

**基本動作と機能解剖
シリーズ①**

立ち上がりにおける重心 コントロールの考え方

～基本動作でみるべき膝関節の機能解剖～

**Gait
Seminar**

**脳外臨床研究会
歩行セミナー講師
理学療法士 中上博之**

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立ち上がり動作を理解する

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03

立ち上がり動作とは

1日の立ち上がり回数

✓33~71回

✓健康な人のみ

平均45回

Study	Measurement Procedure	Population	Daily STSs Mean±SD (95% CI)
Bohannon et al. ¹³⁾	Talley counter used by participants for 7 days	United States Community-dwelling adults (51±21 years): n= 96	46±17 (43–49) Significantly more on weekdays than weekend days.
Dall and Kerr ¹⁴⁾	ActivePAL attached to participants' thighs for 3 or 7 days	Scotland Community-dwelling adults (40±9 years): n= 140	60±22 (57–64) Significantly more by indoor sedentary workers than outdoor active workers. Significantly more during working days than nonworking days.
Grant et al. ¹⁵⁾	ActivePAL attached to participants' thighs for up to 7 days	Scotland Community-dwelling older adults (74±5 years): n = 20	71±25 (59–83)
		Scotland Day hospital attendees (75±8 years): n = 20	57±23 (46–68)
		Scotland Hospital ward residents (81±6 years): n = 30	36±16 (30–42)
deBruin et al. ¹⁶⁾	Custom device attached to participants' sternum for 2 consecutive weekdays during 1 week and 1 of the same days the following week	Switzerland Residential care occupants (88±2 years): n = 11	60±23 (47–73) [week 1] 56±17 (45–67) [week 2]
Van den Berg-Emons et al. ¹⁷⁾	Activity monitor attached to participants' sternum and thighs for 2 consecutive weekdays	The Netherlands Individuals without congestive heart failure or mobility limitations (65±4 years): n = 5	54±19 (30–78)
		The Netherlands Patients with congestive heart failure (64±5 years): n = 5	33±12 (18–48)
De Groot et al. ¹⁸⁾	Activity monitor attached to participants' sternum and thighs for 2 consecutive days	The Netherlands Healthy controls matched with patients scheduled for hip arthroplasty (59±12 years): n = 34	61±23 (53–69)
		The Netherlands Healthy controls matched with patients scheduled for knee arthroplasty (60±11 years): n = 37	61±23 (54–68)
		The Netherlands Patients with osteoarthritis scheduled for hip arthroplasty (60±13 years): n = 34	50±14 (45–55)
		The Netherlands Patients with osteoarthritis scheduled for knee arthroplasty (61±10 years): n = 37	47±14 (42–52)
Egerton and Brauer ¹⁹⁾	ActivePAL attached to participants' thighs for 3 consecutive days	Australia Individuals living at home (71±4 years): n = 15	65±17 (56–74)
		Australia Individuals living in aged care facilities (87±7 years): n = 16	47±27 (33–61)
Lord et al. ²⁰⁾	ActivePAL attached to participants' thighs for 7 days	Australia Individuals living independently in community (79±5 years): n = 56	39±11 (36–42)
Maddocks and Wilcock ²¹⁾	ActivePAL attached to participants' thighs for 6 days (2 weekend)	England Patients with end-stage thoracic cancer (66±9 years): n = 84	45±17 (41–49)
Ryan et al. ²²⁾	ActivePAL attached to thigh for 7 days	Scotland Patients with low back pain (45±11 years): n = 38	59±16 (54–64)

立ち上がり動作とは

必要な機能は？



筋力

バランス

足の位置

椅子の高さ

立ち上がり動作とは 必要な機能は？

TABLE
Mean Angular Positions Computed at Five-Percent Intervals of the Sit-to-Stand Movement Pattern (in Degrees)

Interval	Movement Pattern (%)	Ankle ^a		Knee ^a		Hip ^a		Pelvis ^b		Trunk ^b		Neck ^b		Frankfort ^b Plane	
		\bar{X}	s	\bar{X}	s	\bar{X}	s	\bar{X}	s	\bar{X}	s	\bar{X}	s	\bar{X}	s
Start	0	105.75	6.59	94.61	5.83	135.25	11.55	116.25	10.51	79.78	6.46	62.63	7.94	-2.10	11.94
1	5	105.56	6.72	94.53	5.79	134.57	11.65	115.62	10.56	79.15	6.52	61.93	7.94	-2.61	11.78
2	10	105.23	6.79	94.56	5.81	133.24	11.62	114.28	10.48	77.66	6.55	60.81	8.06	-3.25	11.81
3	15	104.75	6.75	94.57	5.84	130.87	11.53	111.79	10.31	74.83	6.62	59.14	8.28	-4.03	11.95
4	20	104.10	6.63	94.68	5.89	126.94	11.40	107.53	10.14	70.39	6.80	57.09	8.65	-4.80	12.30
5	25	103.26	6.51	95.06	5.94	121.54	11.18	101.33	9.92	64.77	7.21	55.19	9.33	-5.51	12.82
6	30	102.21	6.42	96.02	5.96	115.70	10.80	93.80	9.46	58.62	7.82	53.93	10.37	-5.84	13.59
7	35	101.03	6.35	97.89	5.99	111.60	10.28	86.75	8.59	53.20	8.77	53.40	11.54	-5.71	14.36
8	40	99.93	6.26	101.08	6.20	110.88	10.28	81.65	7.95	49.52	9.90	53.47	12.47	-5.27	14.95
9	45	99.31	6.13	105.90	6.61	113.73	10.64	78.88	7.52	48.22	11.00	54.18	12.88	-4.52	15.09
10	50	99.44	5.98	112.47	7.26	119.39	11.21	77.89	7.33	49.40	11.75	55.64	12.68	-3.38	14.74
11	55	100.28	5.83	120.32	7.75	126.81	11.46	78.11	7.16	52.66	11.90	57.76	11.98	-1.87	13.92
12	60	101.68	5.79	129.07	8.35	135.35	11.41	79.13	6.90	57.55	11.53	60.36	10.99	-0.13	12.87
13	65	103.44	5.78	138.21	8.94	144.33	10.97	80.62	6.53	63.44	10.60	62.98	9.86	1.49	11.79
14	70	105.30	5.79	147.20	9.15	153.19	10.04	82.30	6.12	69.72	9.22	65.27	8.91	2.73	10.95
15	75	107.19	5.63	155.75	9.01	161.49	9.25	83.95	5.84	75.90	7.61	66.94	8.28	3.36	10.39
16	80	108.87	5.31	163.11	8.08	168.60	8.24	85.41	5.61	81.33	6.06	68.08	7.79	3.55	9.91
17	85	110.21	4.94	169.06	6.86	174.32	7.54	86.59	5.45	85.65	4.95	68.88	7.45	3.59	9.56
18	90	111.12	4.67	173.46	5.78	178.68	7.01	87.53	5.30	88.86	4.25	69.54	7.22	3.71	9.43
19	95	111.59	4.51	176.22	5.17	181.56	6.77	88.17	5.18	91.00	3.88	70.09	7.15	3.78	9.31
20	100	111.74	4.45	177.86	4.98	183.40	6.74	88.58	5.13	92.49	3.65	70.06	7.21	3.67	9.28

^a Values define the angular measurements between body segments as delineated by data points.
^b Angular measurements reflect the relationship of the body segment to the positive x axis.

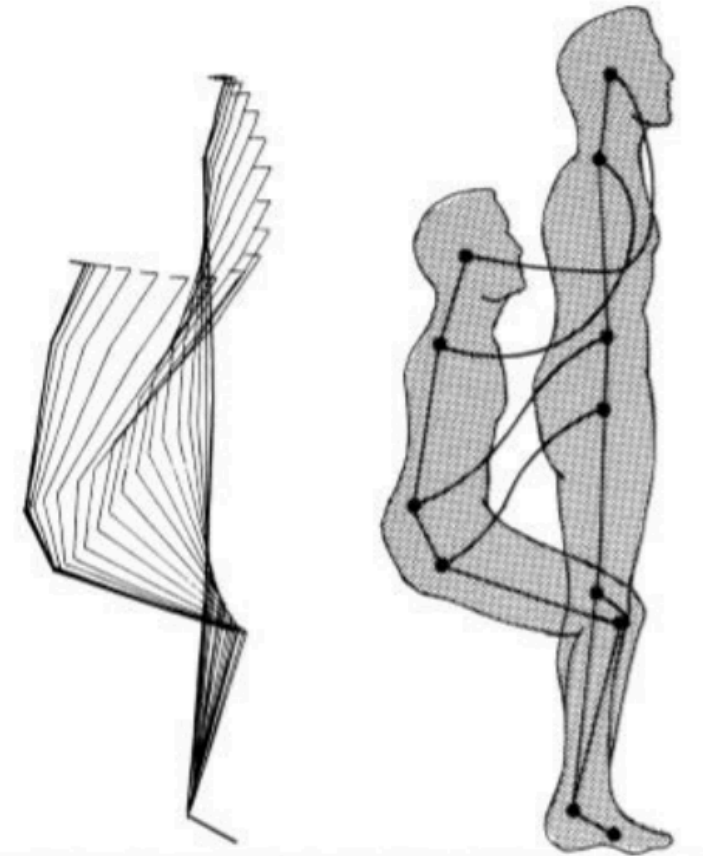
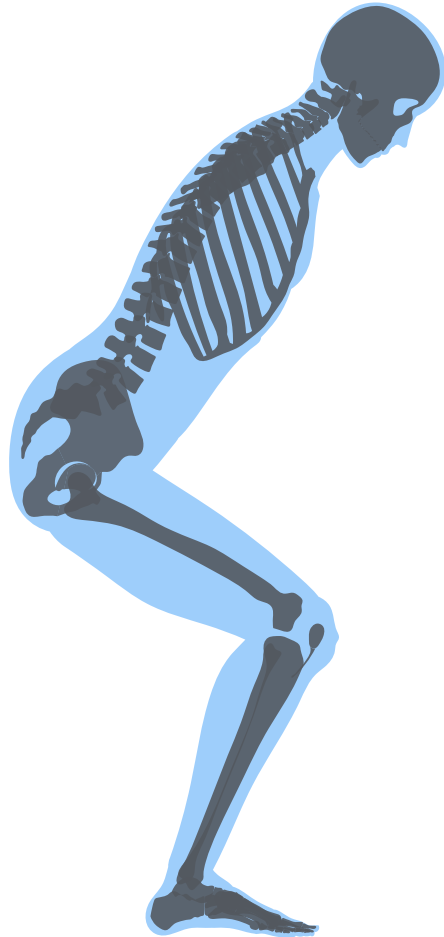


Fig. 3. Left diagram depicts a representative movement pattern. Data points are joined by lines to form 21 stick figures (sampling rate). Enhanced line on the left indicates the initial position; the enhanced line on the right indicates the final position. Right diagram depicts trajectories of data points at the tragus, acromion, midline crest, hip, and knee.

立ち上がり動作とは

必要な機能は？



筋力

バランス

足の位置

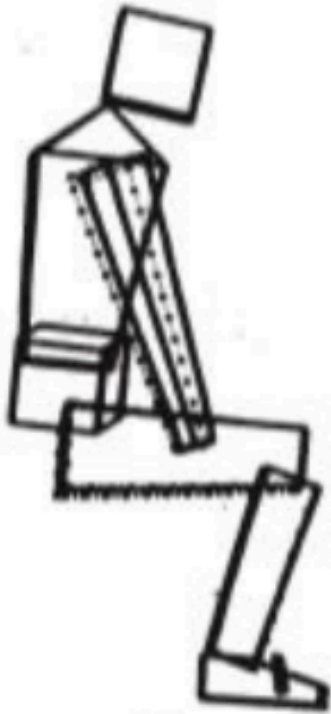
椅子の高さ

移動戦略

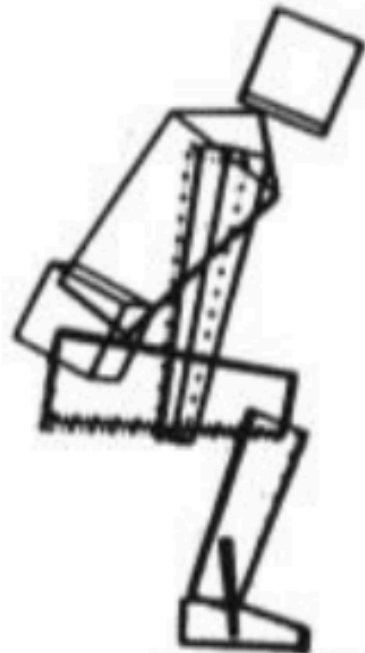
立ち上がり動作とは

必要な機能は？

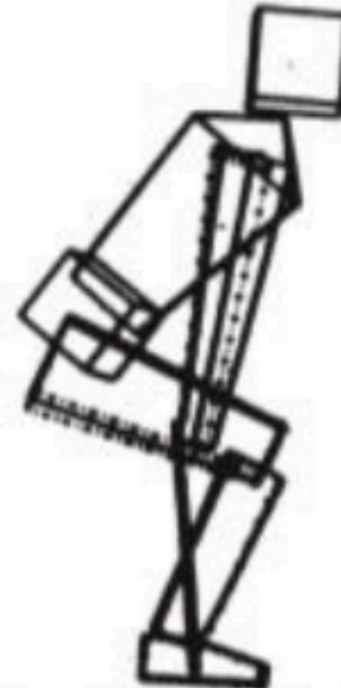
屈曲相



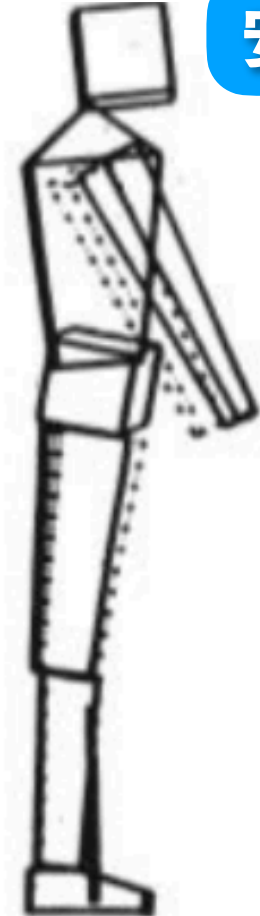
離臀相



伸展相

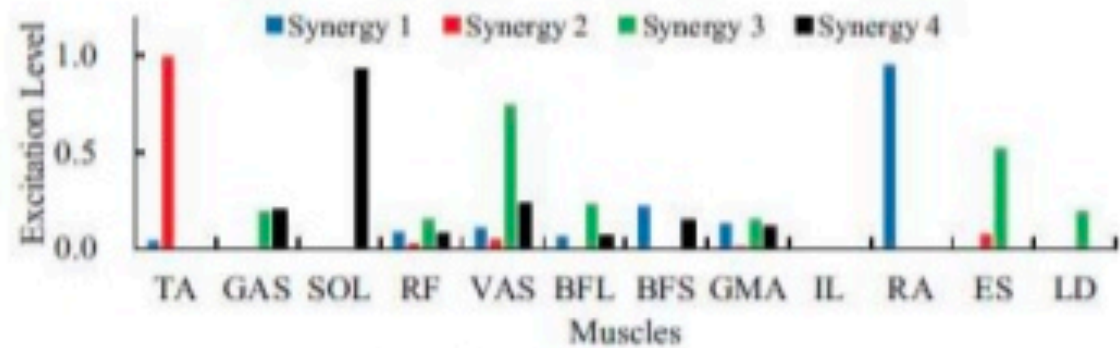


安定相

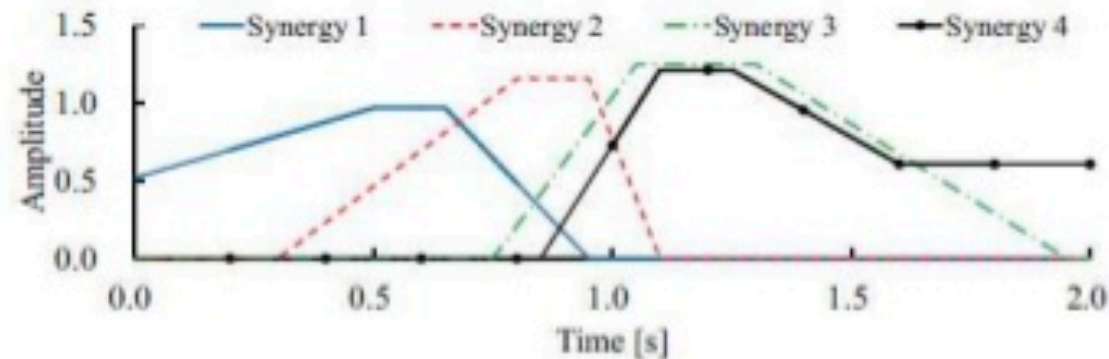


立ち上がり動作とは

必要な機能は？



(a) Spatial Pattern



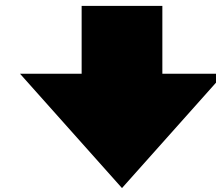
(b) Temporal Pattern

シナジー1：体幹前屈

シナジー2：離臀と重心移動

シナジー3：下肢・体幹伸展

シナジー4：立位の安定



関節の位置（アライメント）
や感覚入力により変化する

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立ち上がり動作とは

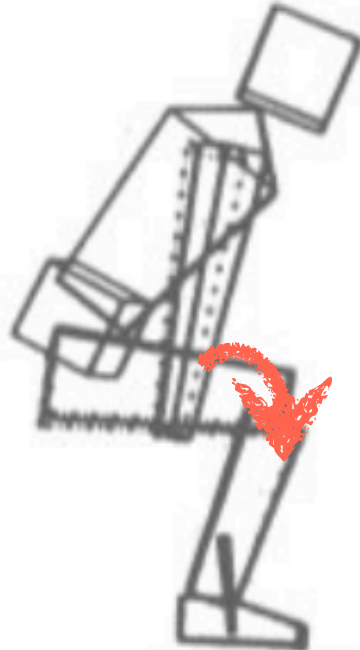
膝関節に必要な機能は？

屈曲相



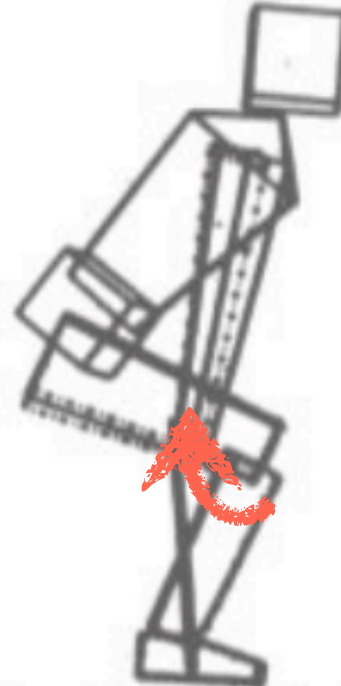
屈曲位保持

離臀相



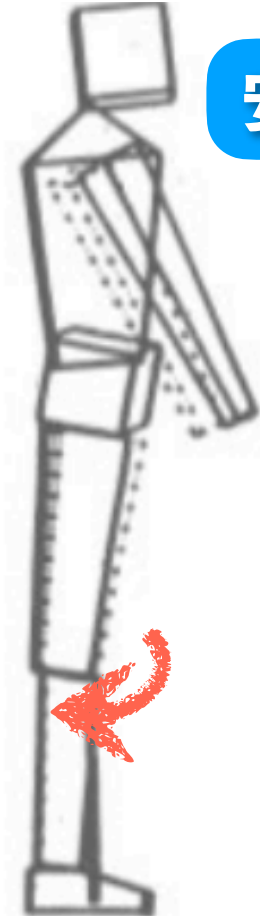
屈曲増大

伸展相



伸展移行

安定相

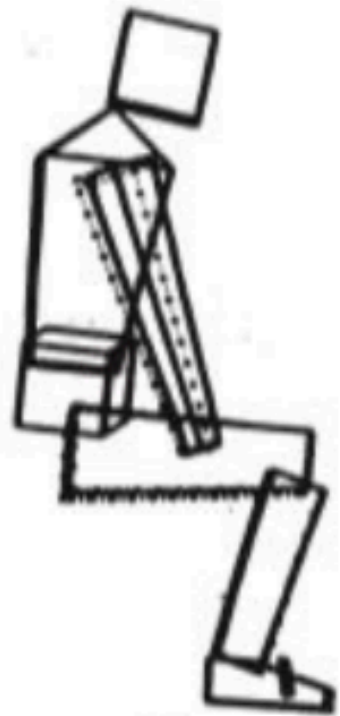


伸展位

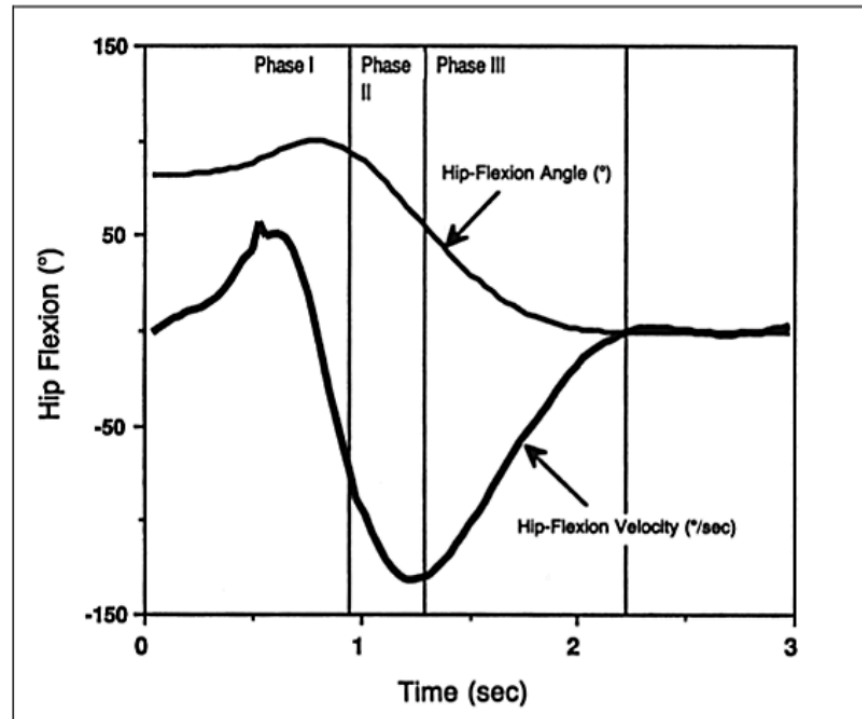
立ち上がり動作とは

必要な機能は？

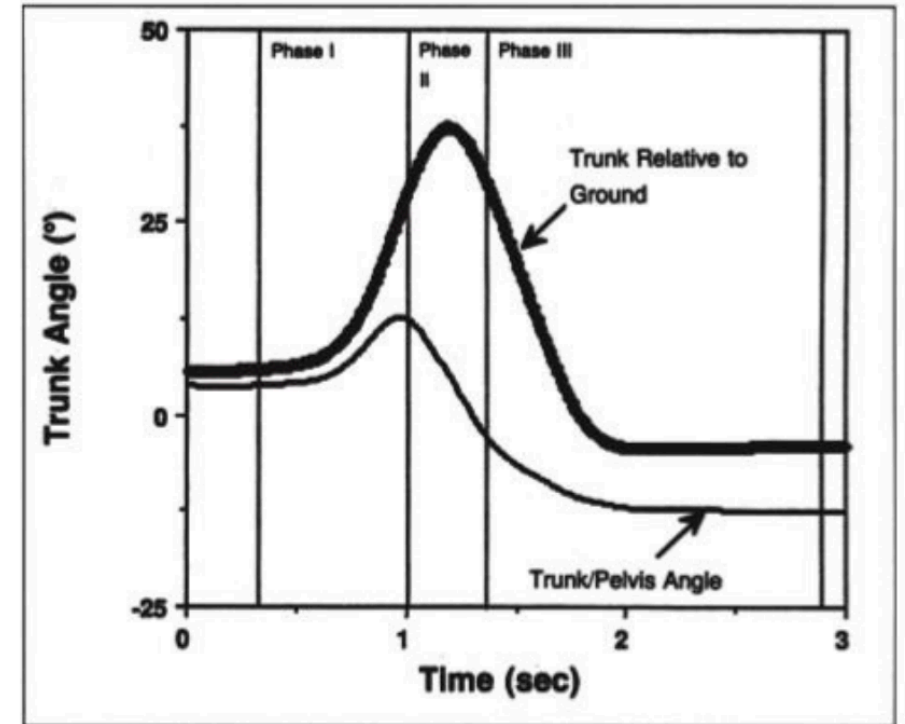
屈曲相



股関節



体幹

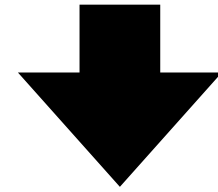


体幹に対して**股関節が先行**して屈曲活動を呈する

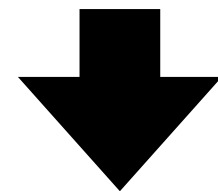
立ち上がり動作とは

必要な機能は？

骨盤の傾斜角度に
違いが生じる

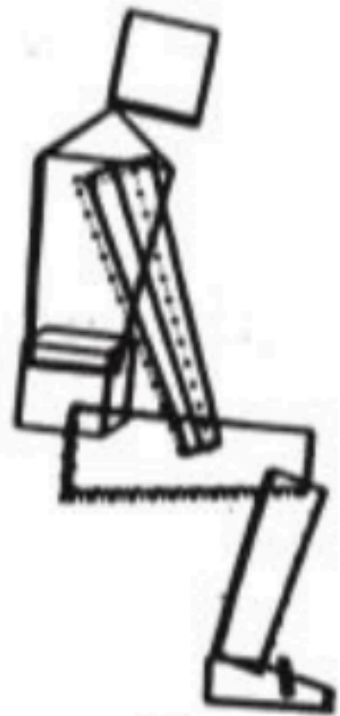


健常者 = 前傾
片麻痺 = 後傾



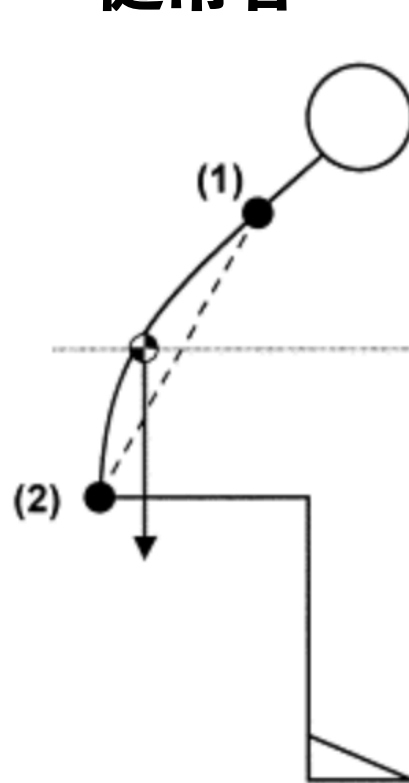
COM後方に

屈曲相



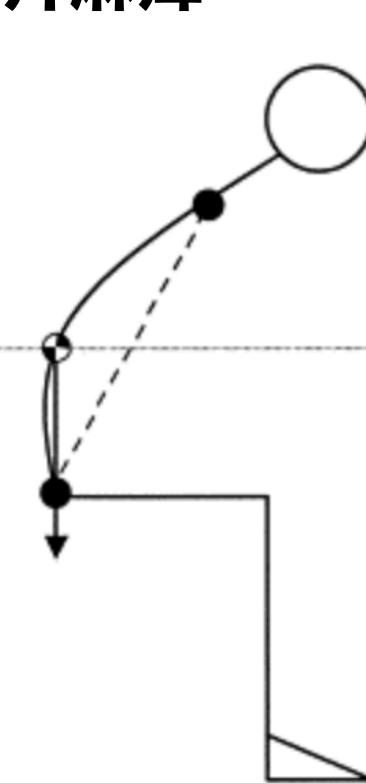
Healthy persons

健常者



Persons with hemiparesis

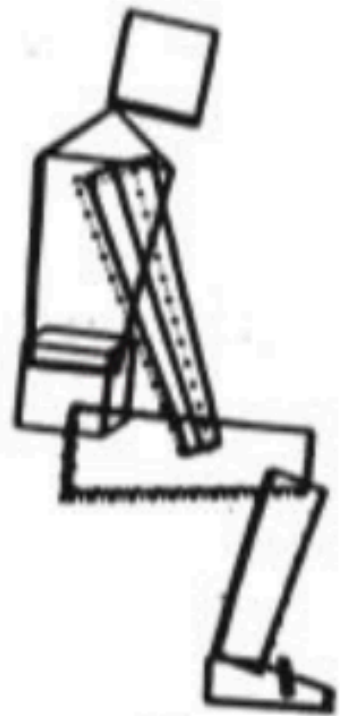
片麻痺



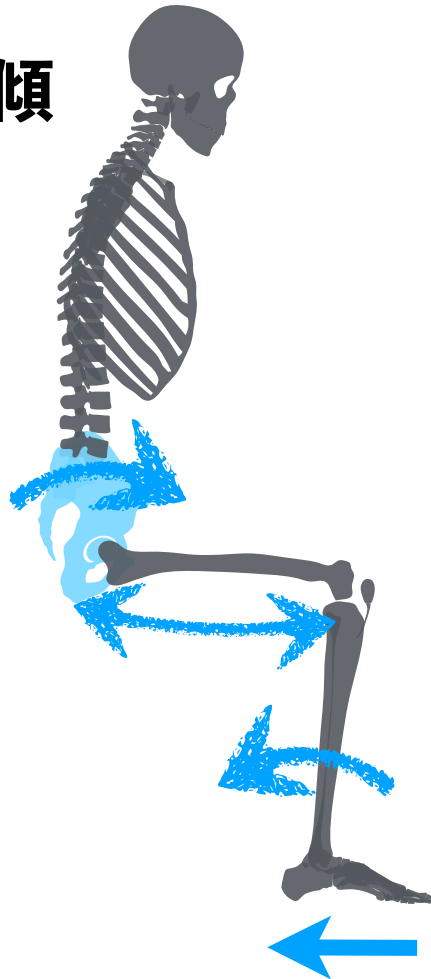
立ち上がり動作とは

必要な機能は？

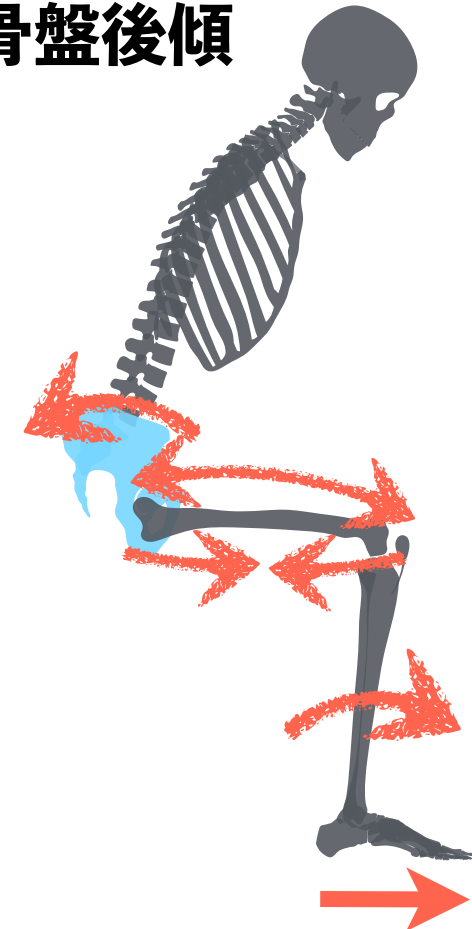
屈曲相



骨盤前傾



骨盤後傾



立ち上がり動作とは 必要な機能は？

屈曲相

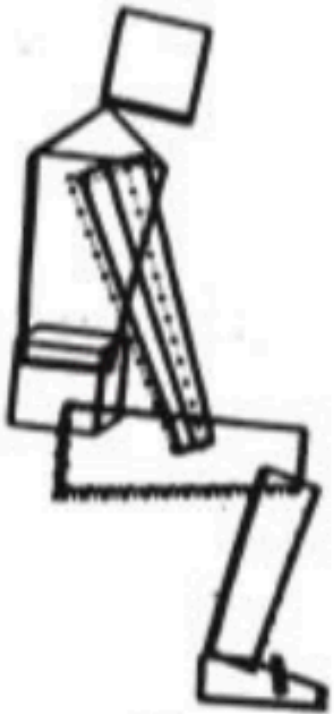


Table 1. Normalized VMO and VL activation, and the VMO/VL ratio during STS in the APT and NPT positions

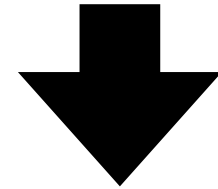
		APT	NPT
Male	VMO	59.6 (± 35.2)	79.5 (± 61.6)*
	VL	54.2 (± 27.9)	71.4 (± 43.7)*
	VMO/VL ratio	1.1 (± 0.4)	1.0 (± 0.3)
Female	VMO	49.5 (± 33.9)	61.5 (± 42.3)*
	VL	47.7 (± 29.3)	60.7 (± 36.1)*
	VMO/VL ratio	1.0 (± 0.3)	1.0 (± 0.2)

APT: anterior pelvic tilt, NPT: neutral pelvic tilt, VMO: vastus medialis oblique, VL: vastus lateralis

*p<0.05

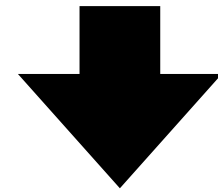
APT = 骨盤前傾

NPT = 骨盤正常



正常 > 前傾位にて
大腿部筋群の活動

上昇あり



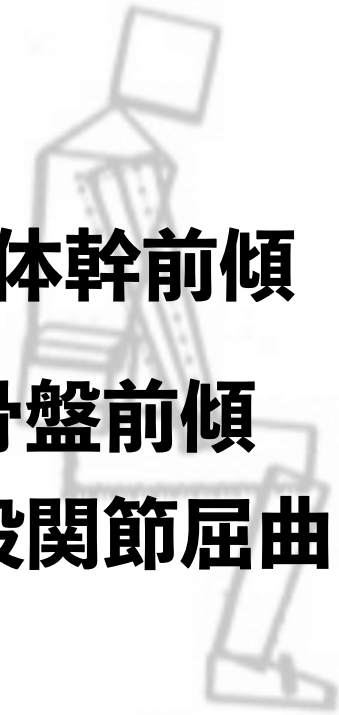
前傾位にて筋活動低下
= 少ない負荷で運動可能

立ち上がり動作とは

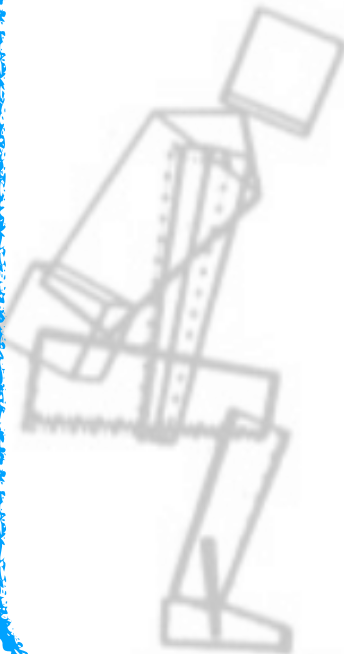
必要な機能は？

屈曲相

体幹前傾
骨盤前傾
股関節屈曲



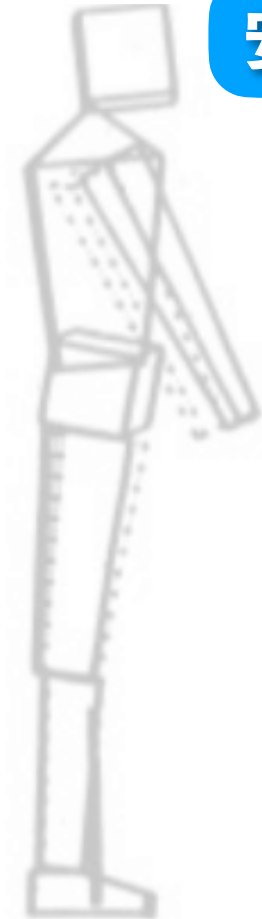
離臀相



伸展相



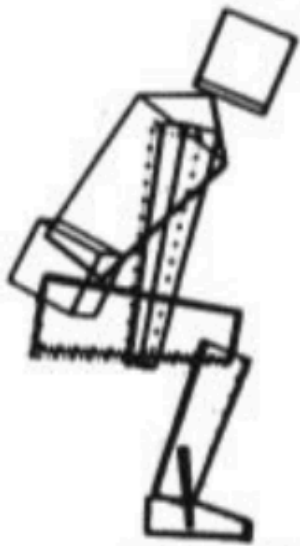
安定相



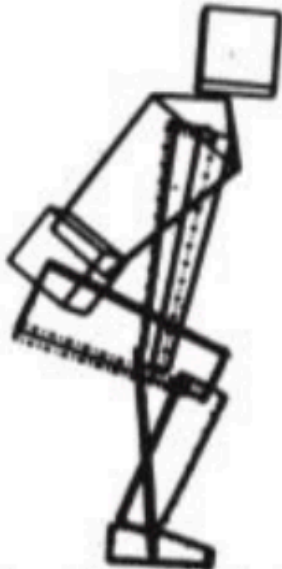
立ち上がり動作とは

必要な機能は？

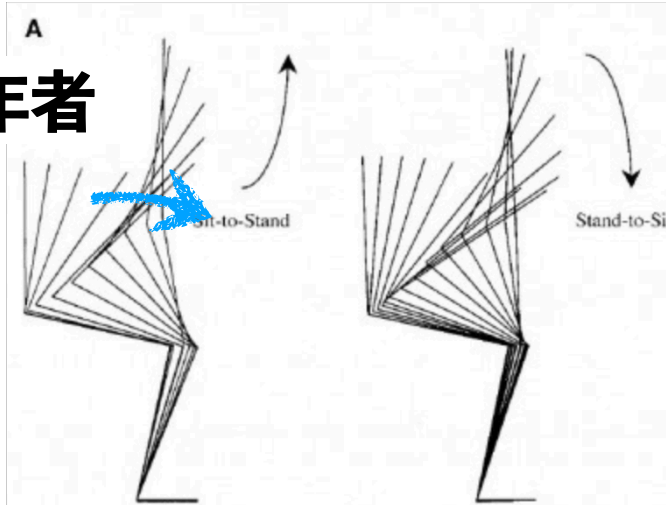
離臀相



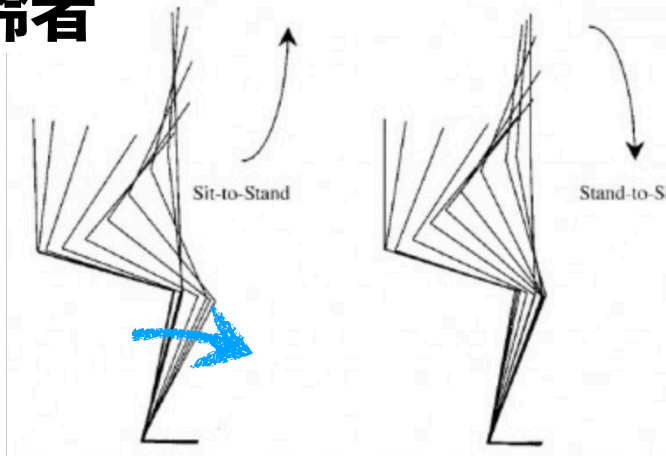
伸展相



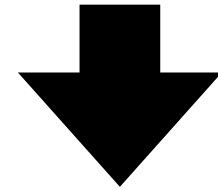
若年者



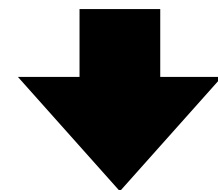
高齢者



下腿前傾角度に
違いが生じる



若年者 = 前傾小
高齢者 = 前傾大



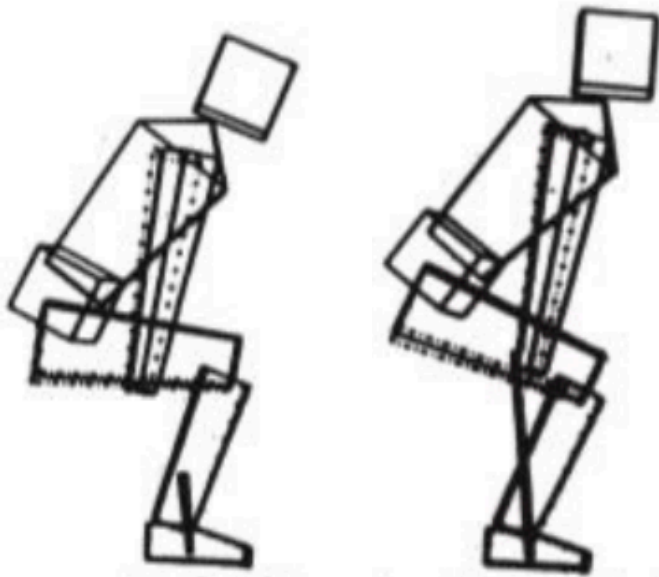
膝関節屈曲角度の
変化

立ち上がり動作とは

必要な機能は？

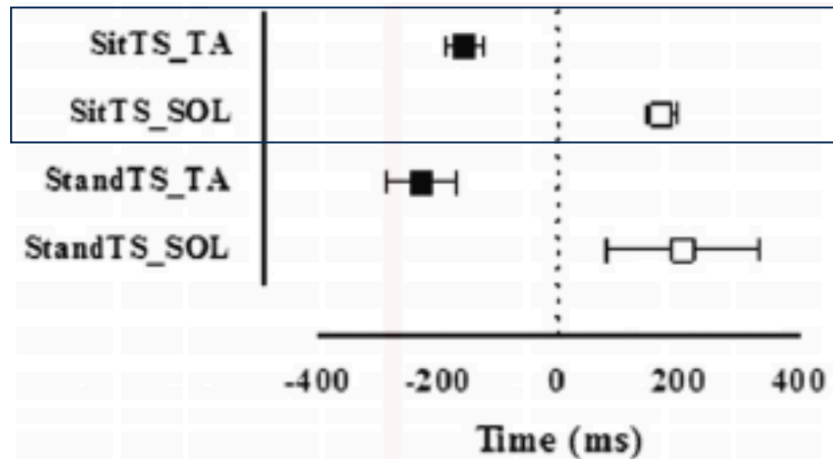
離臀相

伸展相



健常者

離臀



離臀

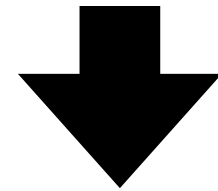
離臀



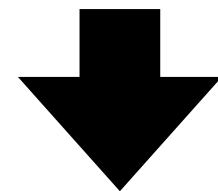
麻痺側

非麻痺側

筋活動のパターン
に違いが生じる



ヒラメ筋の活動
健常者 = 離臀後
片麻痺 = 離臀前

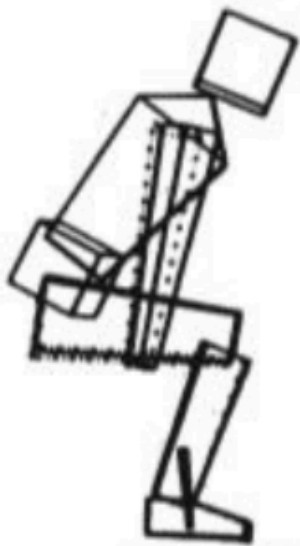


下腿後傾
底屈に作用

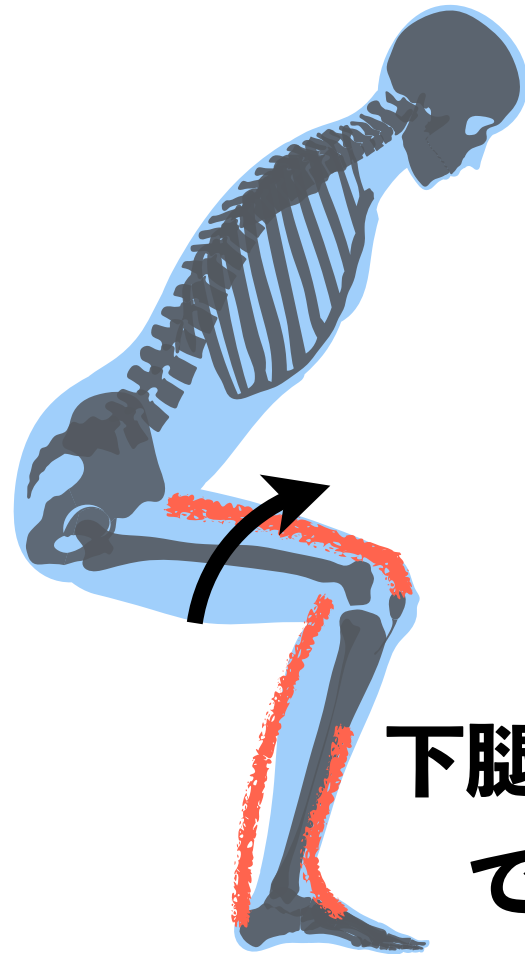
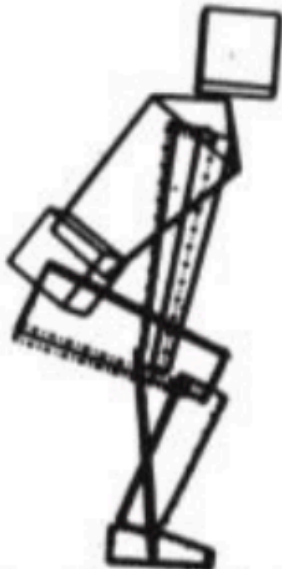
立ち上がり動作とは

必要な機能は？

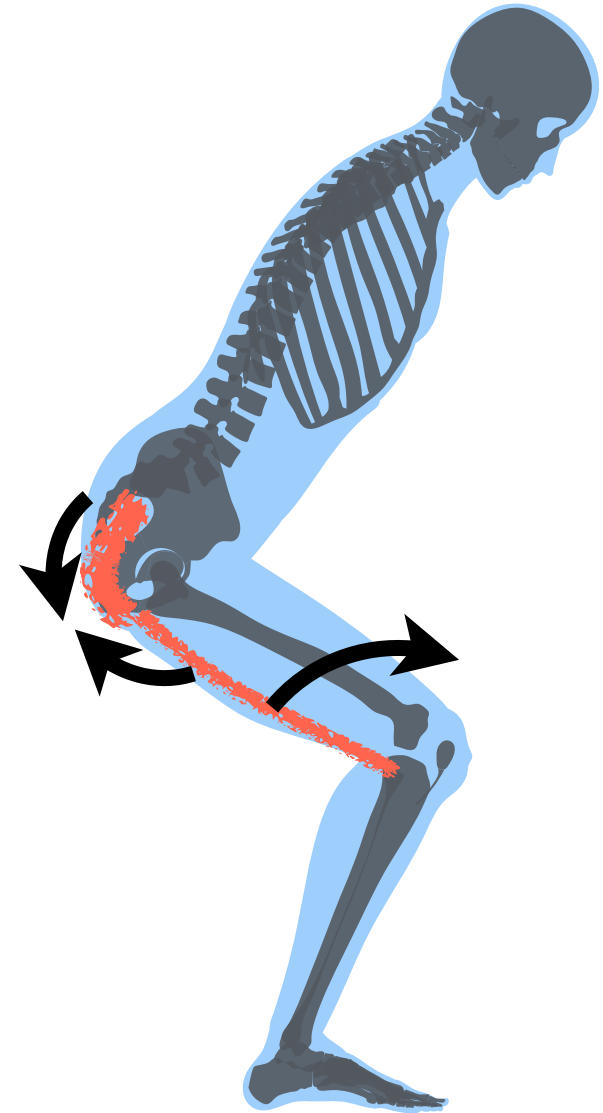
離臀相



伸展相



下腿前傾位
で固定

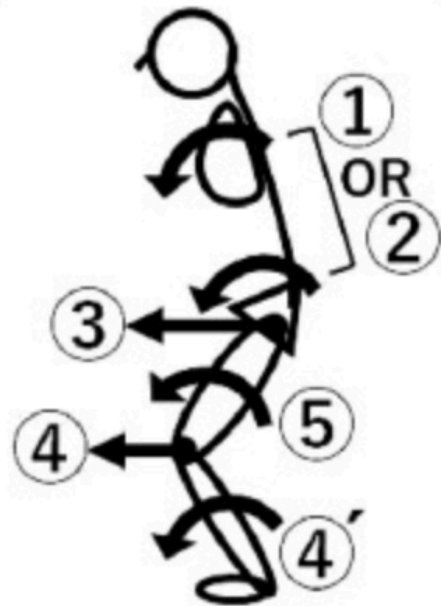


立ち上がり動作とは

必要な機能は？

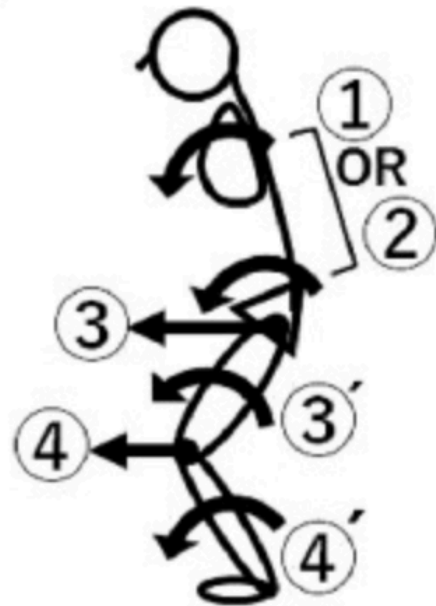
若年者

YOUNG



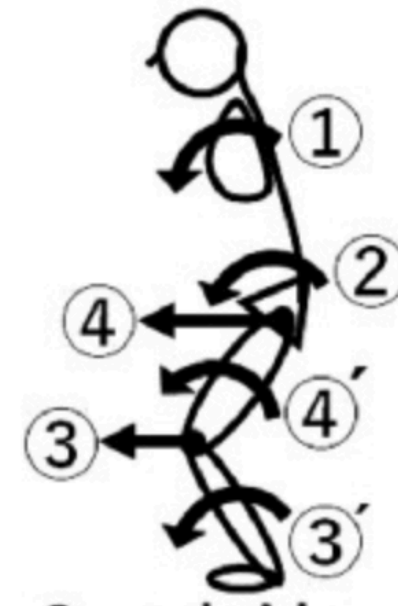
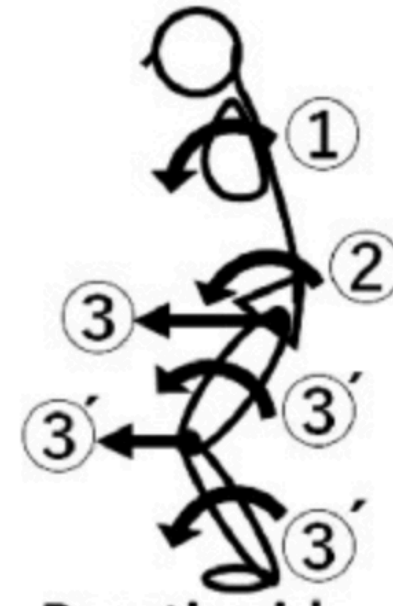
高齢者

ELDERLY



脳卒中

STROKE



運動パターン（シナジー）が異なる

Paretic side
(two-thirds
people)

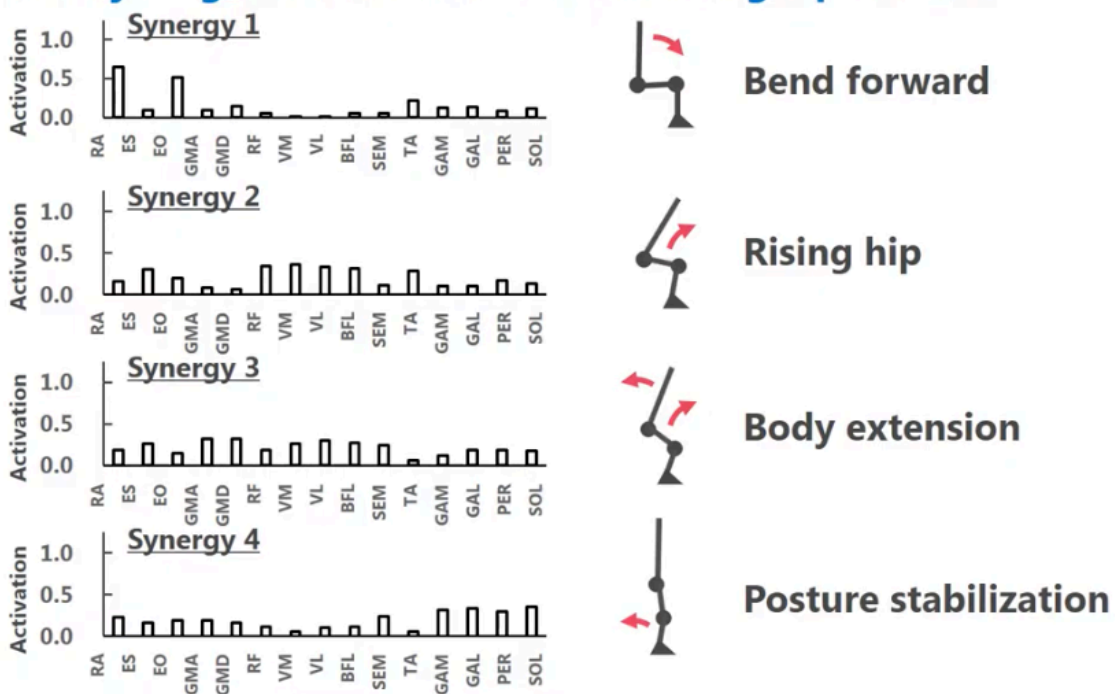
Sound side
& Paretic one

立ち上がり動作とは

筋シナジー（正常）

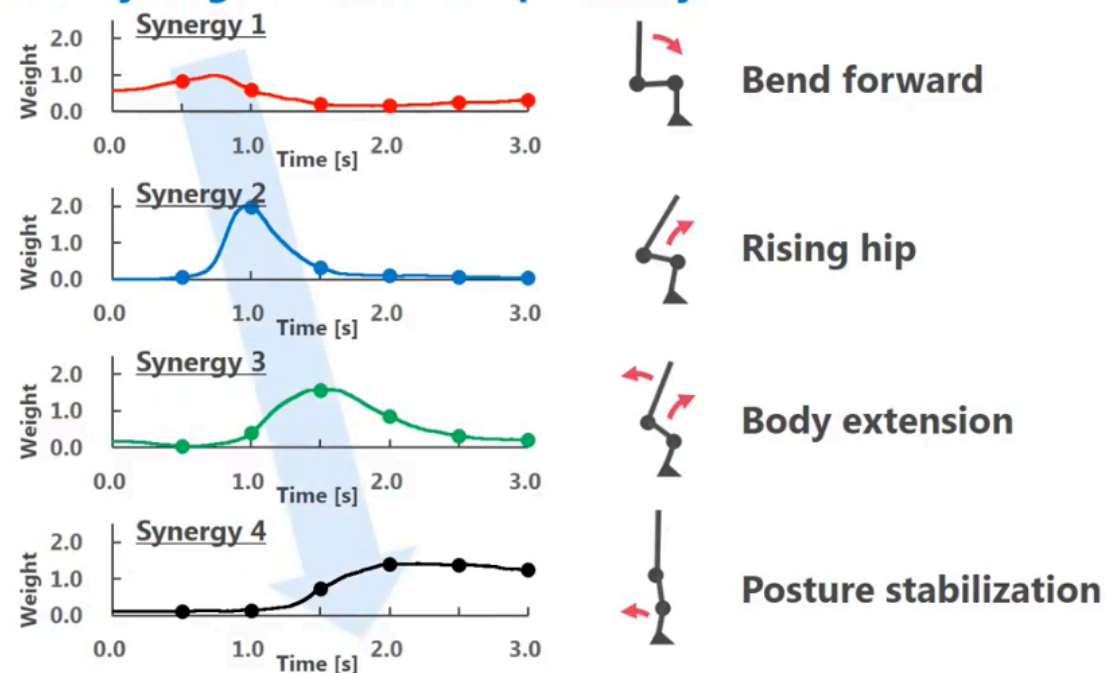
Muscle Synergy Structure in Healthy Elderly

● Four synergies exist in human standing-up motion



Muscle Synergy Structure in Healthy Elderly

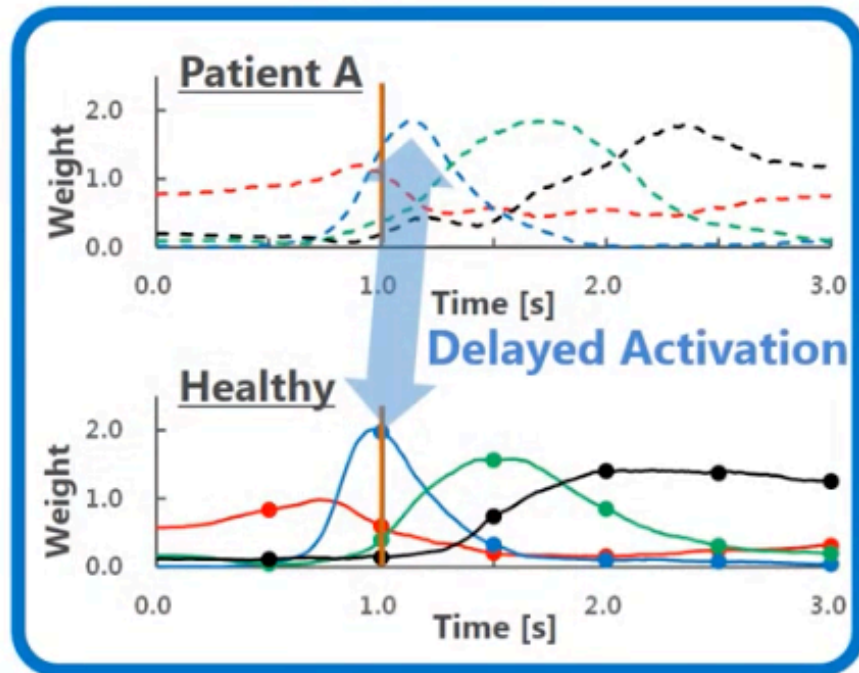
● Four synergies activate sequentially



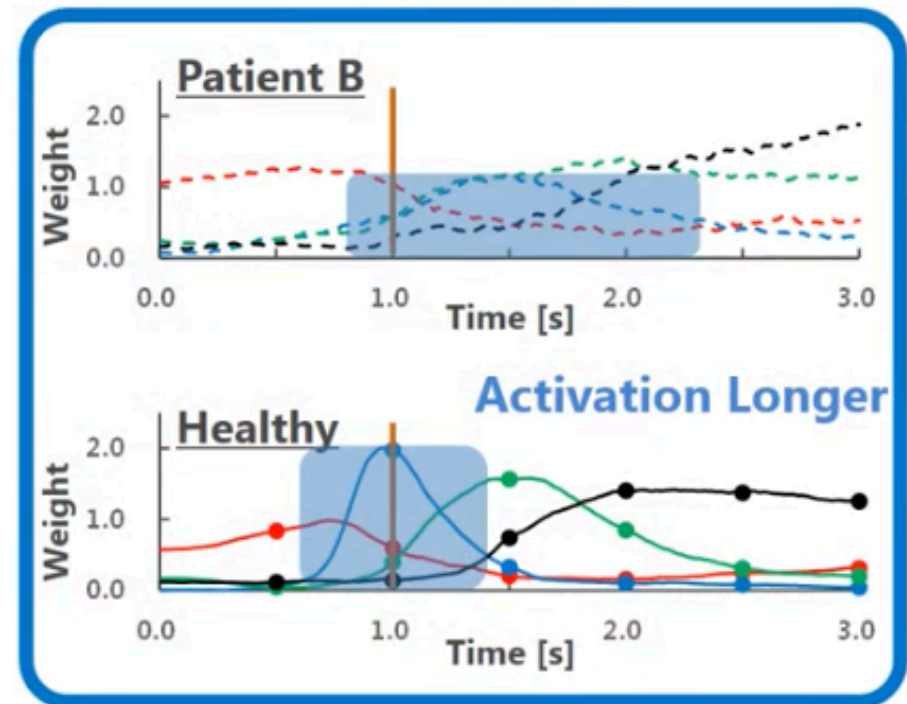
立ち上がり動作とは

筋シナジー（脳卒中）

Group 1
Six patients



Group 2
Six patients



離臀ピークのタイミングが遅れる

長く平坦な筋活動

立ち上がり動作とは

必要な機能は？

屈曲相

体幹前傾
骨盤前傾
股関節屈曲

離臀相

体幹保持
大腿骨回転
下腿前傾

伸展相

体幹伸展
股関節伸展
下腿固定

安定相



Contents

立ち上がり動作を理解する

01

立ち上がり動作における膝関節
の機能や役割を理解する

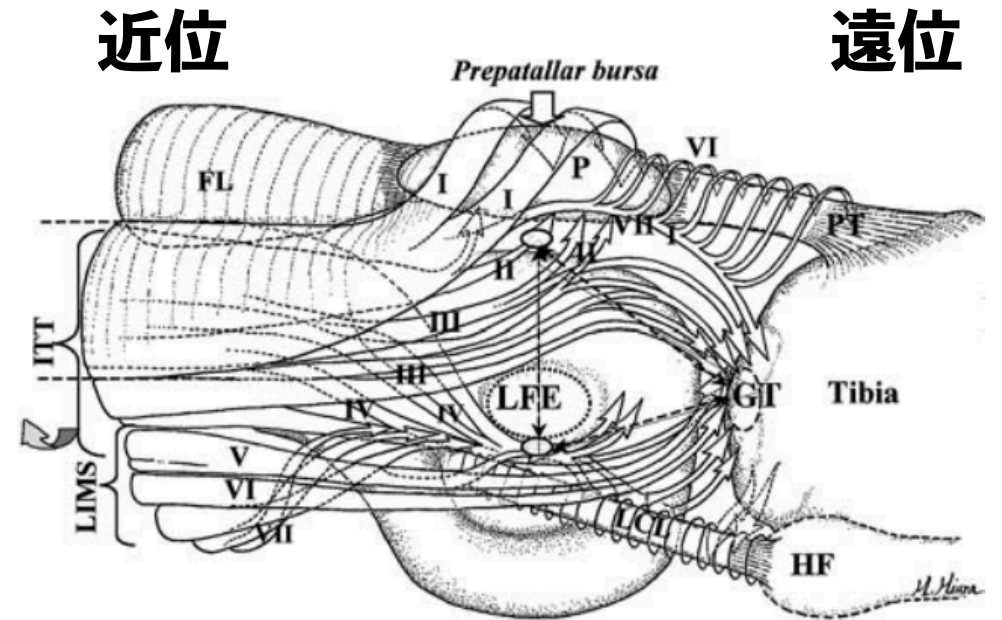
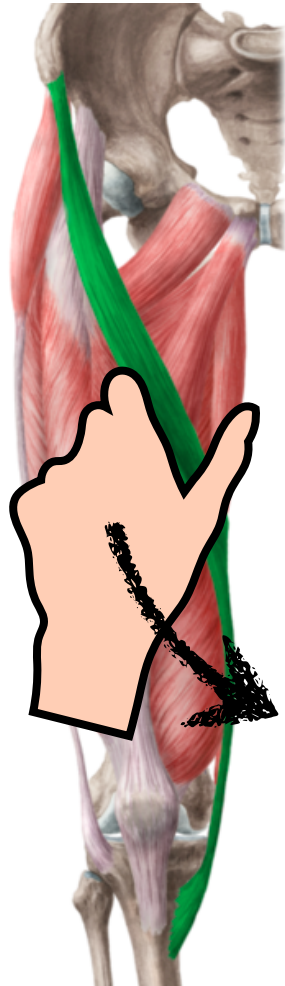
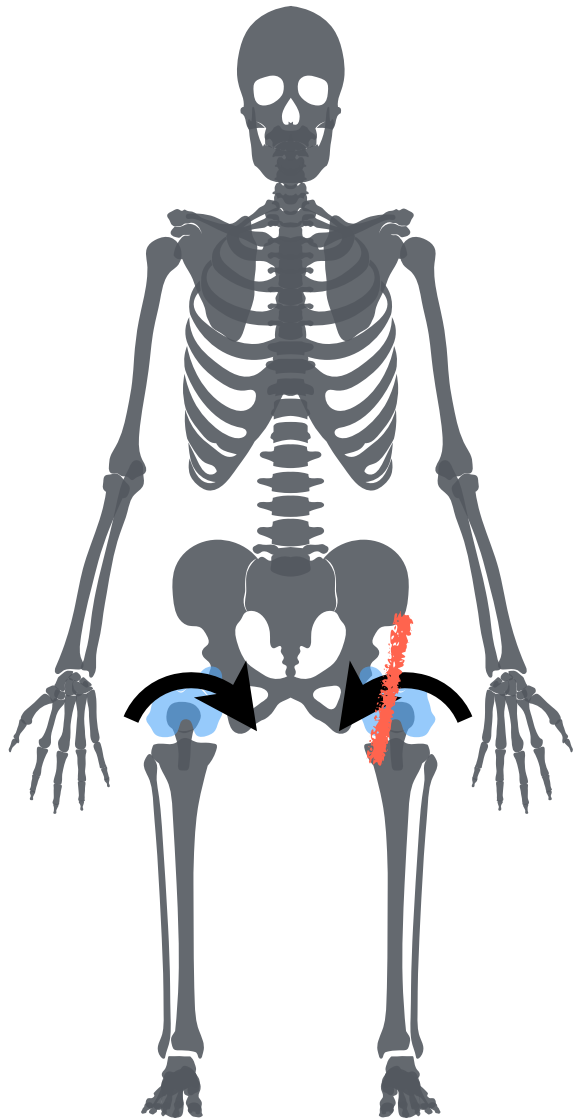
02

膝関節のみるべきポイントを
理解する

03

立ち上がり動作とは

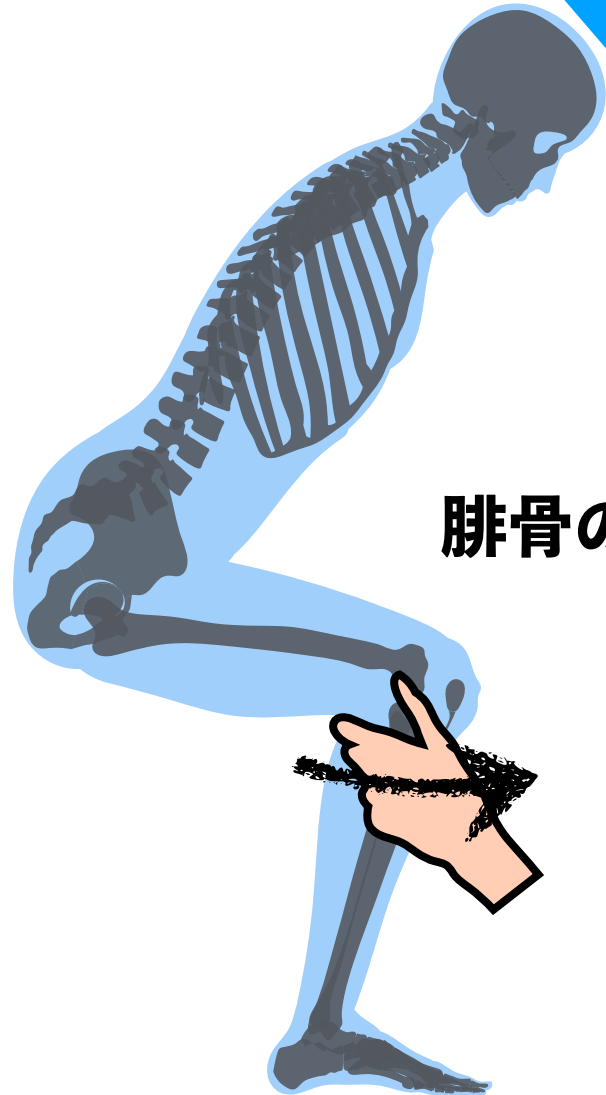
膝関節のみるポイント



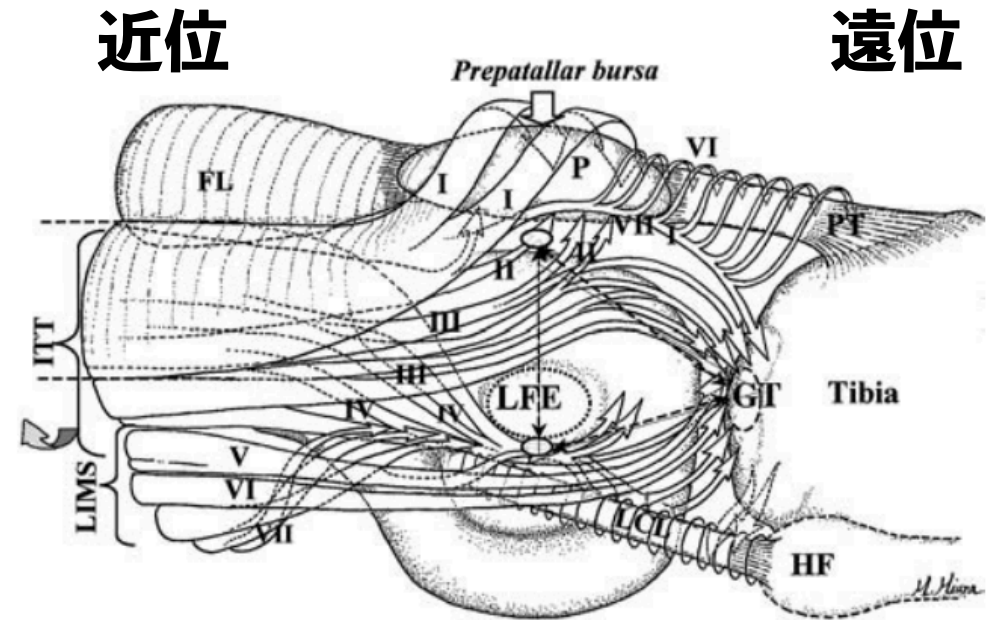
**腸脛靭帯は膝蓋骨にも線維を出し、
大腿骨の外旋作用を呈する**

立ち上がり動作とは

膝関節のみるポイント



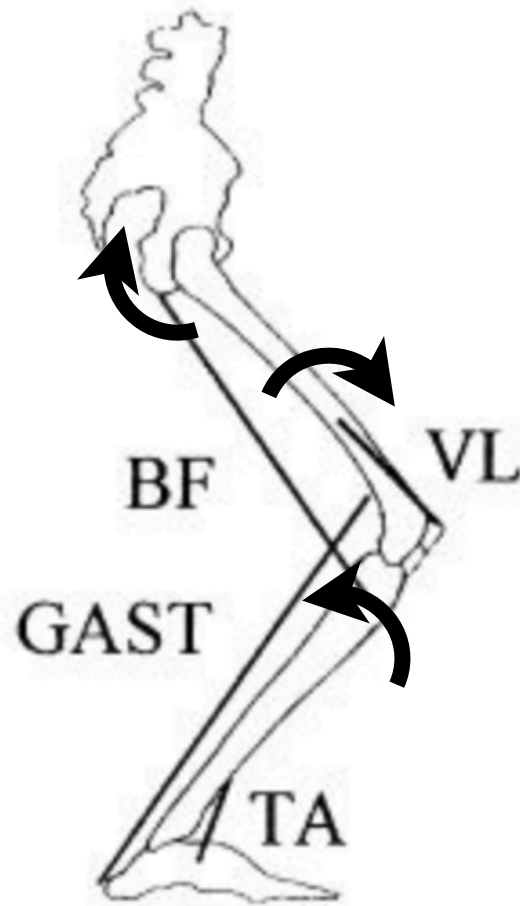
腓骨の前方引き出し



腸脛靭帯は腓骨にも線維を出し、
下腿骨の外旋作用を呈する

立ち上がり動作とは

膝関節のみるポイント



**BF近位(ハムスト) と大臀筋による
股関節伸展**

**BF遠位(ハムスト) による下腿骨の後傾
とVL(外側広筋) による膝伸展**

**TA (前脛骨筋) とGAST(下腿三頭筋)
による下腿骨の安定**

歩行ナイトセミナー⑦

L.R~MS上における力学的要素と臨床でみるポイント

～重心持ち上げに必要な筋活動を紐解く～

4/26月
20:00-22:00

動画
つき

基本動作と機能解剖
シリーズ②

立位における股関節の 安定性と運動性の考え方

～基本動作でみるべき股関節の機能解剖～

5/12水
20:00-21:30

臨床につながる嚥下機能

の評価・アプローチ

～舌骨・甲状軟骨のアライメントから

考えられる原因追求～

4/21水
20:00～21:30

復習用動画付き

脳卒中に関わるセラピストに知っておいて欲しい

脳卒中片麻痺患者の
リーチ動作の再構築

触診とエコーによるリーチ動作の分析
三角筋と上腕二頭筋

4/28(水) 20:00～21:30