending stairs are presented in Tables 13–15.

2. Experimental design, materials, and methods

2.1. Recording of daily activities

Participants fitted with transtibial bone-anchored prostheses including with their own or Free-Flow prosthetic foot performed three and five trials of five standardized daily activities including straight-line level walking (5–10 m walkway), ascending and descending ramp (2.5 m, 13.7 deg incline) and stairs (3 stairs, 20 cm height, 24.5 cm deep, 100 cm wide) following protocol previously used for individuals with transfemoral amputation [1–6]. Participants were instructed to complete each activity at a self-selected comfortable pace as well as to use handrails and take sufficient rest between trials to avoid fatigue if needed.

2.2. Apparatus to measure loading

For each activity, the raw loading data was recorded directly using a state-of-the-art portable kinetic system (iPecsLab, RTC Inc, US) including a tri-axial transducer sending forces and moments data wirelessly data (200 Hz) applied on the implant to a receiver connected to a laptop nearby with an accuracy better than 1 N and 1 Nm, respectively [5–15]. The raw loading datasets were imported into a

Matlab program and offset according to load yielded during calibration and further expressed in Nm and percentage of bodyweight (%BWm).

2.3. Extraction of loading characteristics

Spatio-temporal characteristics including cadence, duration of gait cycle and support phase were determined after manual detection of heel contacts and toe offs using pattern on the forces applied on anteroposterior and long axes of the implant [12].

All loading characteristics were normalized as percentage of the bodyweight. Onsets of the loading local extremum were reported as percentage of support phase after it was time-normalized from 0 to 100% each gait cycle [12].

The loading boundaries per activity corresponding to magnitude of minimum and maximum of the three components of forces and moments for all gait cycles considered without consideration for the time of occurrence.

The loading local extremum for each of the three components of forces and moments corresponded points of inflection between loading slopes that occur consistently over successive gait cycles for a given activity across all participants. The local extremum were detected semi-automatically using searches of maximum or minimum loading magnitude within a set time window.

2.4. Variability

Individual variability of each loading characteristics was determined using the percentage of variation (PV = absolute [[standard deviation/mean] $\times 100$]). We considered than a PV inferior or superior to 20% indicated a low (L) or high (H) variability, respectively [5].

Conflict of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.dib.2019.104510.

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