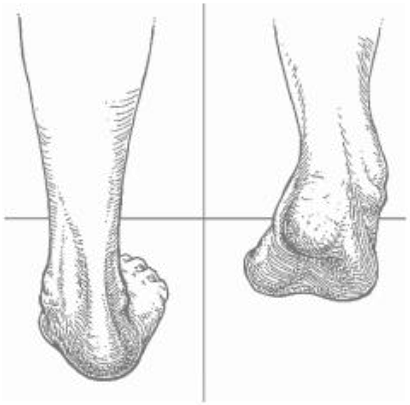
步态分析在KOA中临床应用



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步态分析室　　姜淑云

膝骨关节国外研究

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ORIGINAL ARTICLE

Knee Power Is an Important Parameter in Understanding Medial Knee Joint Load in Knee Osteoarthritis

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Objective. **To determine the extent to which knee extensor strength and power explain variance in knee adduction moment (KAM) peak and impulse in clinical knee osteoarthritis (OA).**

Methods. **Fifty-three adults (mean ± SD age 61.6 ± 6.3 years, 11 men) with clinical knee OA participated. The KAM waveform was calculated from motion and force data and ensemble averaged from 5 walking trials. The KAM peak was normalized to body mass (Nm/kg). The mean KAM impulse reflected the mean total medial knee load during stride (Nm × seconds). For strength, the maximum knee extensor moment attained from maximal voluntary isometric contractions (MVIC) was normalized to body mass (Nm/kg). For power, the maximum knee extensor power during isotonic contractions, with the resistance set at 25% of MVIC, was normalized to body mass (W/kg). Covariates included age, sex, knee pain on the Knee Injury and Osteoarthritis Outcome Score, gait speed, and body mass index (BMI). Relationships of the KAM peak and impulse with strength and power were examined using sequential stepwise forward linear regressions.**

Results. **Covariates did not explain variance in the KAM peak. While extensor strength did not, peak knee extensor power explained 8% of the variance in the KAM peak ($P = 0.02$). Sex and BMI explained 24% of the variance in the KAM impulse ($P < 0.05$). Sex, BMI, and knee extensor power explained 31% of the variance in the KAM impulse ($P = 0.02$), with power contributing 7% ($P < 0.05$).**

Conclusion. **Knee extensor power was more important than isometric knee strength in understanding medial knee loads during gait.**

INTRODUCTION

Given that knee musculature has the capacity to modify the loading environment at the knee (1), there has been much interest in a potential role of muscle in the development and progression of knee osteoarthritis (OA). Deficits in knee extensor strength, i.e., reductions in the net maximum extensor moment during voluntary contractions, are related to pain and mobility impairments in people with knee OA (2). However, changes in knee extensor muscle strength are not necessarily related to progression of knee OA. In a prospective, 30-month study

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Dr. Adachi has received consultant fees, speaking fees, and/or honoraria (less than $10,000 each) from Merck and Novartis, and (more than $10,000 each) from Amgen and Eli Lilly.

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SYMPOSIUM: CURRENT APPROACHES IN CEREBRAL PALSY, A FOCUS ON GAIT PROBLEMS

Current Approaches in Cerebral Palsy, A Focus on Gait Problems

Editorial Comment

Kirk W. Dabney MD, Freeman Miller MD

Published online: 14 March 2012

In modern terms, cerebral palsy is defined as a childhood condition in which a motor deficit occurs due to a static, nonprogressive lesion of the brain. From a historical perspective, William John Little was the first to characterize spastic cerebral palsy in the 1830s [1]. He described it as a brain injury due to oxygen deprivation to the brain at birth. Sir William Osler was one of the first early researchers to study cerebral palsy and wrote the first book on the topic, *The Cerebral Palsies of Children* [2]. Cerebral palsy is a heterogeneous condition. The size and location of the brain lesion approximates both the severity and characterization of motor involvement. Gait problems are common in ambulatory patients with cerebral palsy. Ambulatory ability may vary from independent ambulation to the need for ambulatory aids such as a walker. In the latter case, ambulatory ability may also depend on good upper extremity function.

In this symposium, "Current Approaches in Cerebral Palsy, A Focus on Gait Problems," pediatric orthopaedic surgeons from cerebral palsy centers in various countries have been invited to focus on current problems that affect ambulatory children with cerebral palsy. The initial article highlights current assessment and outcome measurement tools for the upper extremity. These tools are helpful in assessing upper extremity function in patients who may require upper limb function for the use of an ambulatory aid.

Fig. 1 Kirk W. Dabney, MD, is shown.

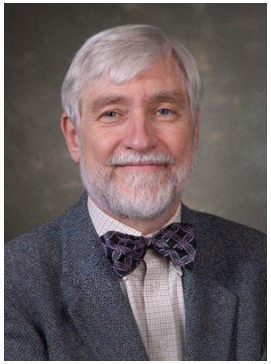

Fig. 2 Freeman Miller, MD, is shown.

All ICMJE Conflict of Interest Forms for authors and *Clinical Orthopaedics and Related Research* editors and board members are on file with the publication and can be viewed on request.

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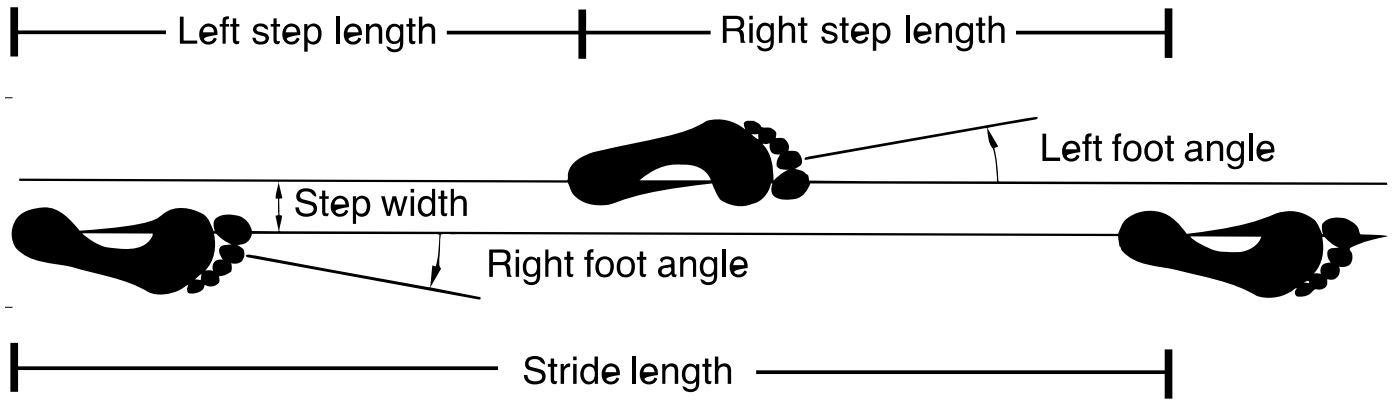
步态

- 人类步行的行为特征
- 国内进入临床10余年

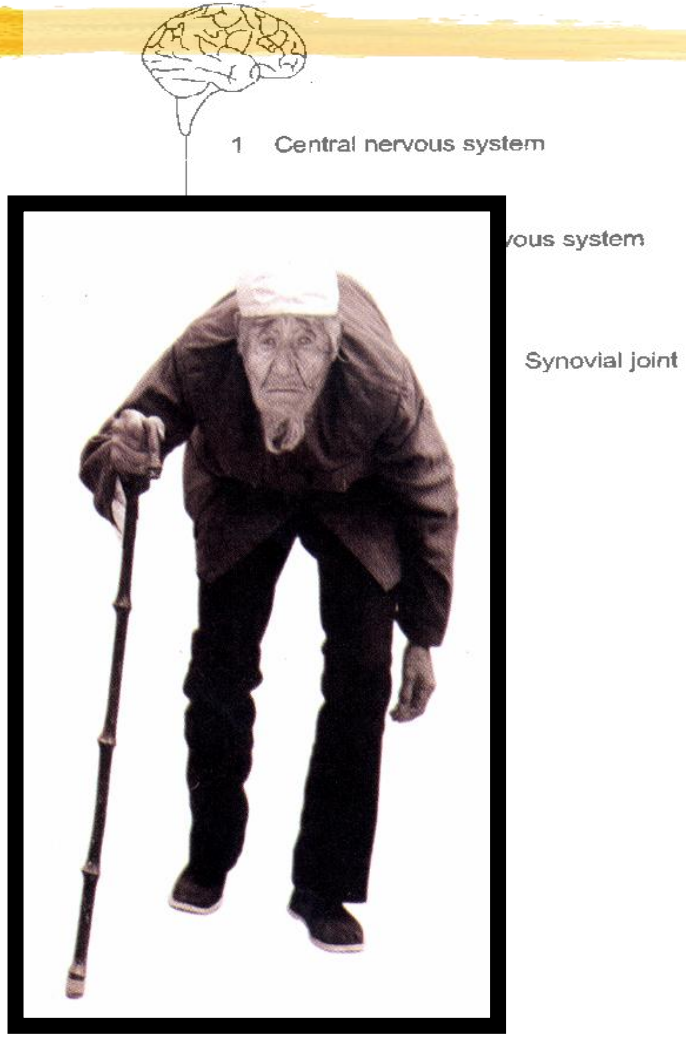
正常步行5个主要属性

- 稳定的支撑相
- 在摆动相足够的足廓清
  - 足够的步长
- 着地前合适的足的位置
- 能量贮存



步行的必要条件

- 步行控制
  - 中枢命令
  - 身体平衡
  - 协调控制
    - 下肢关节和肌肉协同运动
    - 上肢和躯干的姿势
  - 足够体力
  - 。。。



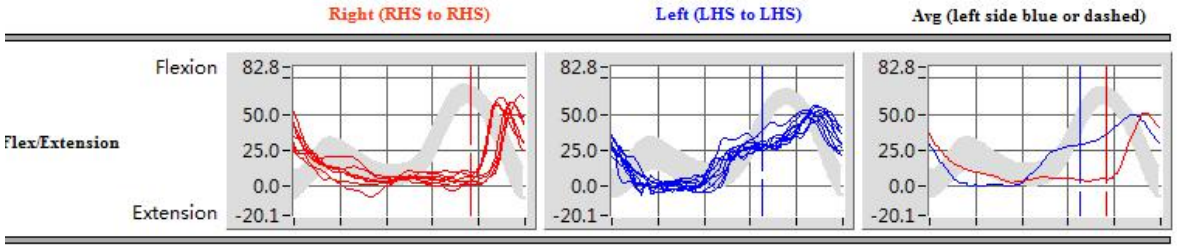
步行的影响因素

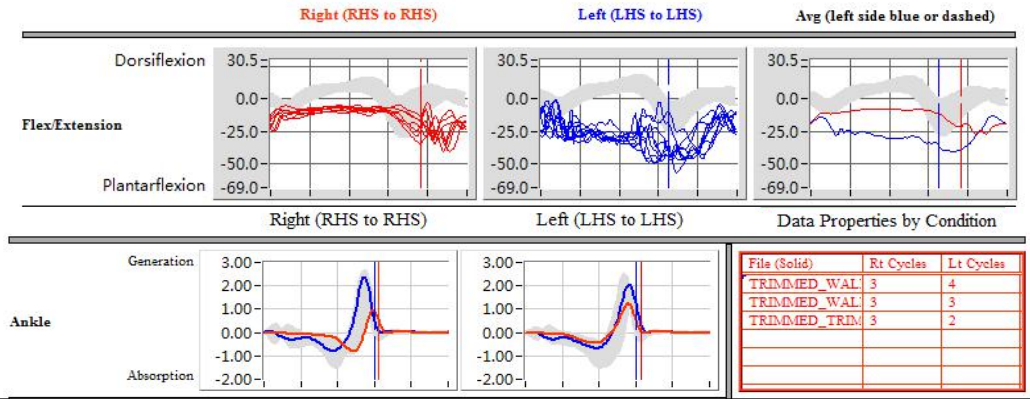
- 独立
- 代偿
- 相互影响
  - 无力
  - 疼痛
  - 痉挛
  - 畸形
  - 。 。 。

WHY？为什么做步态分析？

- 发现异常
- 分析原因
- 评定程度
- 制定方案
- 评价效果

伸膝-踝关节背屈(°)	0	-20
屈膝-踝关节背屈(°)	14	0





正常步态？

- 性别
- 年龄
- 身体构造
- 习惯
- 。。。

步态分析注意事项

- 场地和位置
  - 面积至少6m×8m
  - 光线充足
- 尽量少穿衣服便于真实表现观察
- 顺序
  - 避免观察时相上的跳跃
- 注意双侧对比
- 正确选择检查参数

步态分析方法

- 定性分析
- 定量分析

定性分析

- 步态的总体情况
  - 步行节奏
  - 对称性
  - 流畅性
  - 身体重心的偏移
  - 躯干在行走中的趋向性
  - 上肢摆动情况
  - 辅助具的使用
  - 行走中的神态表情

Hoffer步行能力分级

Ⅰ 不能步行者

Ⅱ 非功能性步行者

i 膝-踝-足矫形器或肘拐等辅助器具能在治疗室内行走

ii 耗能大速度慢距离短无功能性价值

iii 预防压疮、血液循环障碍、骨质疏松

Ⅲ 家庭性步行者

i 用踝-足矫形器、手杖等可在家行走自如

ii 但不能在室外长时间行走

Ⅳ 社区性步行者

i 用或不用踝-足矫形器、手杖可在室外和所在社区内步行

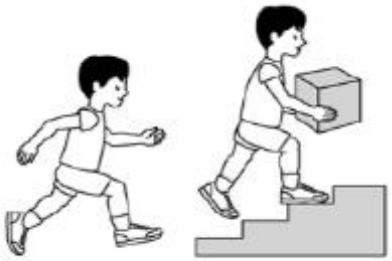
ii 进行散步及去公园、诊所购物等活动

iii 但时间不能长

iv 如果活动超出社区范围仍须乘坐轮椅

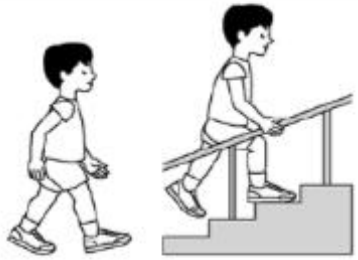
FIM 功能独立性测量

- 7分:完全独立-不用辅助设备或用具在合理的时间内至少能安全地步行50米
- 6分:有条件的独立-步行者可独立步行50米但需要使用辅助具如下肢矫形器等
- 5分:*监护或准备-可以步行50米但需要他人监护提示及做行走前的准备工作*
- *4分:最小量帮助-步行时需他人轻轻用手接触或偶尔帮助*
- *3分:中等量帮助-步行时需他人轻轻地上提患者身体*
- *2分:最大量帮助-患者至少独立完成25%-49%的50米行走*
- *1分:完全帮助-患者仅完成不足25%的行走动作*



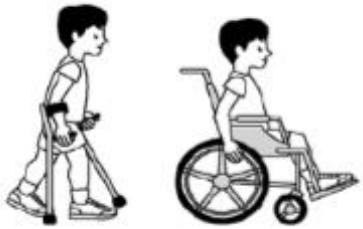
GMFCS Level I

Children walk indoors and outdoors and climb stairs without limitation. Children perform gross motor skills including running and jumping, but speed, balance and co-ordination are impaired.



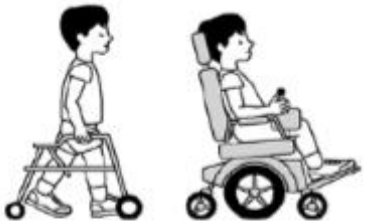
GMFCS Level II

Children walk indoors and outdoors and climb stairs holding onto a railing but experience limitations walking on uneven surfaces and inclines and walking in crowds or confined spaces.



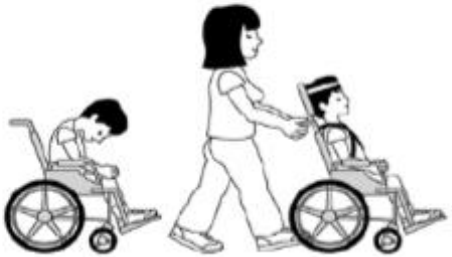
GMFCS Level III

Children walk indoors or outdoors on a level surface with an assistive mobility device. Children may climb stairs holding onto a railing. Children may propel a wheelchair manually or are transported when traveling for long distances or outdoors on uneven terrain.



GMFCS Level IV

Children may continue to walk for short distances on a walker or rely more on wheeled mobility at home and school and in the community.

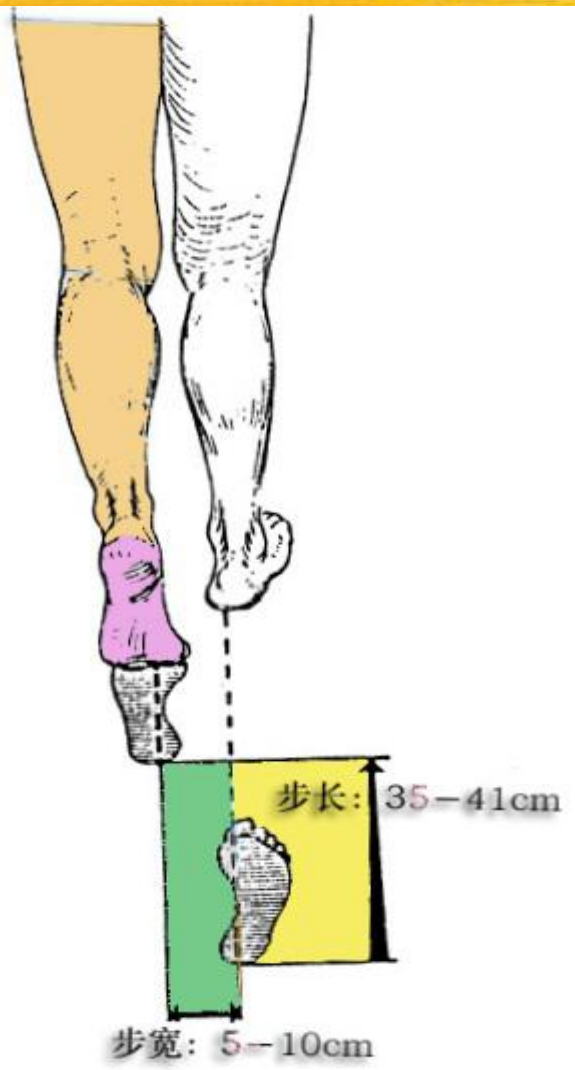


GMFCS Level V

Physical impairment restricts voluntary control of movement and the ability to maintain antigravity head and trunk postures. All areas of motor function are limited. Children have no means of independent mobility and are transported.

定量分析

- 足印法
- 足底开关
- 电子步态垫
- 三维步态分析

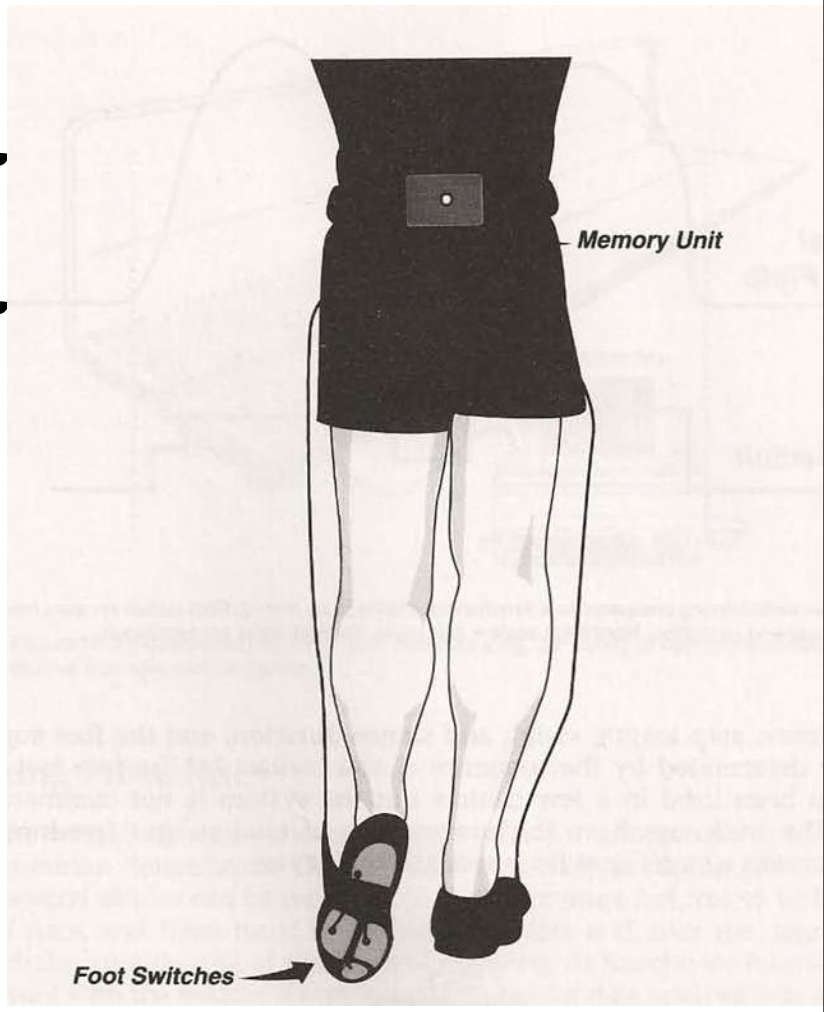


足印法

- 在足底涂上墨汁在步行通道铺上白纸
- 受试者走过白纸留下足迹测量距离
- 在黑色通道上均匀撒上白色粉末
- 让患者赤足通过通道留下足迹
- 步行同时秒表记录时间
- 不需要复杂设备
- 十分耗时

足开关

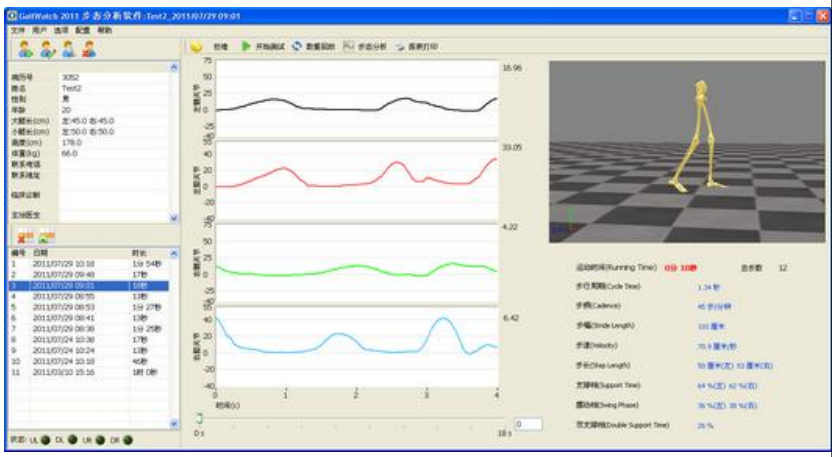
- 足跟触地首先触发跟开关
- 前脚掌触地时触发掌开关
- 脚跟离地时关闭跟开关
- 脚尖离地时关闭掌开关



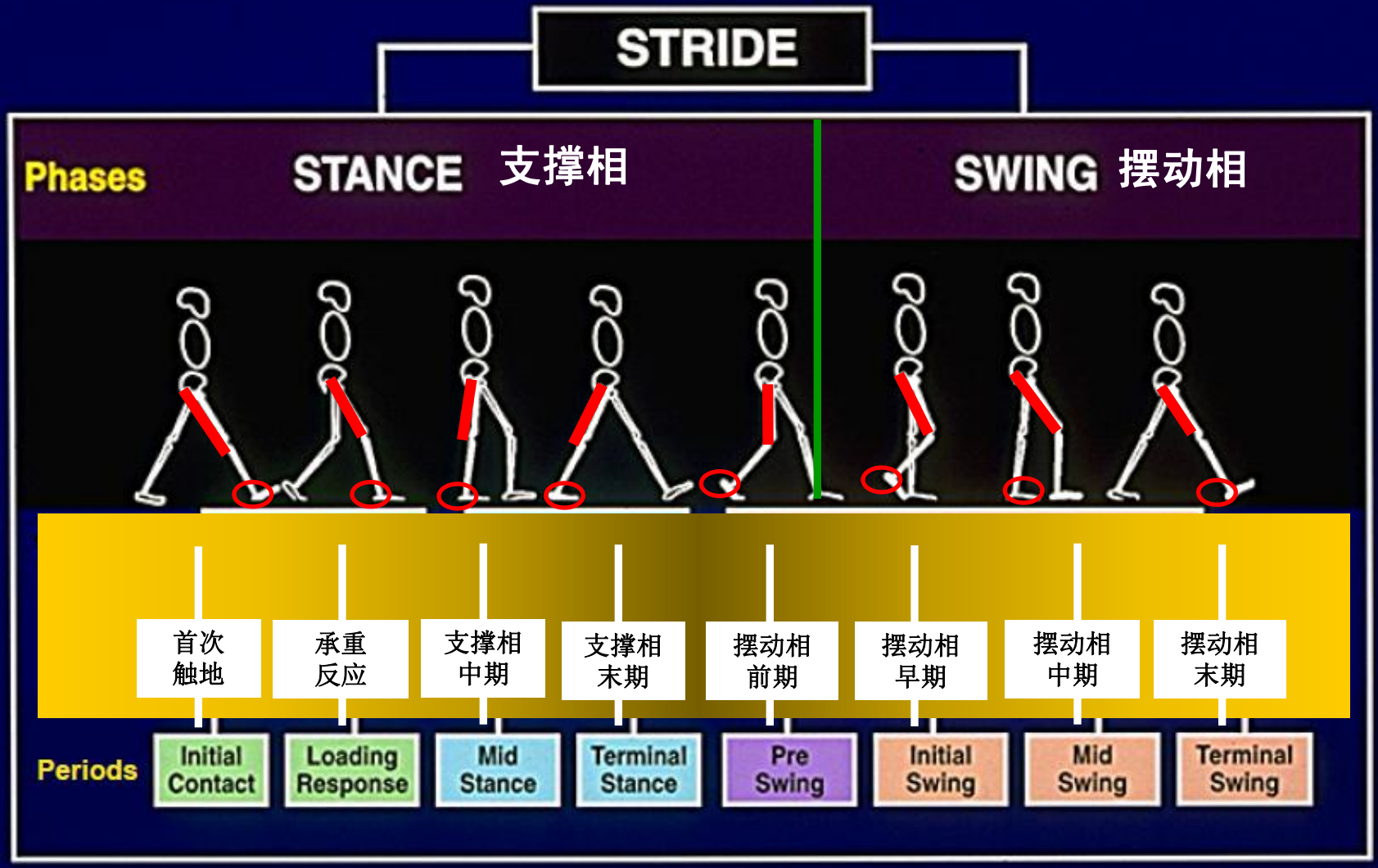
电子步态垫

- 3-4米
- 10,000个压力传感器
- 足底的压力直接被监测并转换为数字信号
- 瞬时测定所有步行时间/空间参数

步态分析仪



The Gait Cycle



步态周期（**gait cycle)**

- 步态周期（gait cycle）= 跨步长（stride）
- Gait cycle =支撑相+摆动相
- Stride=2step=left step+right step
- 单支撑相=对侧足摆动相

支撑相

- 支撑相(stance phase):步行中足与地始终有接触的阶段，占步行周期的60-62%
- 下肢承重力小于体重或身体不稳定时此期缩短，以将重心迅速转移到另一足，保持身体平衡
- 双支撑相（double support）:支撑足首次触地及承重反应期相当于对侧足的减重反应和足离地
- 2 double support + 2 single support
- 患者步行障碍时往往首先出现的异常就是双支撑相时间延长，步行速度减慢，以增加步行的稳定性
- 走→跑

步态分析数据-时空参数

- 步长(step length):是一足的足跟着地点到另一足足跟着地点的距离
- 步幅(stride length):是一足的足跟着地点到同一足下次足跟着地点的距离
- 步宽(step width):是一足的纵线到另一足的纵线之间的距离
- 步速(velocity):是步行时每分钟走过的距离
- 步频(cadence):是步行时每分钟走过的步数

步态分析数据-时空参数

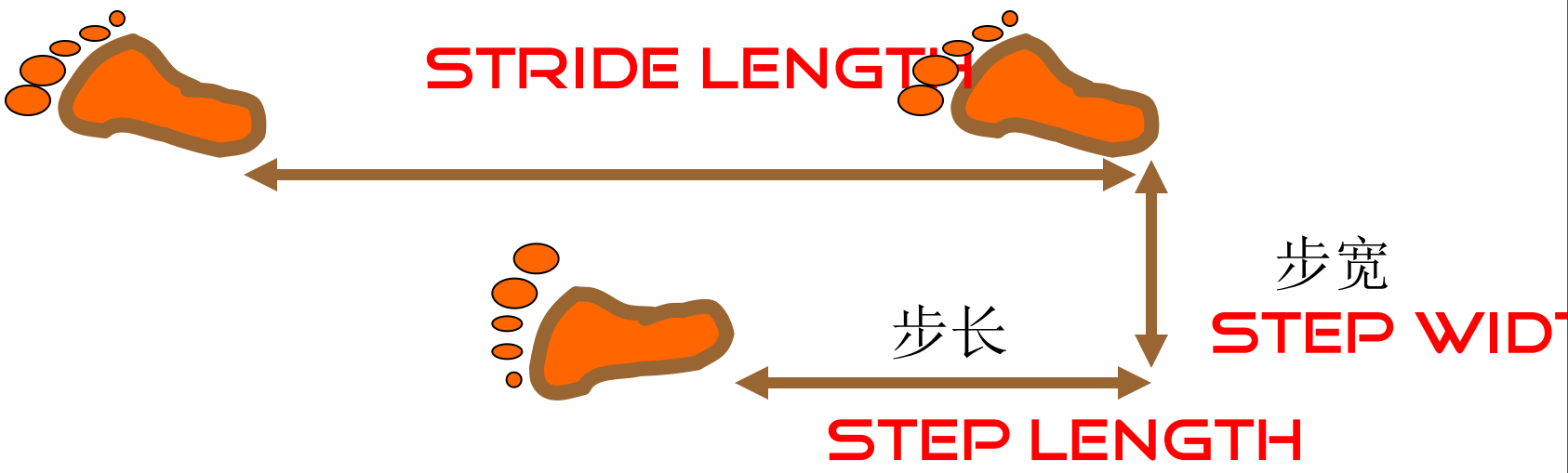


Table 1.1

Floor Contact Periods

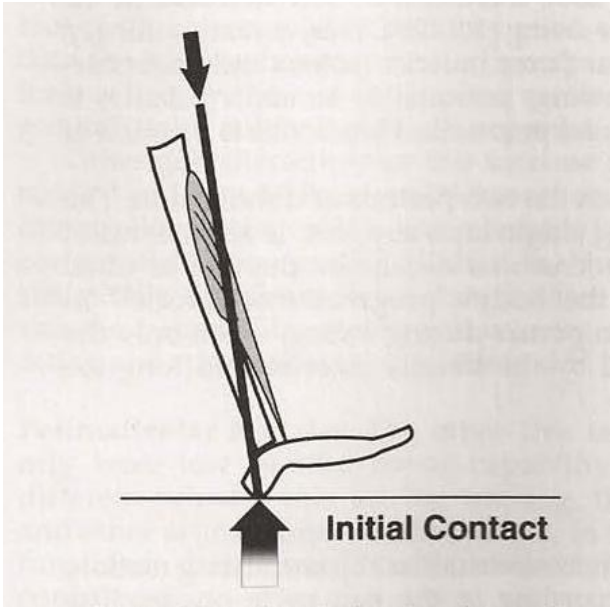
Stance		60%
Initial Double Stance	10%	
Single Limb Support	40%	
Terminal Double Stance	10%	
Swing		40%

步态分析数据-运动学

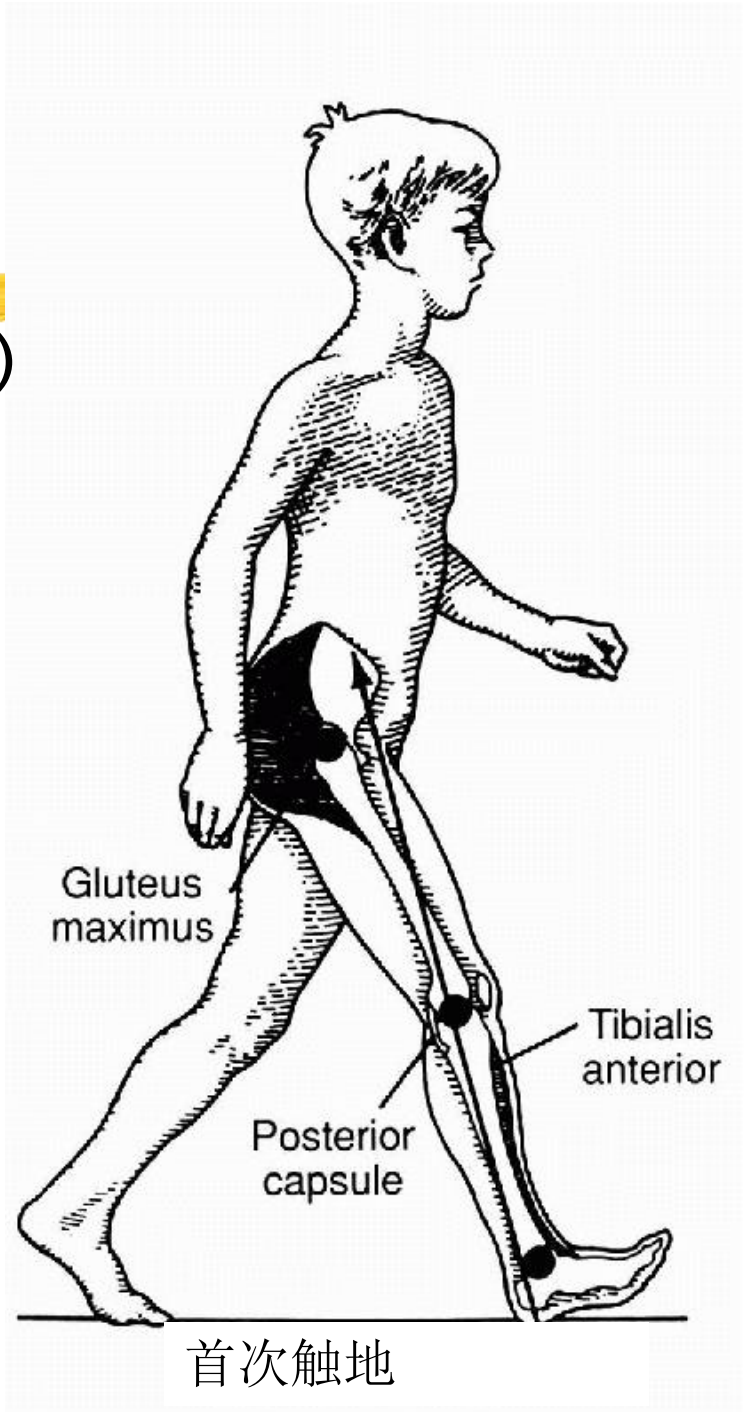
- 步行过程中髋、膝、踝、躯干、骨盆、肩肘等关节运动角度
- 足偏角(toe angle):是足的长轴和纵线形成的夹角

支撑相早期

- 首次触地(initial contact)
- 指足跟接触地面的瞬间
- 使下肢前向运动减速
- 落实足在支撑相位置的动作



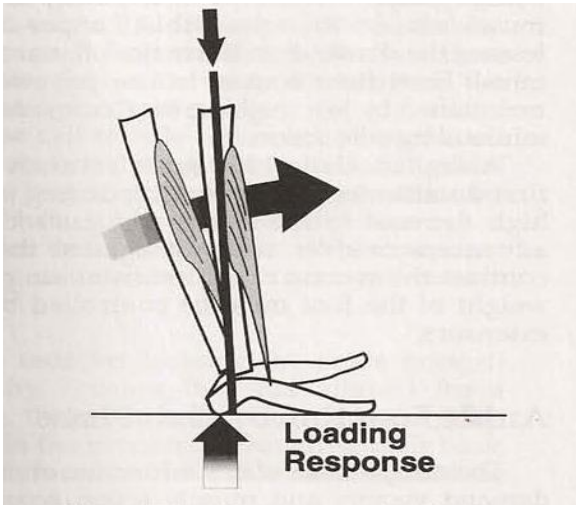
胫前肌控制，向量在足跟内



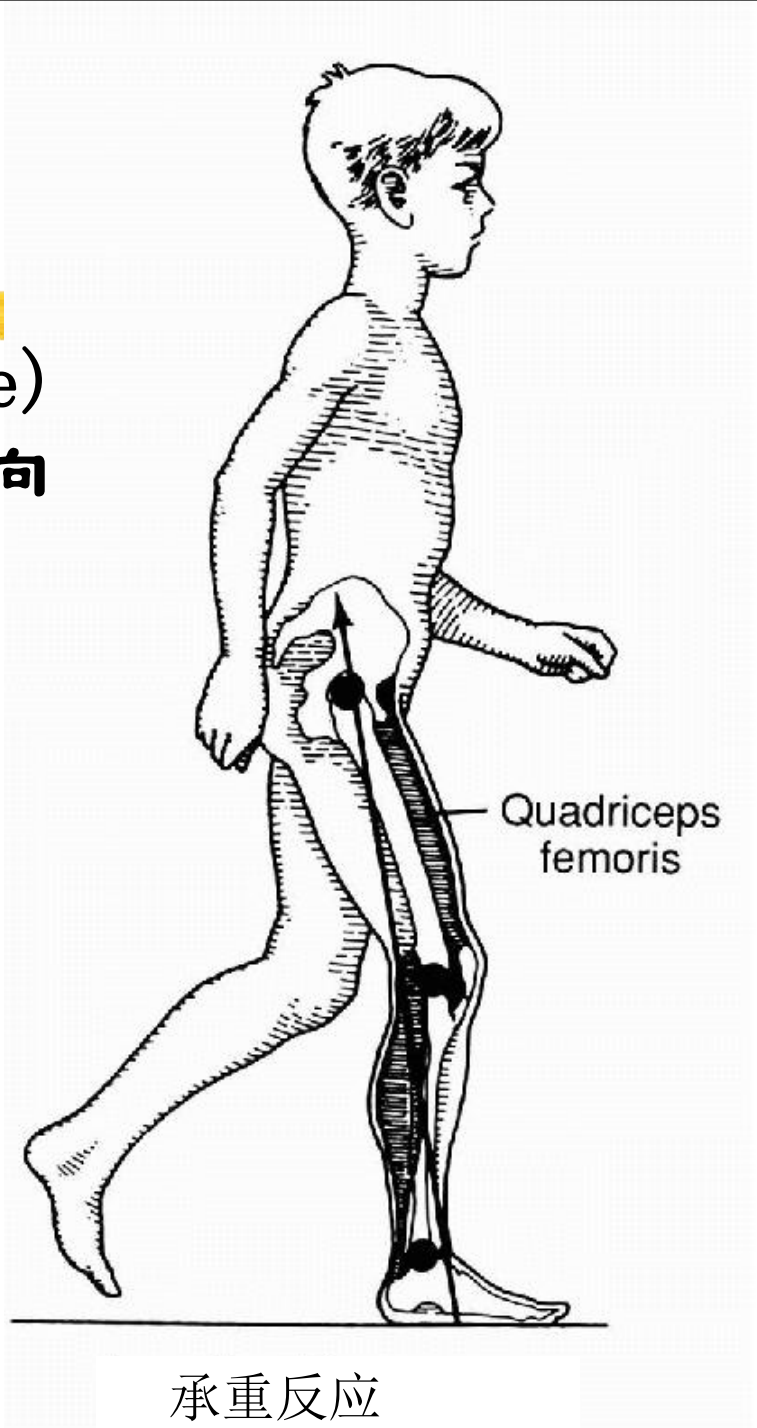
首次触地

支撑相早期

- 承重反应(loading response)
- 指首次触地之后重心由足跟向全足转移的过程
- 支撑相早期
  - 步行周期的10%~12%



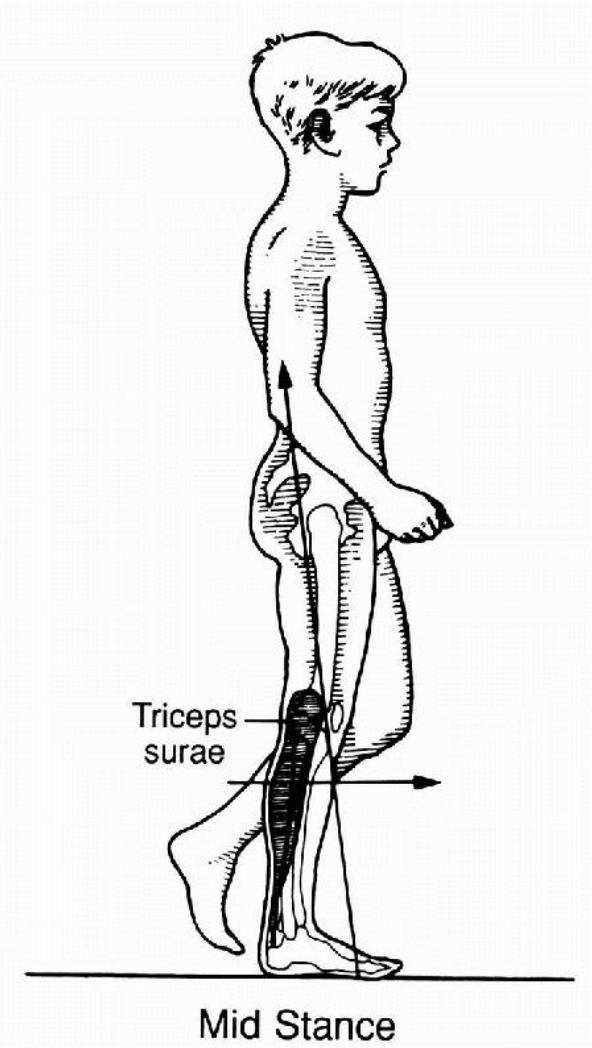
首次触地



承重反应

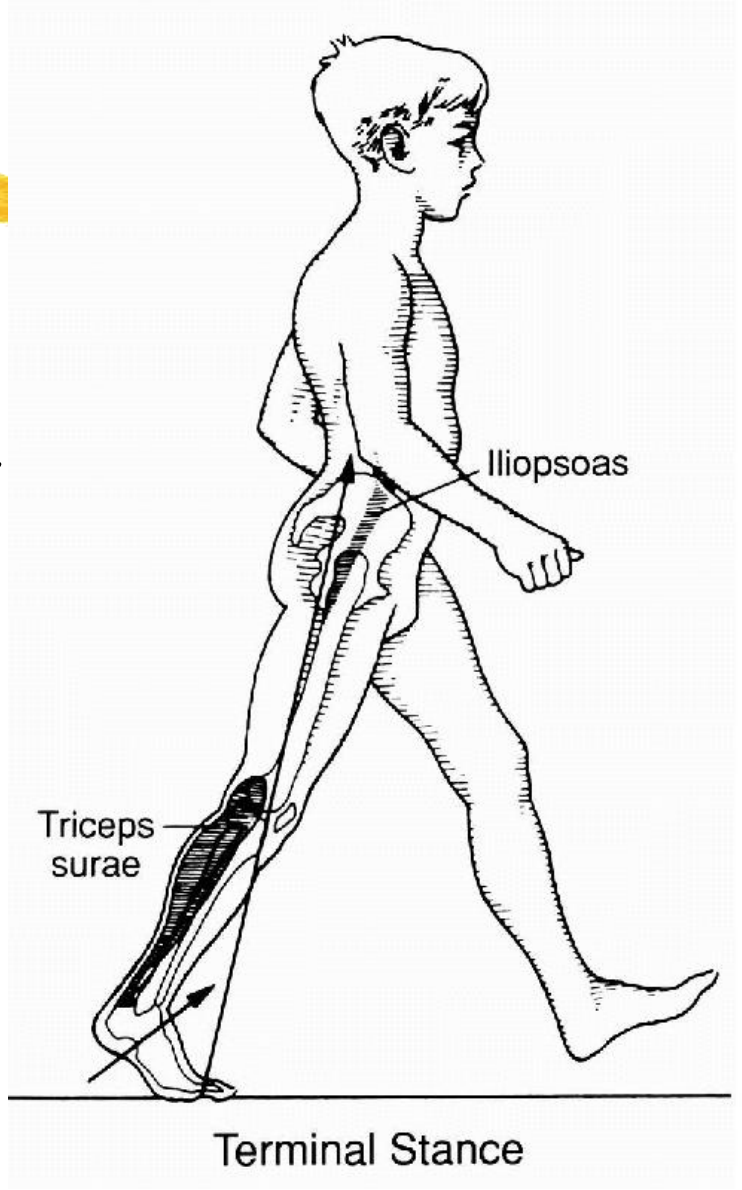
支撑相中期

- 支撑足全部着地
- 对侧足处于摆动相
- 是唯一单足支撑全部重力的时
- 正常步速时大约为步行周期的38%~40%



支撑相末期

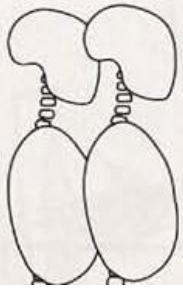
- 指下肢主动加速蹬离(push off)的阶段
- 开始于足跟抬起，结束于足离地
- 在缓慢步行时可以没有蹬离
- 只是足趾离开地面 (toe off)



踝足关节滚轴作用

Heel Rocker　　Ankle Rocker　　Forefoot Rocker

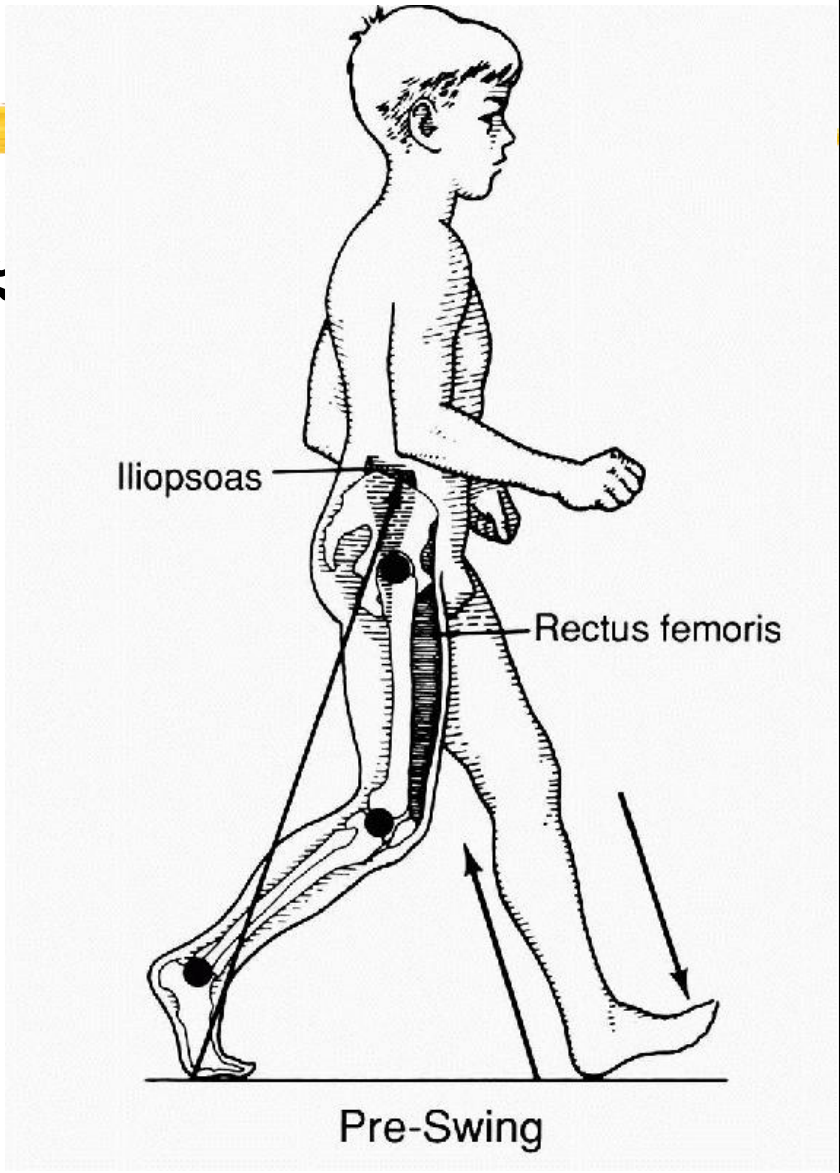
Figure 3.19 Progression (arrow) over the supporting foot is assisted by the actions of three functional rockers (1) heel rocker, (2) ankle rocker, (3) forefoot rocker.



足跟轴　　踝关节轴　　前足轴

摆动相

- 摆动相(swing phase)
- 步行中足始终与地无接触的阶段
- 占步行周期的38-40%
- 足廓清
  - 步行摆动相下肢适当离开地面，以保证肢体向前行进
    - 骨盆稳定性参与廓清机制



摆动相早期

- 主要的动作
  - 足廓清地面
  - 屈髋带动屈膝
- 加速肢体前向摆动
- 占步行周期13%~15%

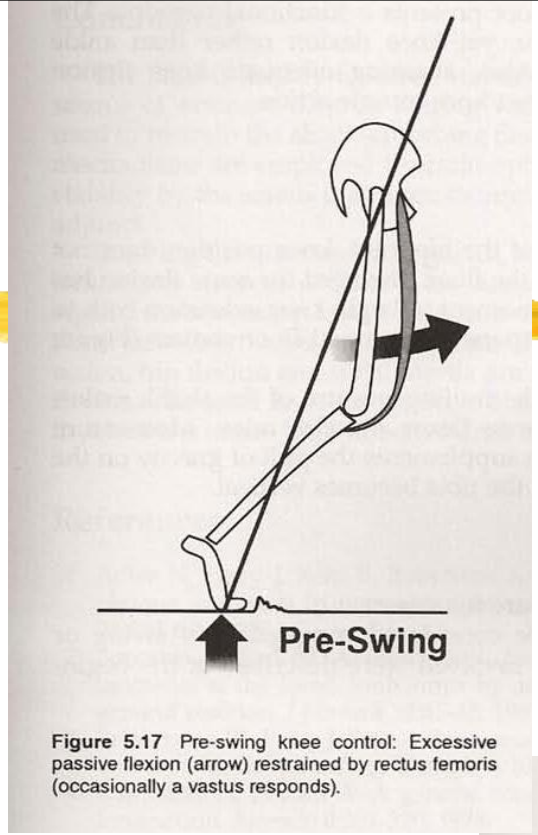
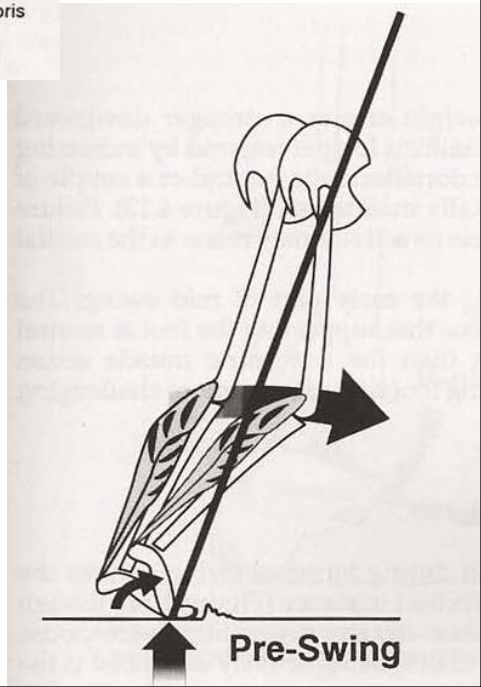


Figure 5.17 Pre-swing knee control: Excessive passive flexion (arrow) restrained by rectus femoris (occasionally a vastus responds).



摆动相中期(mid swing)

- 足廓清仍然是主要任务
- 占步行周期的10%
- 参与肌肉
  - 为胫前肌－踝关节背屈

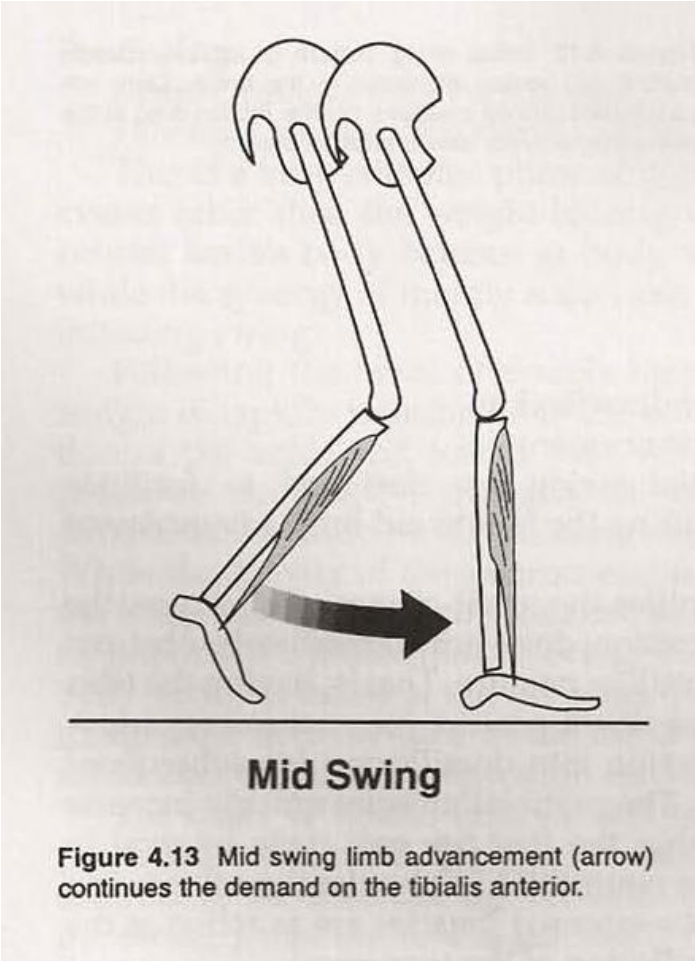
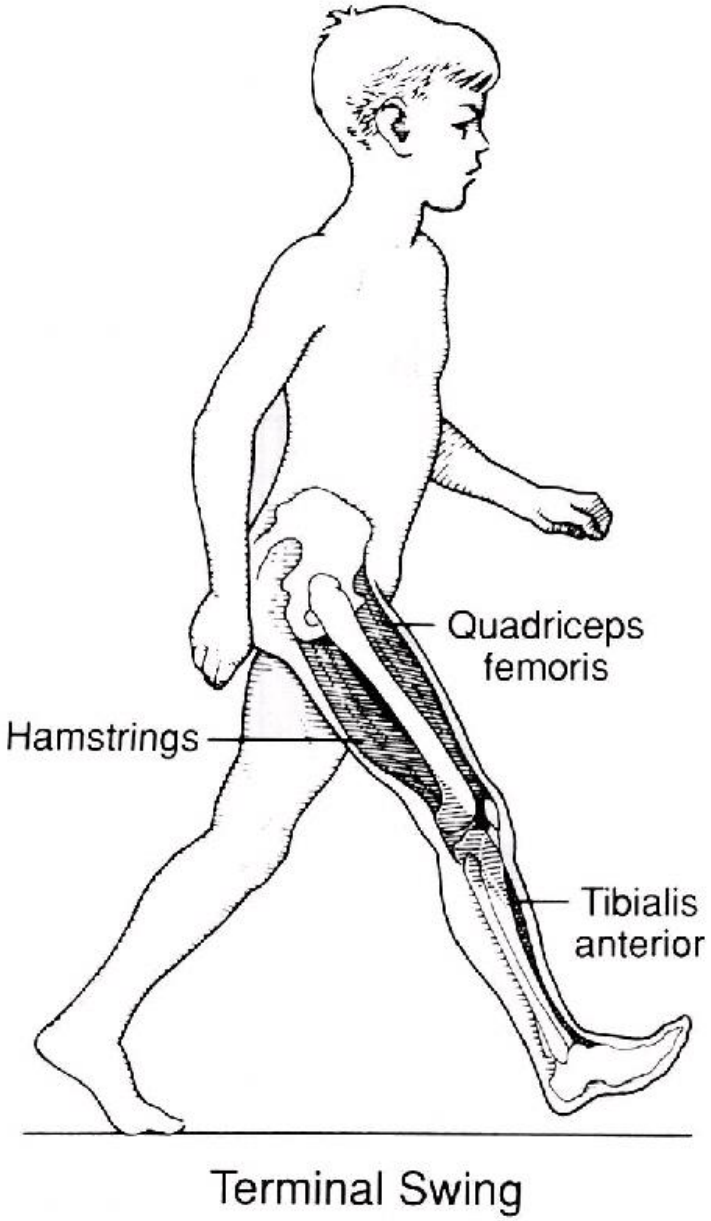


Figure 4.13 Mid swing limb advancement (arrow) continues the demand on the tibialis anterior.

摆动相末期

- 主要任务是下肢前向运动减速
- 准备足着地的姿势
- 占步行周期的15%



三维步态分析系统

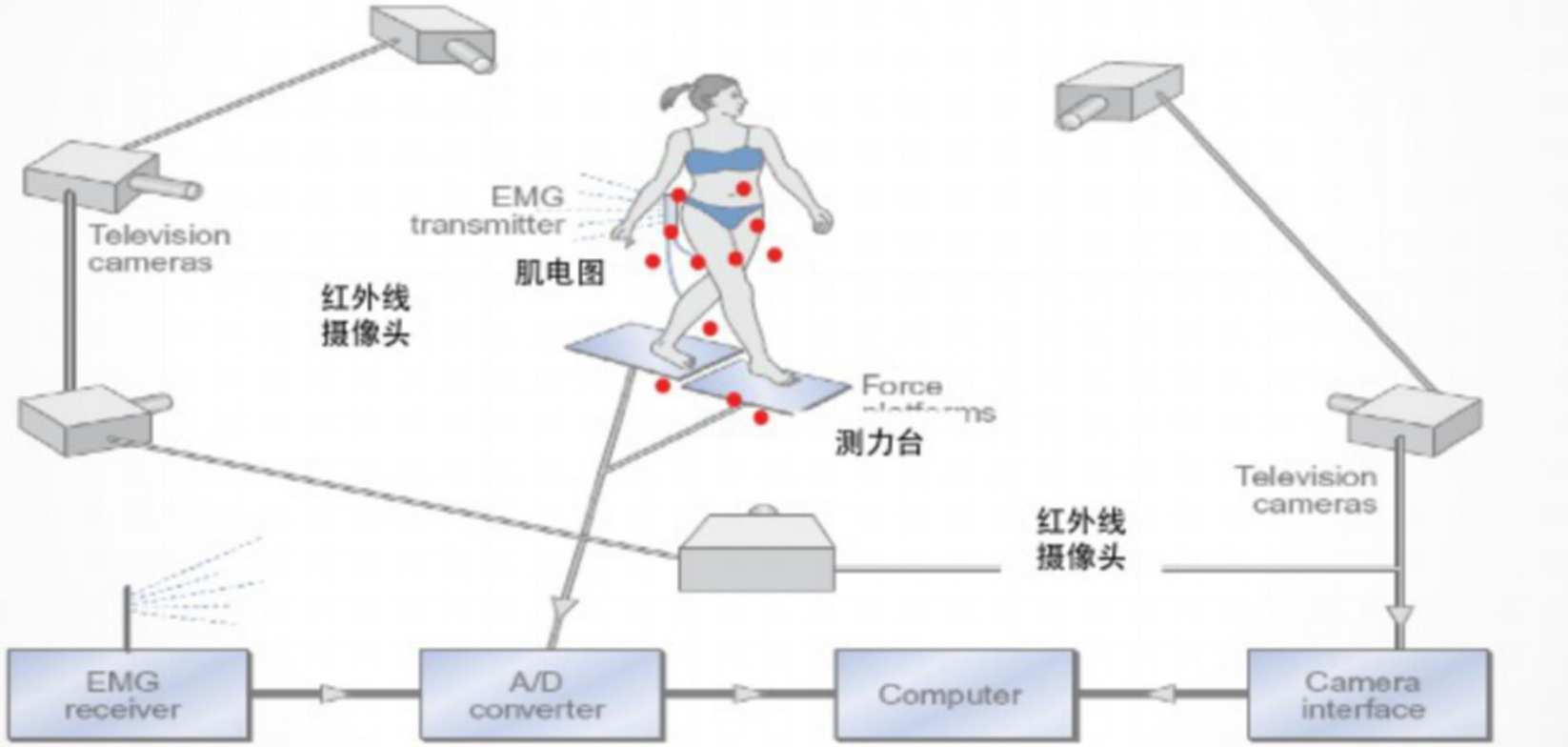
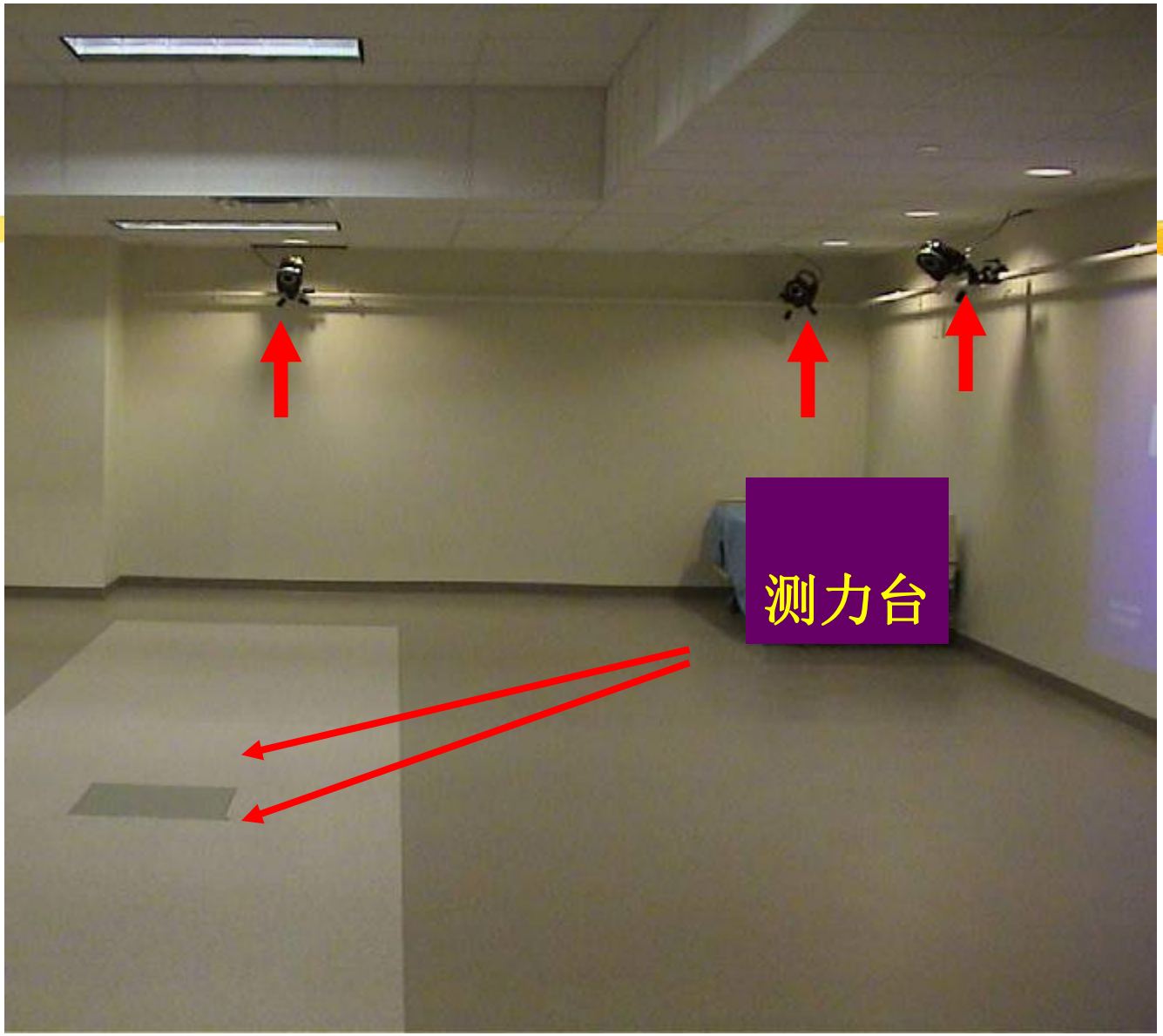
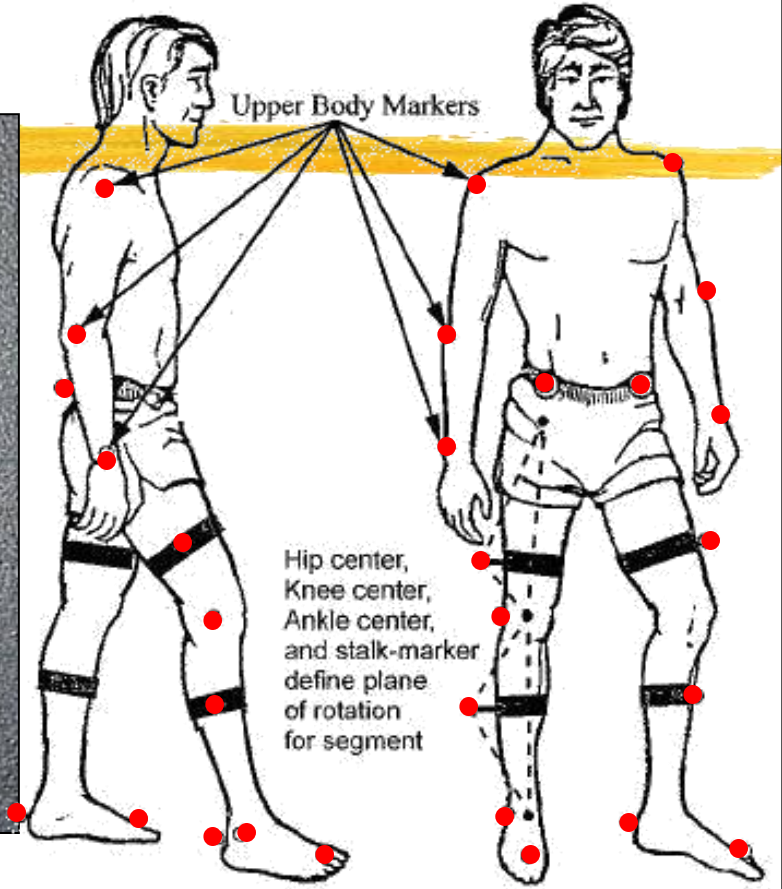
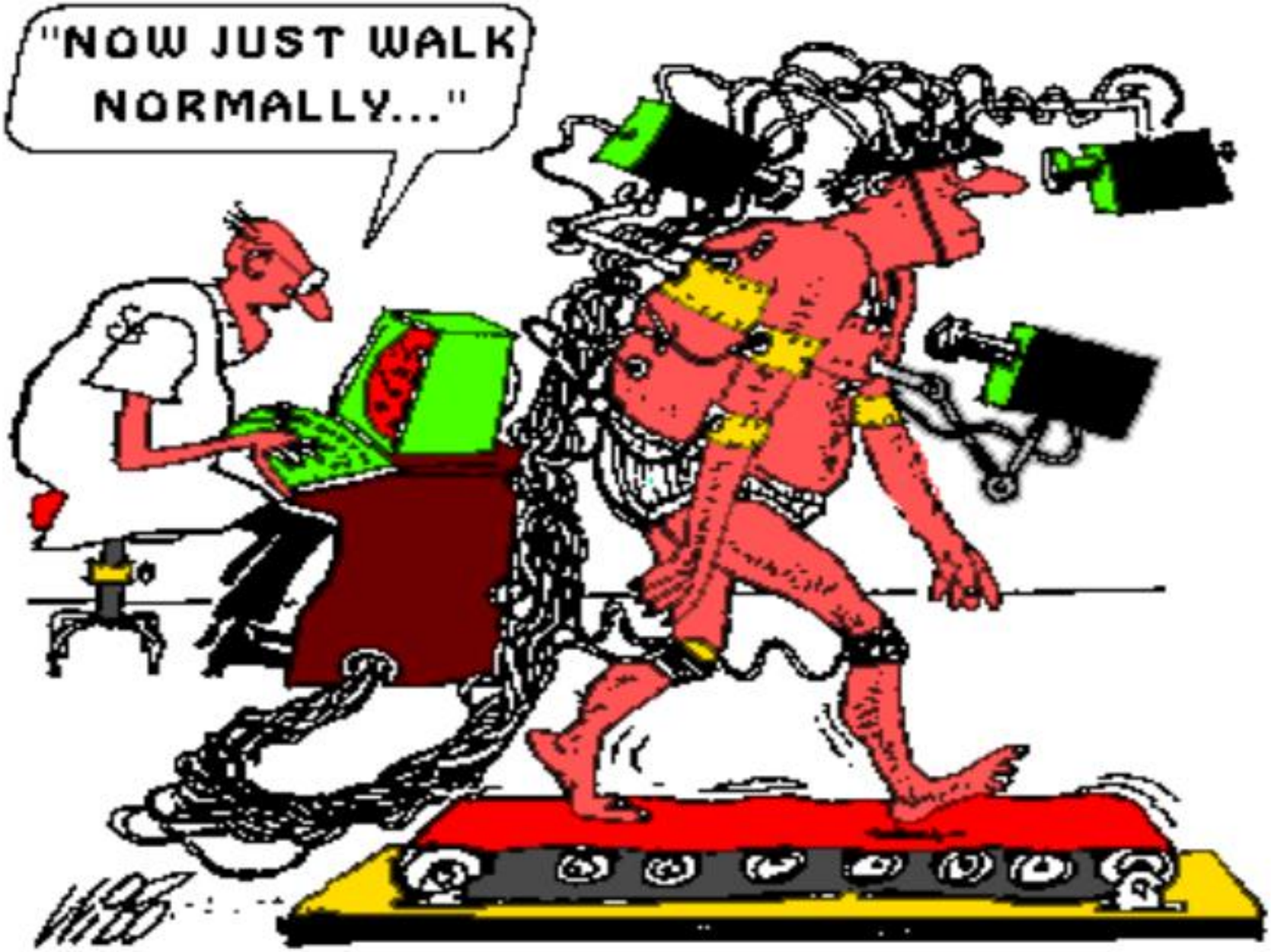


Fig. 4.1
kinema
amera


测力台

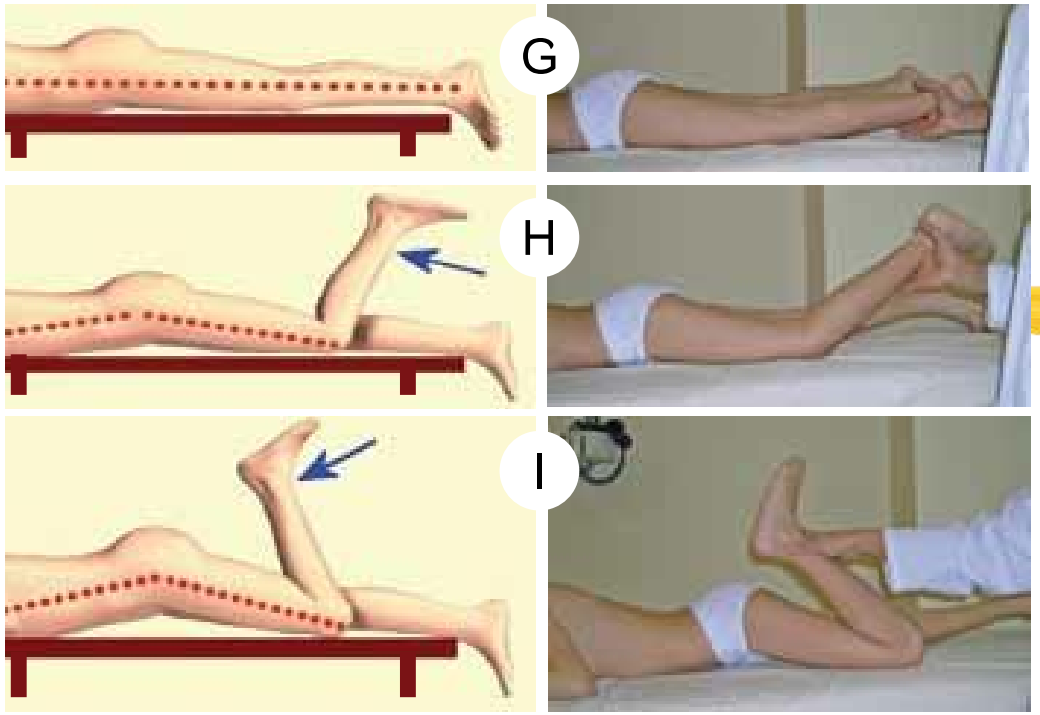

Upper Body Markers
Hip center,
Knee center,
Ankle center,
and stalk-marker
define plane
of rotation
for segment


"NOW JUST WALK NORMALLY..."

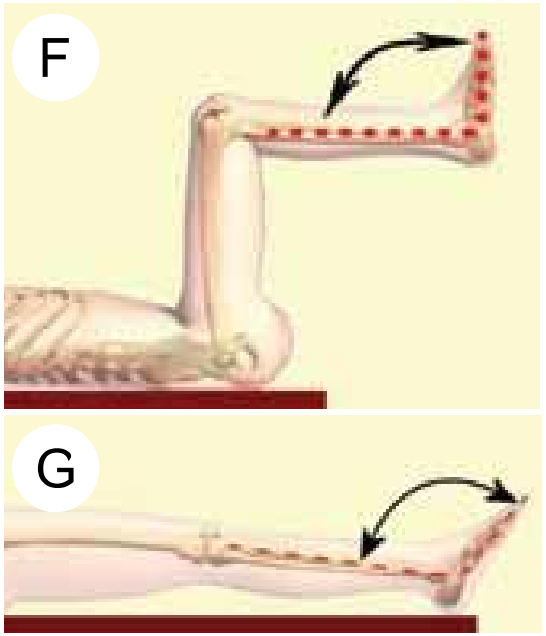
物理评估

- 评估：肌力，肌张力
- 测量
  - 长度：下肢长度，小腿围，足长
  - 关节被动活动角度
    - Pop角
    - Silfverskiold Test

	左	右
髋关节屈曲	１０５	１１０
髋关节内旋	１９	２８
髋关节外旋	５０	５０
膝关节屈曲	１３４	１３６
腘角	３４	３２
Ely 测试	５０	５０
伸膝-踝关节背屈	４０	２４
屈膝-踝关节背屈	４２	４０
踝关节跖屈	４０	３８
Thigh Foot 角度	２８内	３４内
胫骨扭转	8	6
下肢长度	３４	３６
小腿周径	１９．３	２９
足长	１４	１４



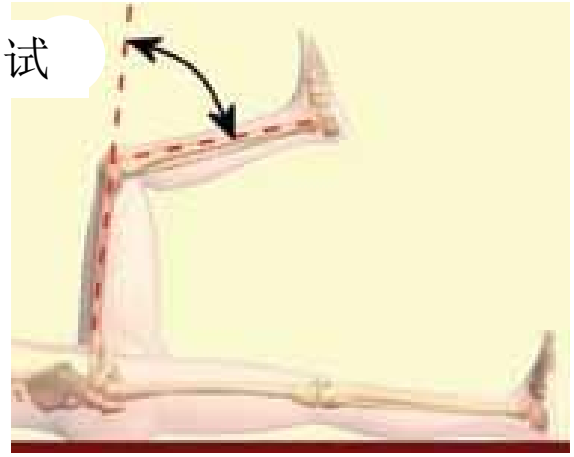
Ely试验



Silfverskiold试验

Thigh-Foot 角度

Pop角度测试



影像学资料

- 实时再现步态
- 分析依据
- 对比资料

时空参数

MotionAnalysis

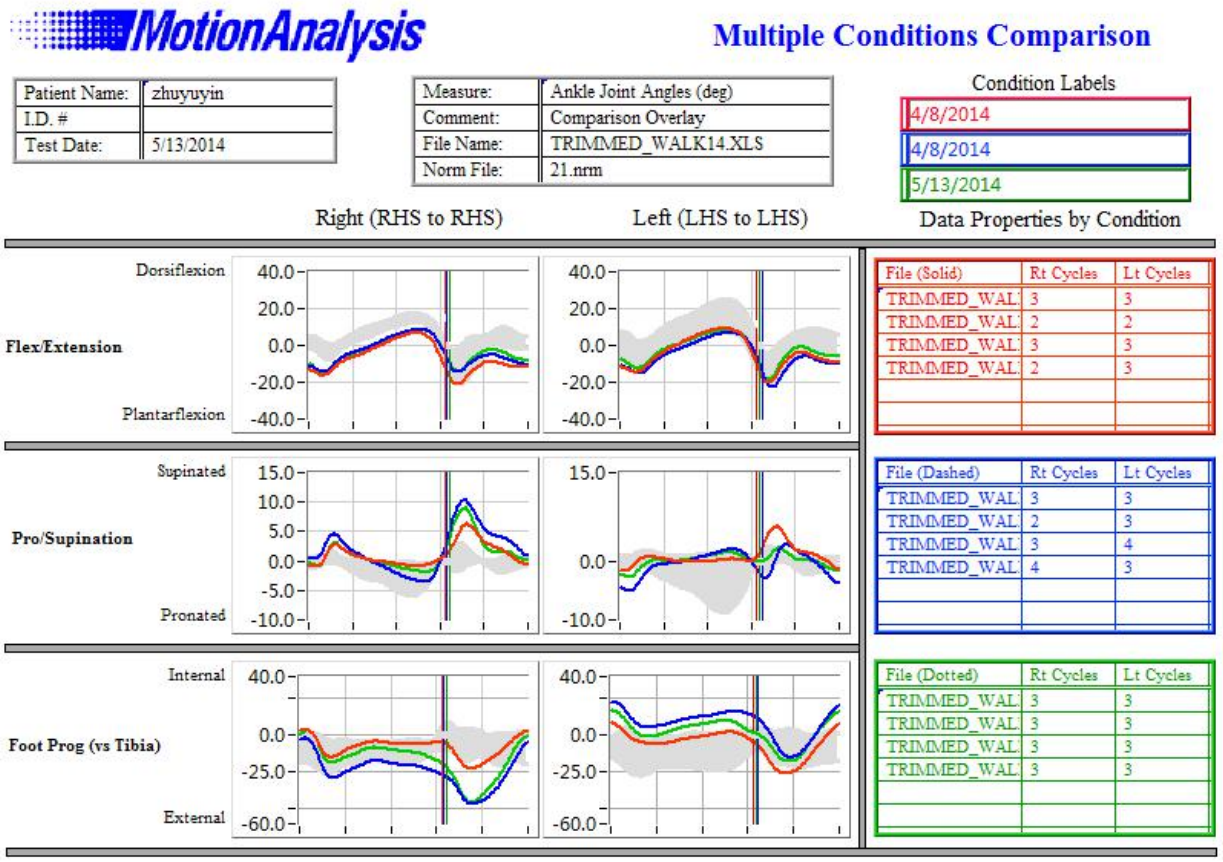
Aggregate Temporal/Spatial Data

Patient Name:	zhuyuyin	Measure:	Spatial_Temporal
I.D. #		File Name:	TRIMMED_WALK14.XLS
Test Date:	5/13/2014	Norm File:	21.nrm

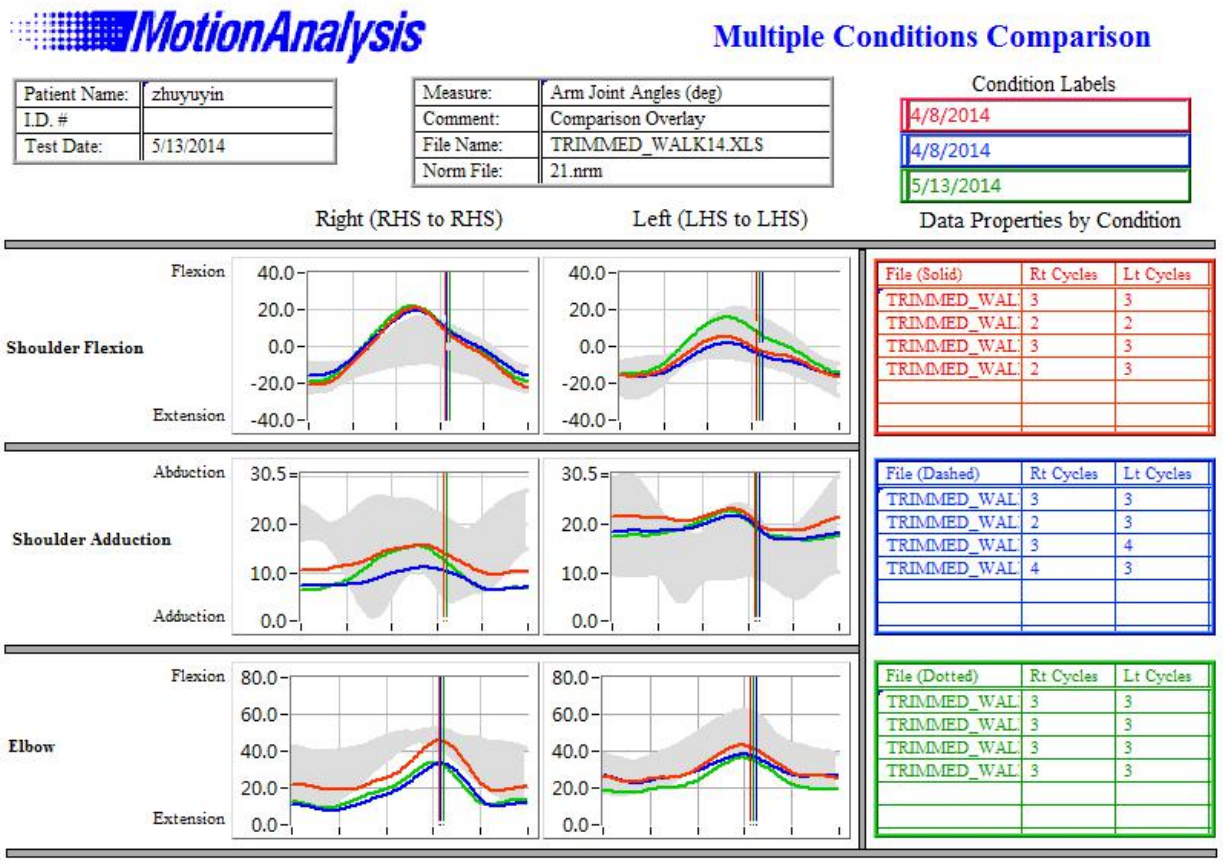
Comment: Comparison Overlay

	Right Side Measures				Left Side Measures		
	4/8/201	4/8/201	5/13/20	Normal	4/8/201	4/8/201	5/13/20
Step Length Avg (cm)	52.03	50.10	48.33	64.88	53.57	51.39	53.36
Standard Deviation	2.60	2.73	4.06	7.60	2.43	3.49	3.14
Number of Steps	14.00	14.00	15.00	10.00	11.00	15.00	13.00
Stride Length Avg (cm)	106.51	101.46	101.25	129.82	105.93	101.45	102.52
Standard Deviation	3.67	4.31	3.22	15.05	3.91	4.06	3.40
Number of Strides	10.00	12.00	12.00	10.00	11.00	13.00	12.00
Forward Velocity Avg (cm/s	98.57	93.71	88.59	118.34	98.63	93.72	89.79
Standard Deviation	3.64	4.38	3.59	17.83	3.55	4.87	3.02
Number of Strides	10.00	12.00	12.00	10.00	11.00	13.00	12.00
Cadence Avg (steps/min)	111.03	111.01	105.36	109.46	111.70	110.68	105.39
Standard Deviation	3.03	3.31	3.60	8.52	4.00	4.41	4.04
Number of Steps	10.00	12.00	12.00	10.00	11.00	13.00	12.00
Total Support Time (%)	62.52	62.88	64.41	60.56	62.56	64.74	63.57
Standard Deviation	1.67	1.41	2.00	0.87	1.52	2.17	1.83
Number of Strides	10.00	12.00	12.00	10.00	11.00	13.00	12.00
Swing Phase (%)	37.48	37.12	35.59	39.44	37.44	35.26	36.43
Standard Deviation	1.67	1.41	2.00	0.87	1.52	2.17	1.83
Number of Strides	10.00	12.00	12.00	10.00	11.00	13.00	12.00
Initial Double Support Time	12.01	13.72	13.63	10.53	12.83	14.18	14.23
Standard Deviation	0.77	1.25	1.45	0.83	0.82	1.48	1.58
Number of Strides	10.00	12.00	12.00	10.00	11.00	13.00	12.00
Single Support Time (%)	37.44	35.26	36.43	39.44	37.48	37.12	35.59
Standard Deviation	1.52	2.17	1.83	0.87	1.67	1.41	2.00
Number of Strides	11.00	13.00	12.00	10.00	10.00	12.00	12.00
Step Width (cm)	14.76	12.09	15.68	11.97			
Standard Deviation	2.34	1.19	3.02	3.31			
Number of Trials	4.00	4.00	4.00	10.00			

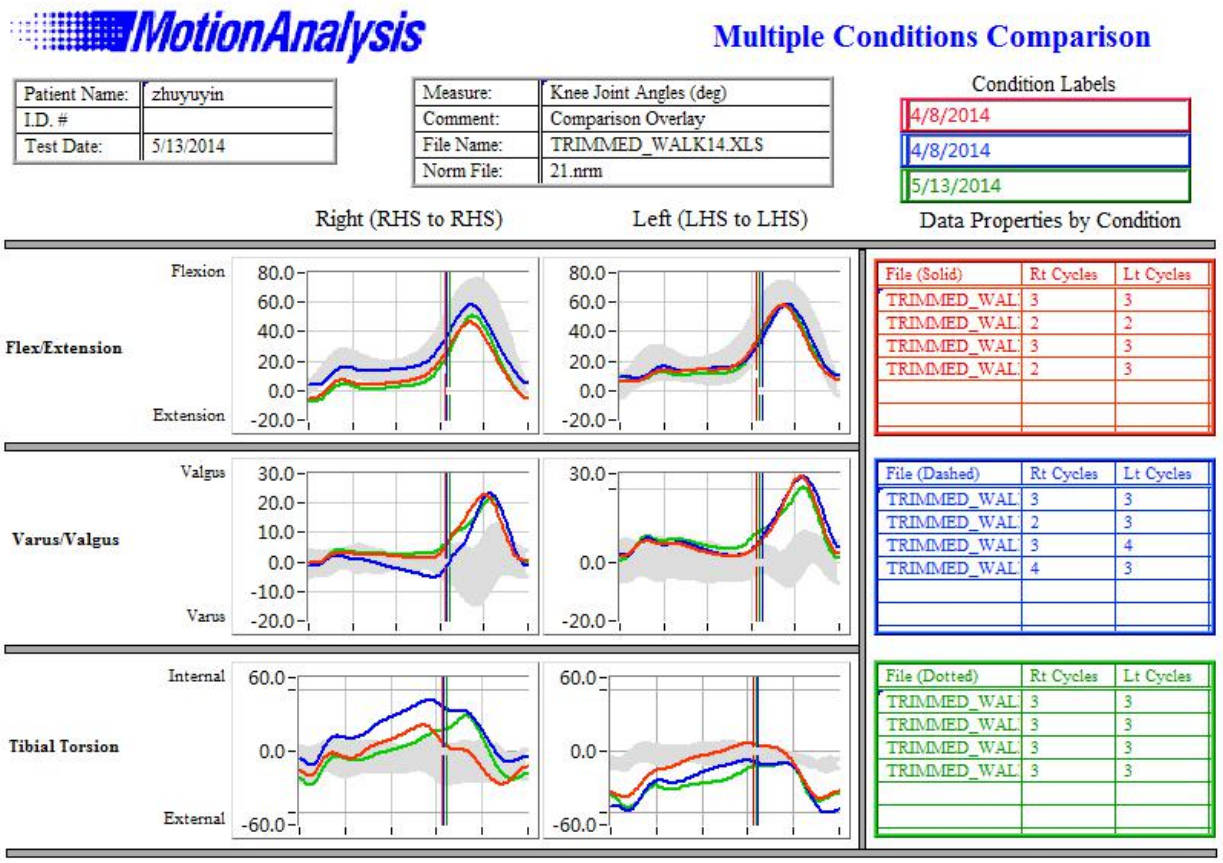
踝关节运动角度


MotionAnalysis
Multiple Conditions Comparison
Patient Name: zhuyuyin
I.D. #
Test Date: 5/13/2014
Measure: Ankle Joint Angles (deg)
Comment: Comparison Overlay
File Name: TRIMMED_WALK14.XLS
Norm File: 21.nrm
Condition Labels
4/8/2014
4/8/2014
5/13/2014
Right (RHS to RHS)
Left (LHS to LHS)
Data Properties by Condition
Dorsiflexion
Flex/Extension
Plantarflexion
40.0
20.0
0.0
-20.0
-40.0
Supinated
Pro/Supination
Pronated
15.0
10.0
5.0
0.0
-5.0
-10.0
Internal
Foot Prog (vs Tibia)
External
-25.0
-60.0
File (Solid) Rt Cycles Lt Cycles
TRIMMED_WAL 3 3
TRIMMED_WAL 2 2
TRIMMED_WAL 3 3
TRIMMED_WAL 2 3
File (Dashed) Rt Cycles Lt Cycles
TRIMMED_WAL 3 3
TRIMMED_WAL 2 3
TRIMMED_WAL 3 4
TRIMMED_WAL 4 3
File (Dotted) Rt Cycles Lt Cycles
TRIMMED_WAL 3 3
TRIMMED_WAL 3 3
TRIMMED_WAL 3 3
TRIMMED_WAL 3 3

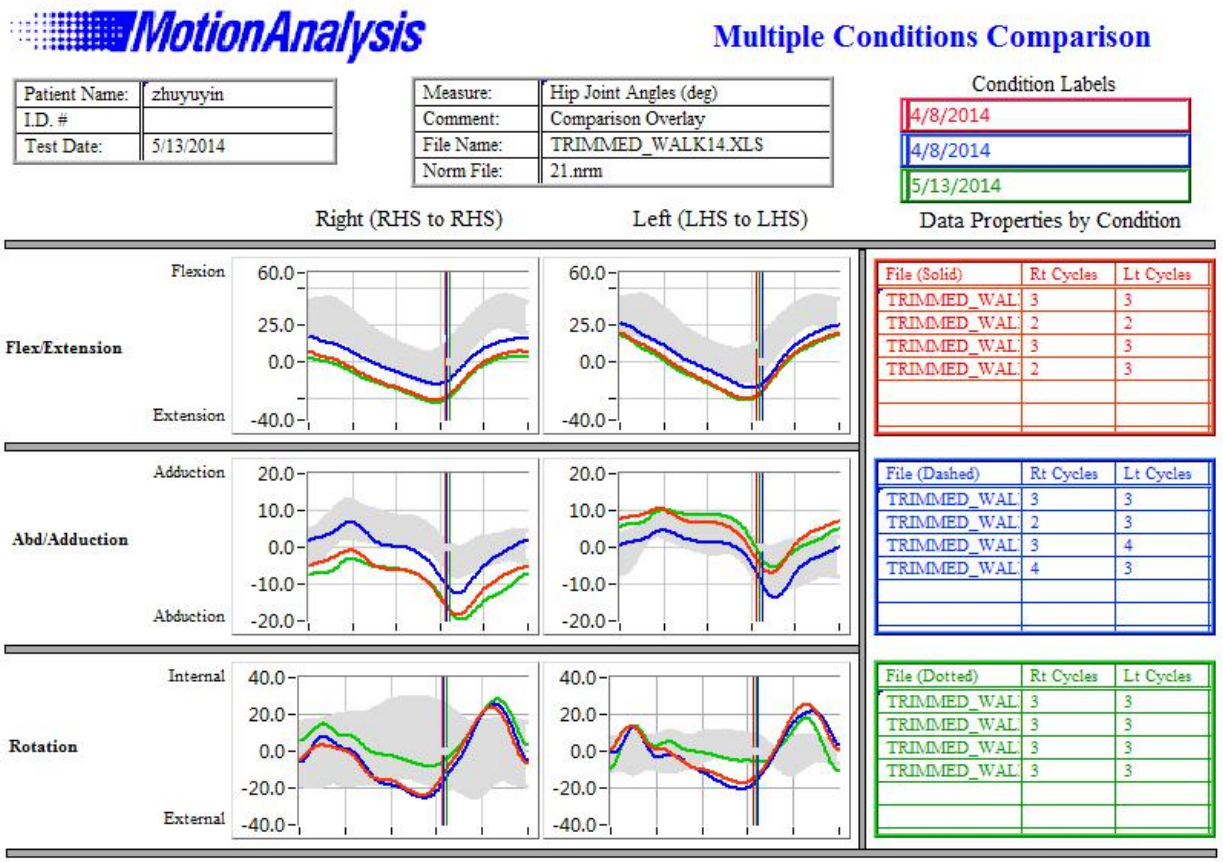
肩关节运动角度


MotionAnalysis
Multiple Conditions Comparison
Patient Name: zhuyuyin
I.D. #
Test Date: 5/13/2014
Measure: Arm Joint Angles (deg)
Comment: Comparison Overlay
File Name: TRIMMED_WALK14.XLS
Norm File: 21.nrm
Condition Labels
4/8/2014
4/8/2014
5/13/2014
Right (RHS to RHS)
Left (LHS to LHS)
Data Properties by Condition
Shoulder Flexion
Flexion
Extension
40.0
20.0
0.0
-20.0
-40.0
Shoulder Adduction
Abduction
Adduction
30.5
10.0
Elbow
80.0
60.0
File (Solid) Rt Cycles Lt Cycles
TRIMMED_WAL 3 3
TRIMMED_WAL 2 2
TRIMMED_WAL 3 3
TRIMMED_WAL 2 3
File (Dashed) Rt Cycles Lt Cycles
TRIMMED_WAL 3 3
TRIMMED_WAL 2 3
TRIMMED_WAL 3 4
TRIMMED_WAL 4 3
File (Dotted) Rt Cycles Lt Cycles
TRIMMED_WAL 3 3
TRIMMED_WAL 3 3
TRIMMED_WAL 3 3
TRIMMED_WAL 3 3

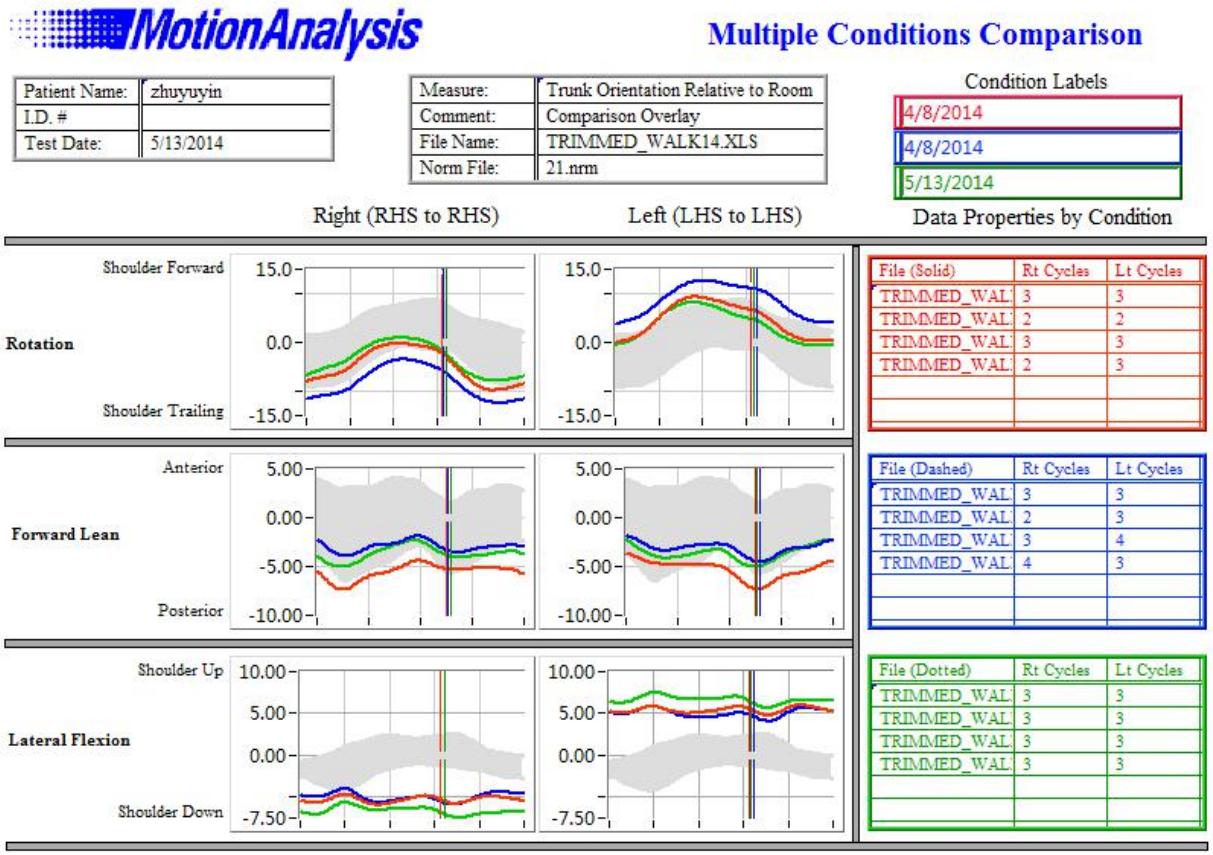
膝关节运动角度


MotionAnalysis
Multiple Conditions Comparison
Patient Name: zhuyuyin
I.D. #
Test Date: 5/13/2014
Measure: Knee Joint Angles (deg)
Comment: Comparison Overlay
File Name: TRIMMED_WALK14.XLS
Norm File: 21.nrm
Condition Labels
4/8/2014
4/8/2014
5/13/2014
Right (RHS to RHS)
Left (LHS to LHS)
Data Properties by Condition
Flex/Extension
Flexion
Extension
80.0
60.0
40.0
20.0
0.0
-20.0
Varus/Valgus
Valgus
Varus
30.0
20.0
10.0
0.0
-10.0
-20.0
Tibial Torsion
Internal
External
60.0
0.0
-60.0
File (Solid) Rt Cycles Lt Cycles
TRIMMED_WAL 3 3
TRIMMED_WAL 2 2
TRIMMED_WAL 3 3
TRIMMED_WAL 2 3
File (Dashed) Rt Cycles Lt Cycles
TRIMMED_WAL 3 3
TRIMMED_WAL 2 3
TRIMMED_WAL 3 4
TRIMMED_WAL 4 3
File (Dotted) Rt Cycles Lt Cycles
TRIMMED_WAL 3 3
TRIMMED_WAL 3 3
TRIMMED_WAL 3 3
TRIMMED_WAL 3 3

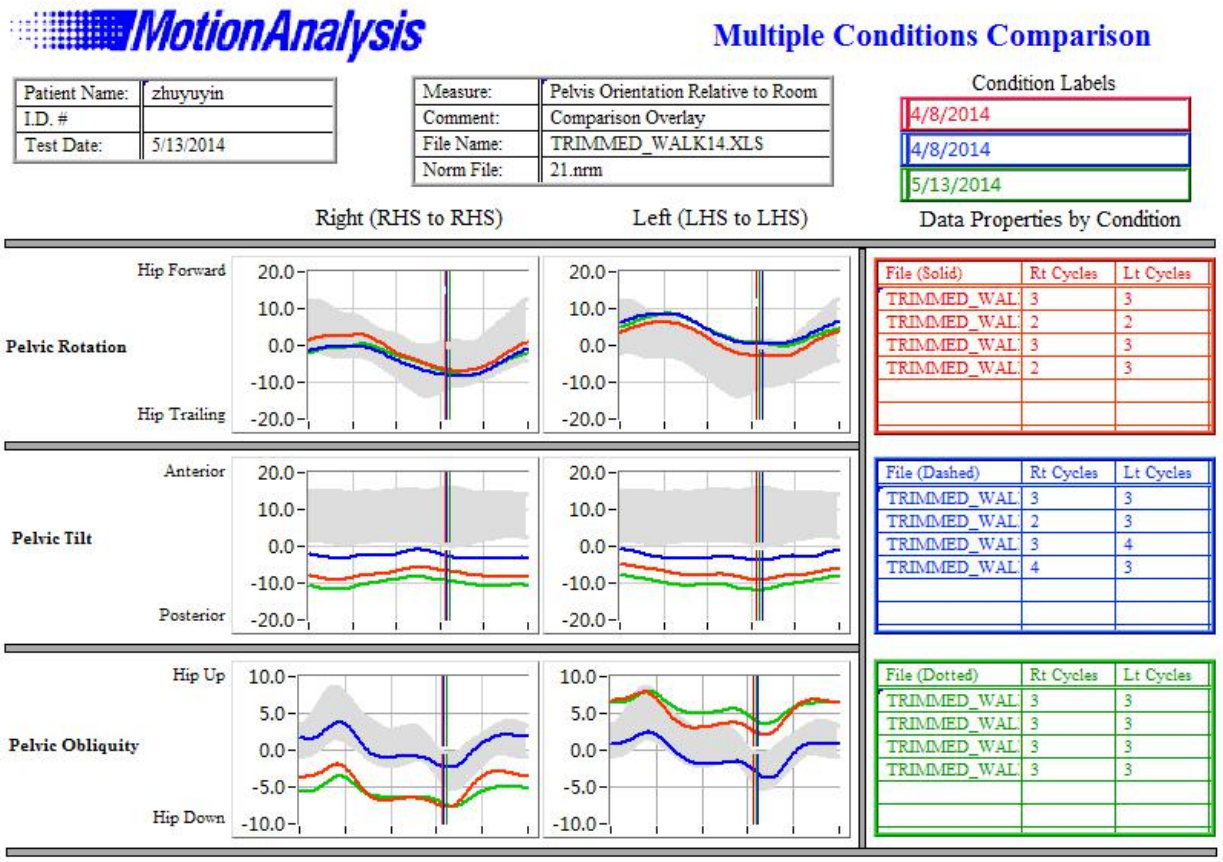
髋关节运动角度


MotionAnalysis
Multiple Conditions Comparison
Patient Name: zhuyuyin
I.D. #
Test Date: 5/13/2014
Measure: Hip Joint Angles (deg)
Comment: Comparison Overlay
File Name: TRIMMED_WALK14.XLS
Norm File: 21.nrm
Condition Labels
4/8/2014
4/8/2014
5/13/2014
Right (RHS to RHS)
Left (LHS to LHS)
Data Properties by Condition
Flex/Extension
Flexion
Extension
60.0
25.0
0.0
-40.0
Abd/Adduction
Adduction
Abduction
20.0
10.0
0.0
-10.0
-20.0
Rotation
Internal
External
40.0
20.0
0.0
-20.0
-40.0
File (Solid) Rt Cycles Lt Cycles
TRIMMED_WAL 3 3
TRIMMED_WAL 2 2
TRIMMED_WAL 3 3
TRIMMED_WAL 2 3
File (Dashed) Rt Cycles Lt Cycles
TRIMMED_WAL 3 3
TRIMMED_WAL 2 3
TRIMMED_WAL 3 4
TRIMMED_WAL 4 3
File (Dotted) Rt Cycles Lt Cycles
TRIMMED_WAL 3 3
TRIMMED_WAL 3 3
TRIMMED_WAL 3 3
TRIMMED_WAL 3 3

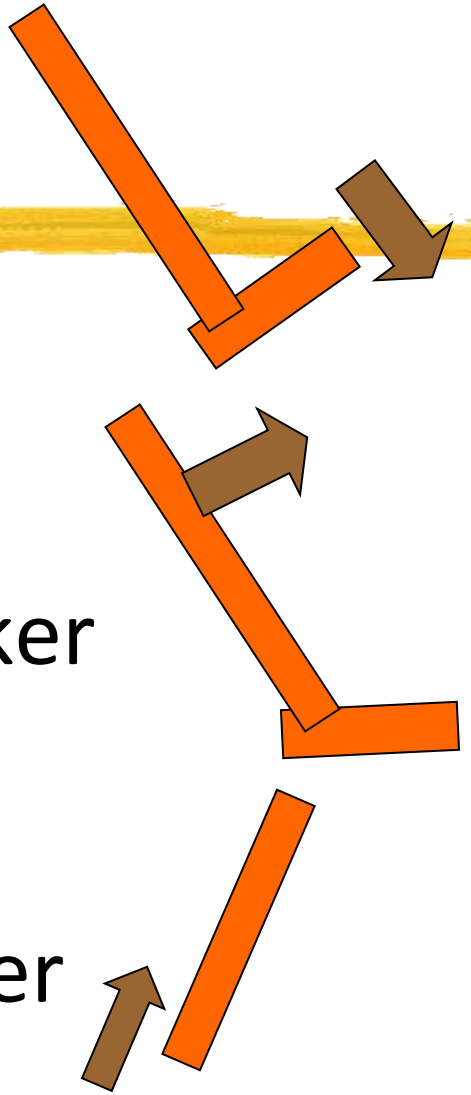
躯干运动角度


MotionAnalysis
Multiple Conditions Comparison
Patient Name: zhuyuyin
I.D. #
Test Date: 5/13/2014
Measure: Trunk Orientation Relative to Room
Comment: Comparison Overlay
File Name: TRIMMED_WALK14.XLS
Norm File: 21.nrm
Condition Labels
4/8/2014
4/8/2014
5/13/2014
Right (RHS to RHS)
Left (LHS to LHS)
Data Properties by Condition
Rotation
Shoulder Forward
Shoulder Trailing
15.0
0.0
-15.0
Forward Lean
Anterior
Posterior
5.00
0.00
-5.00
-10.00
Lateral Flexion
Shoulder Up
Shoulder Down
10.00
5.00
0.00
-7.50
File (Solid) Rt Cycles Lt Cycles
TRIMMED_WAL 3 3
TRIMMED_WAL 2 2
TRIMMED_WAL 3 3
TRIMMED_WAL 2 3
File (Dashed) Rt Cycles Lt Cycles
TRIMMED_WAL 3 3
TRIMMED_WAL 2 3
TRIMMED_WAL 3 4
TRIMMED_WAL 4 3
File (Dotted) Rt Cycles Lt Cycles
TRIMMED_WAL 3 3
TRIMMED_WAL 3 3
TRIMMED_WAL 3 3
TRIMMED_WAL 3 3

骨盆运动角度

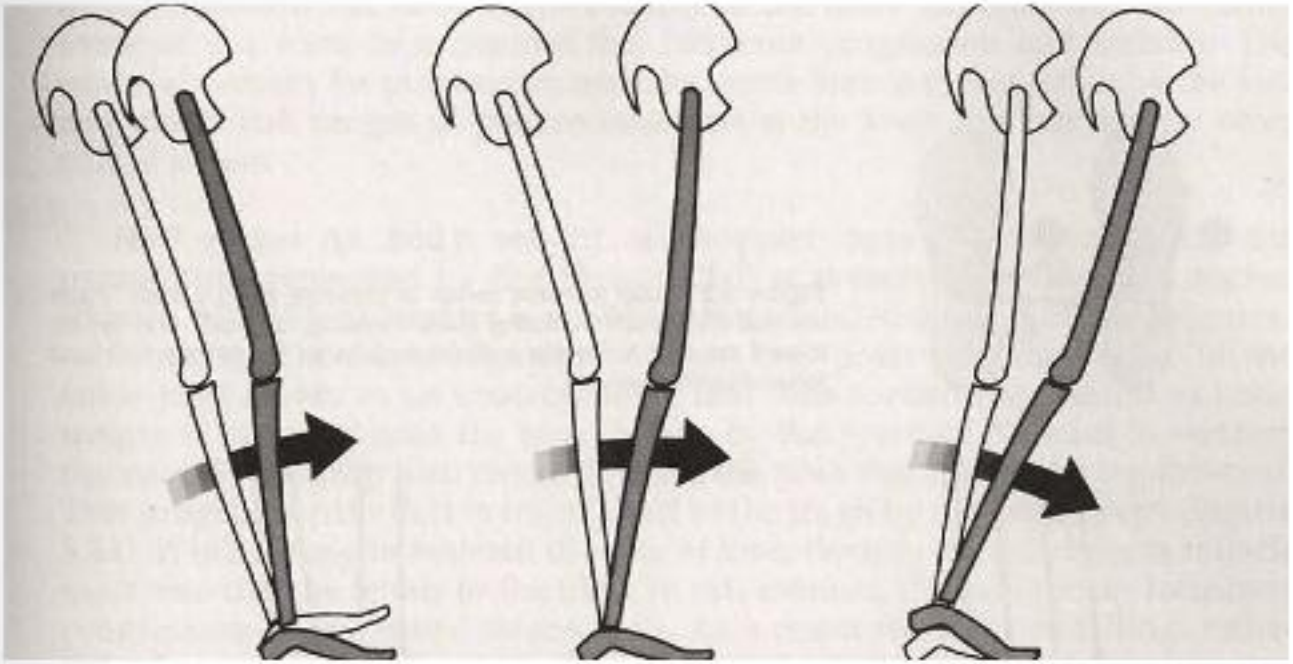

MotionAnalysis
Multiple Conditions Comparison
Patient Name: zhuyuyin
I.D. #
Test Date: 5/13/2014
Measure: Pelvis Orientation Relative to Room
Comment: Comparison Overlay
File Name: TRIMMED_WALK14.XLS
Norm File: 21.nrm
Condition Labels
4/8/2014
4/8/2014
5/13/2014
Right (RHS to RHS)
Left (LHS to LHS)
Data Properties by Condition
Pelvic Rotation
Hip Forward
Hip Trailing
Pelvic Tilt
Anterior
Posterior
Pelvic Obliquity
Hip Up
Hip Down
20.0
10.0
0.0
-10.0
-20.0
5.0
-5.0
File (Solid) Rt Cycles Lt Cycles
TRIMMED_WAL 3 3
TRIMMED_WAL 2 2
TRIMMED_WAL 3 3
TRIMMED_WAL 2 3
File (Dashed) Rt Cycles Lt Cycles
TRIMMED_WAL 3 3
TRIMMED_WAL 2 3
TRIMMED_WAL 3 4
TRIMMED_WAL 4 3
File (Dotted) Rt Cycles Lt Cycles
TRIMMED_WAL 3 3
TRIMMED_WAL 3 3
TRIMMED_WAL 3 3
TRIMMED_WAL 3 3

踝足关节滚轴作用



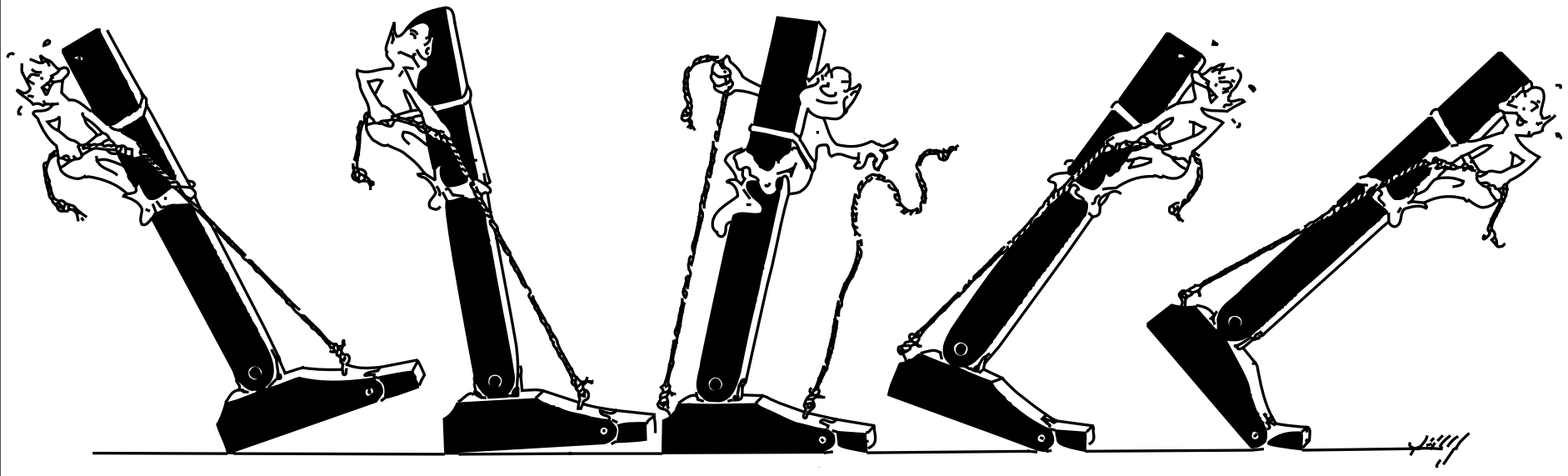
- First rocker: Heel Rocker
  - 踝关节跖屈
  - 胫骨固定
  - 足放平
- Second Rocker: Ankle Rocker
  - 踝关节背屈
  - 足固定
  - 胫骨向前运动越过足
- Third rocker:Foreoot Rocker
  - 足跟抬起
  - 前足背屈

踝足关节滚轴作用



足跟轴　　踝关节轴　　前足轴

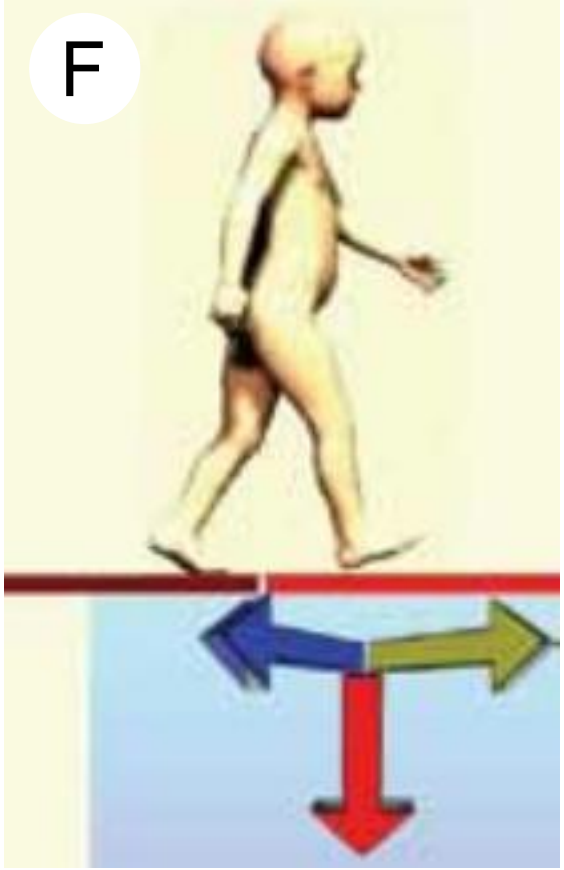
胫前肌和小腿三头肌在支撑相作用

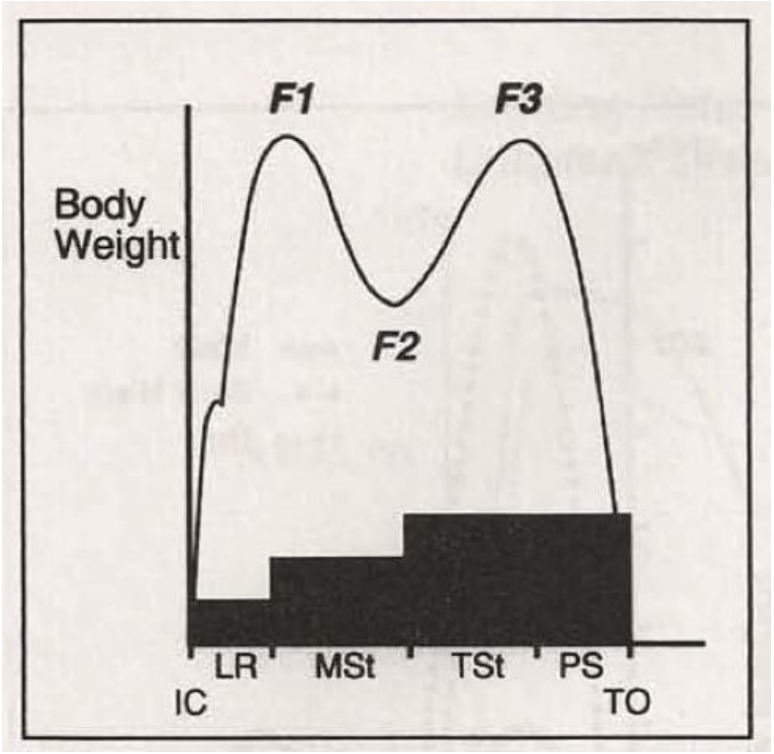


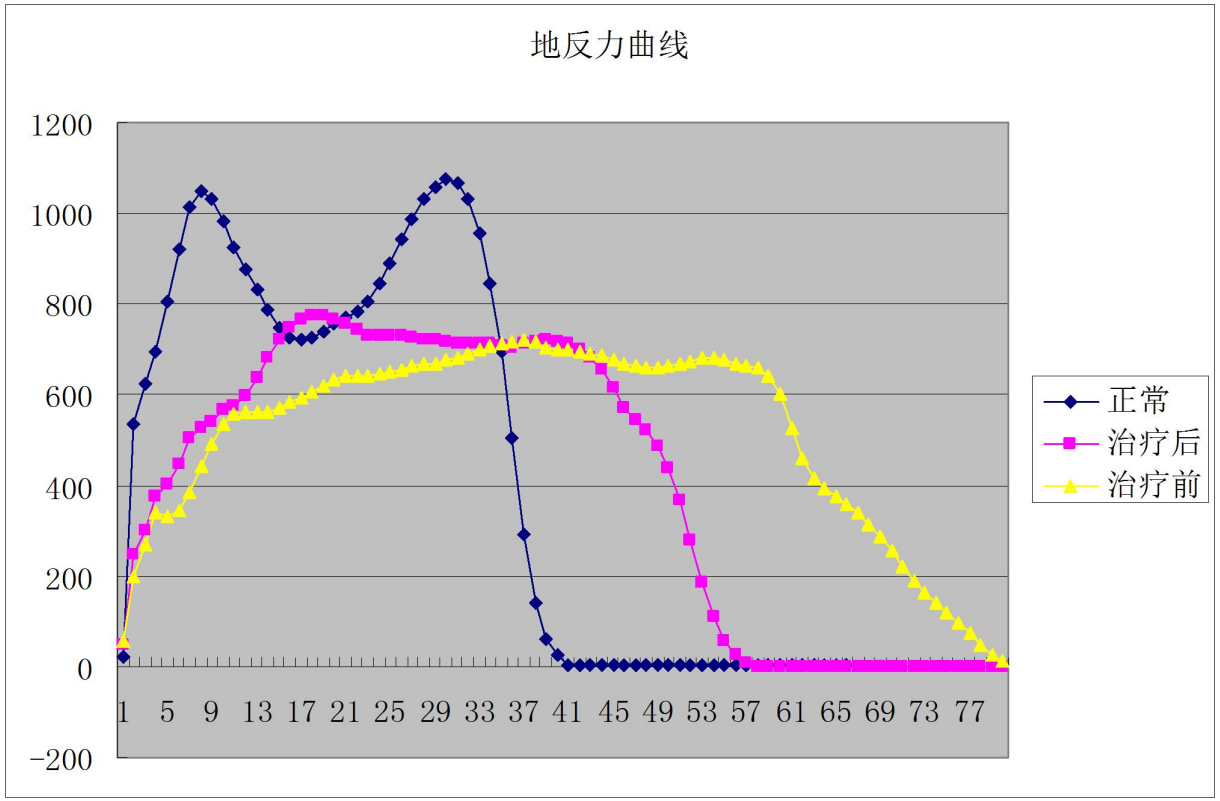
步行时力的产生

- 肌肉产生的力
- 地心引力
- 动量产生的力momentum
- 地面反作用力

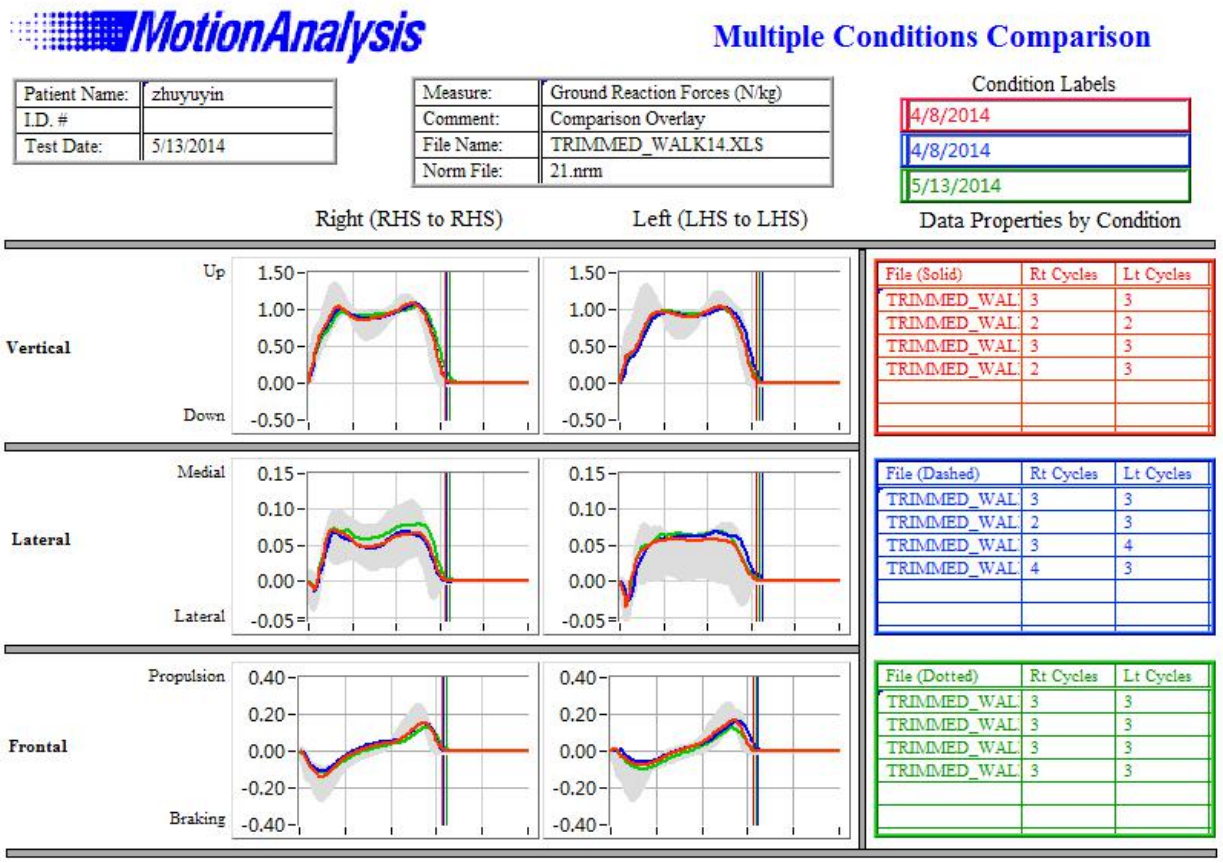
动力学数据 - 力,力矩,功率



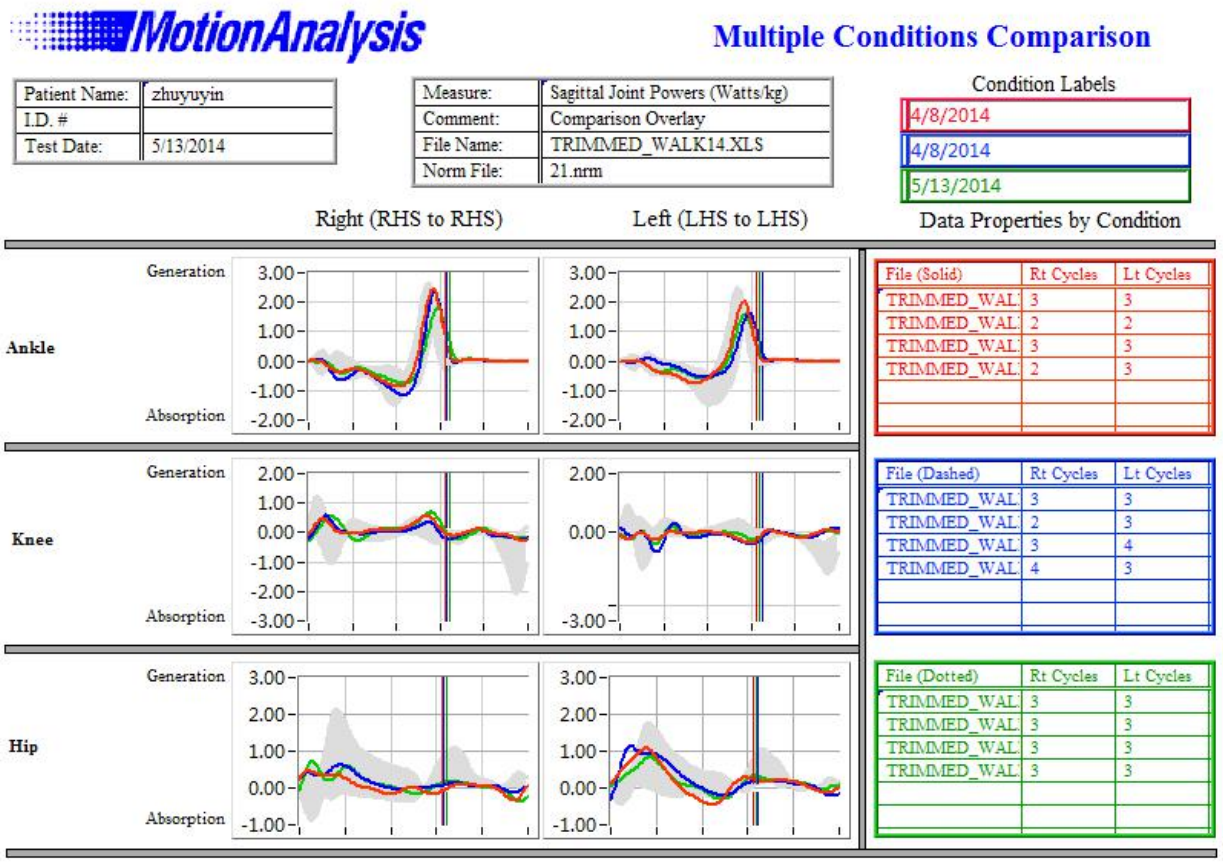



地反力曲线
1200
1000
800
600
400
200
0
-200
1 5 9 13 17 21 25 29 33 37 41 45 49 53 57 61 65 69 73 77
正常
治疗后
治疗前

地反力

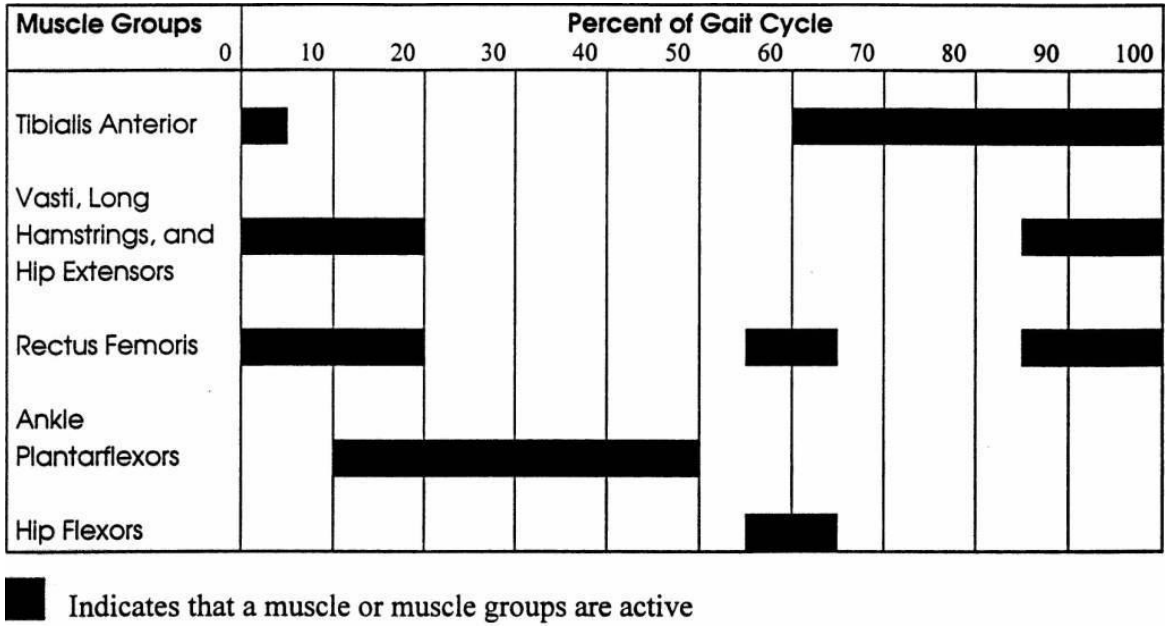

MotionAnalysis
Multiple Conditions Comparison
Patient Name: zhuyuyin
I.D. #
Test Date: 5/13/2014
Measure: Ground Reaction Forces (N/kg)
Comment: Comparison Overlay
File Name: TRIMMED_WALK14.XLS
Norm File: 21.nrm
Condition Labels
4/8/2014
4/8/2014
5/13/2014
Right (RHS to RHS)
Left (LHS to LHS)
Data Properties by Condition
Vertical
Up
Down
1.50
1.00
0.50
0.00
-0.50
Lateral
Medial
Lateral
0.15
0.10
0.05
0.00
-0.05
Frontal
Propulsion
Braking
0.40
0.20
0.00
-0.20
-0.40
File (Solid) Rt Cycles Lt Cycles
TRIMMED_WAL 3 3
TRIMMED_WAL 2 2
TRIMMED_WAL 3 3
TRIMMED_WAL 2 3
File (Dashed) Rt Cycles Lt Cycles
TRIMMED_WAL 3 3
TRIMMED_WAL 2 3
TRIMMED_WAL 3 4
TRIMMED_WAL 4 3
File (Dotted) Rt Cycles Lt Cycles
TRIMMED_WAL 3 3
TRIMMED_WAL 3 3
TRIMMED_WAL 3 3
TRIMMED_WAL 3 3

关节做功

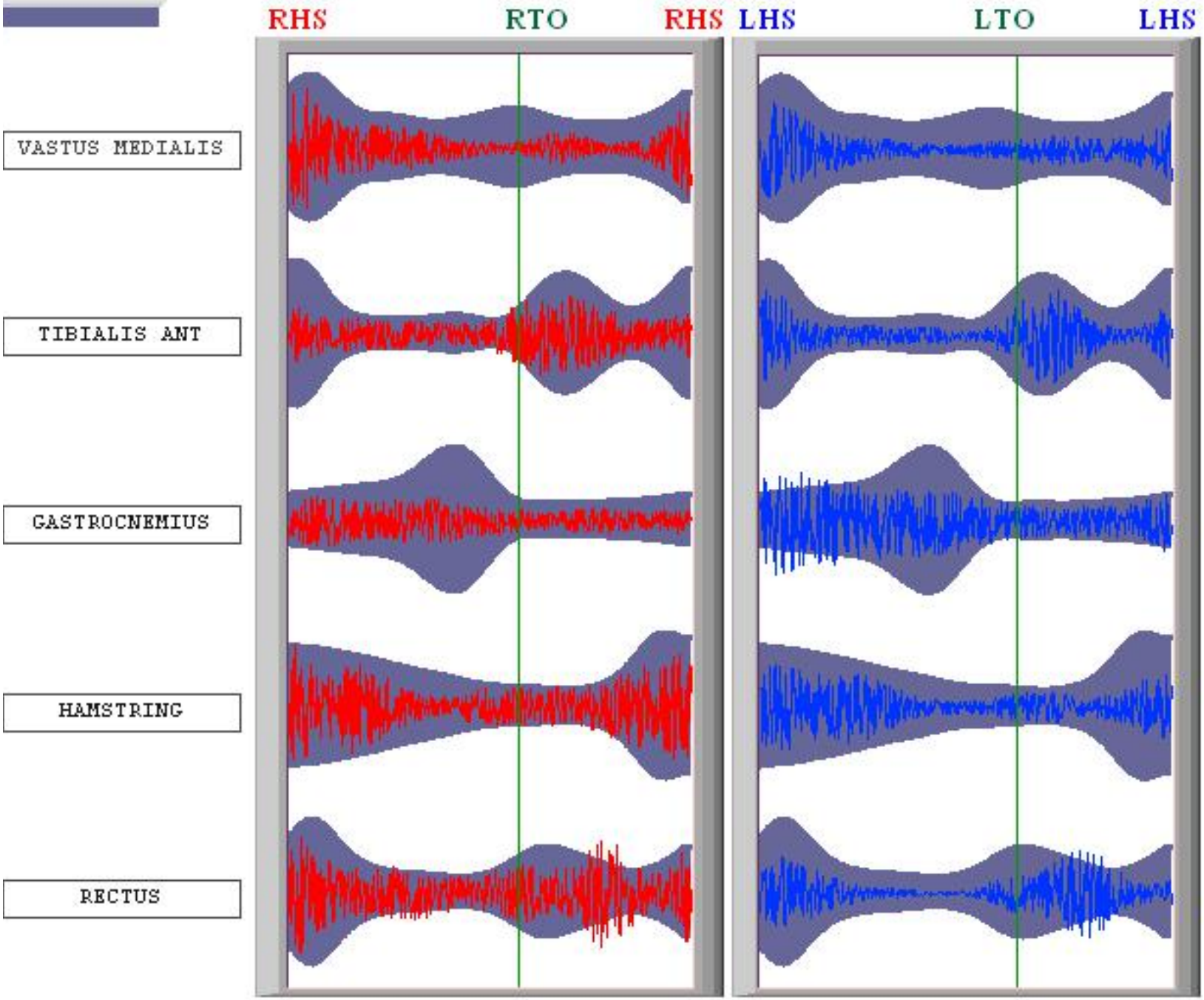

MotionAnalysis
Multiple Conditions Comparison
Patient Name: zhuyuyin
I.D. #
Test Date: 5/13/2014
Measure: Sagittal Joint Powers (Watts/kg)
Comment: Comparison Overlay
File Name: TRIMMED_WALK14.XLS
Norm File: 21.nrm
Condition Labels
4/8/2014
4/8/2014
5/13/2014
Right (RHS to RHS)
Left (LHS to LHS)
Data Properties by Condition
Ankle
Knee
Hip
Generation
Absorption
File (Solid) Rt Cycles Lt Cycles
TRIMMED_WAL 3 3
TRIMMED_WAL 2 2
TRIMMED_WAL 3 3
TRIMMED_WAL 2 3
File (Dashed) Rt Cycles Lt Cycles
TRIMMED_WAL 3 3
TRIMMED_WAL 2 3
TRIMMED_WAL 3 4
TRIMMED_WAL 4 3
File (Dotted) Rt Cycles Lt Cycles
TRIMMED_WAL 3 3
TRIMMED_WAL 3 3
TRIMMED_WAL 3 3
TRIMMED_WAL 3 3

动态肌电图

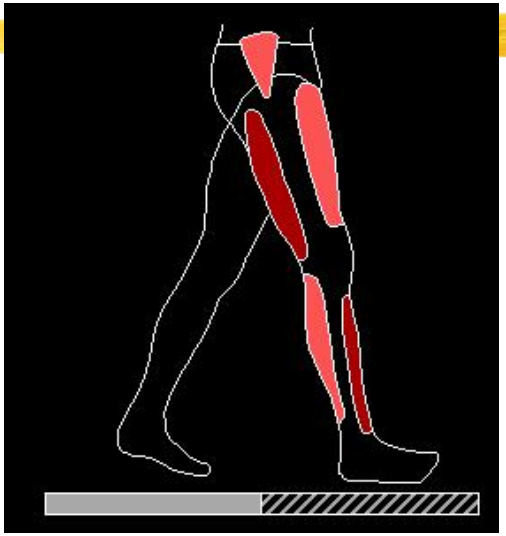
- 步态分析极端重要的组成部分
- 检测步行肘肌肉活动与步态关系
  - 痉挛
  - 无力
  - 挛缩

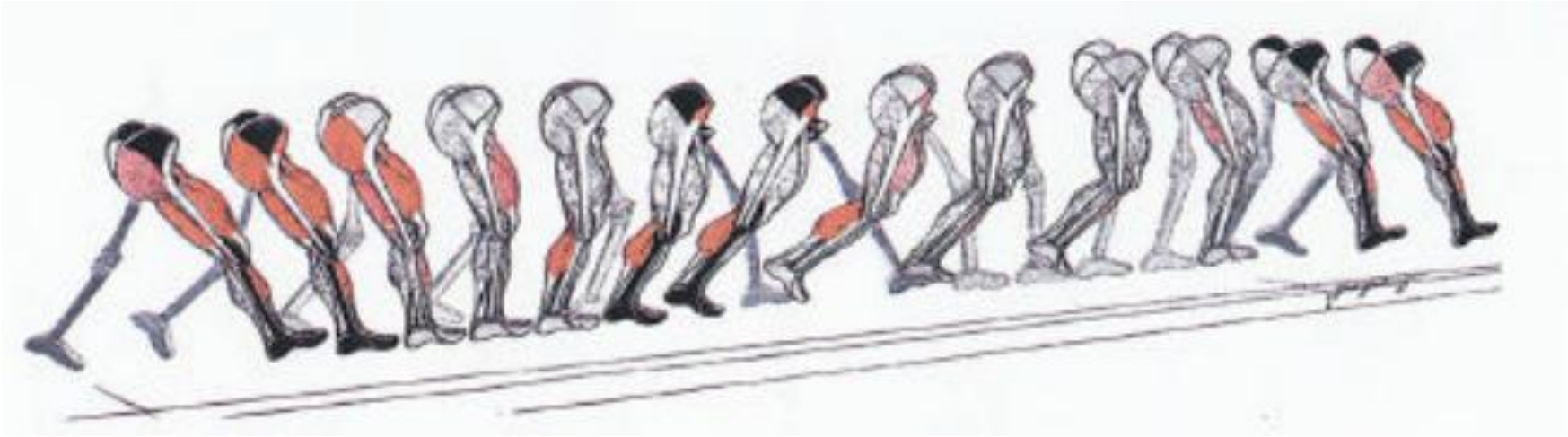


Normal Waveform

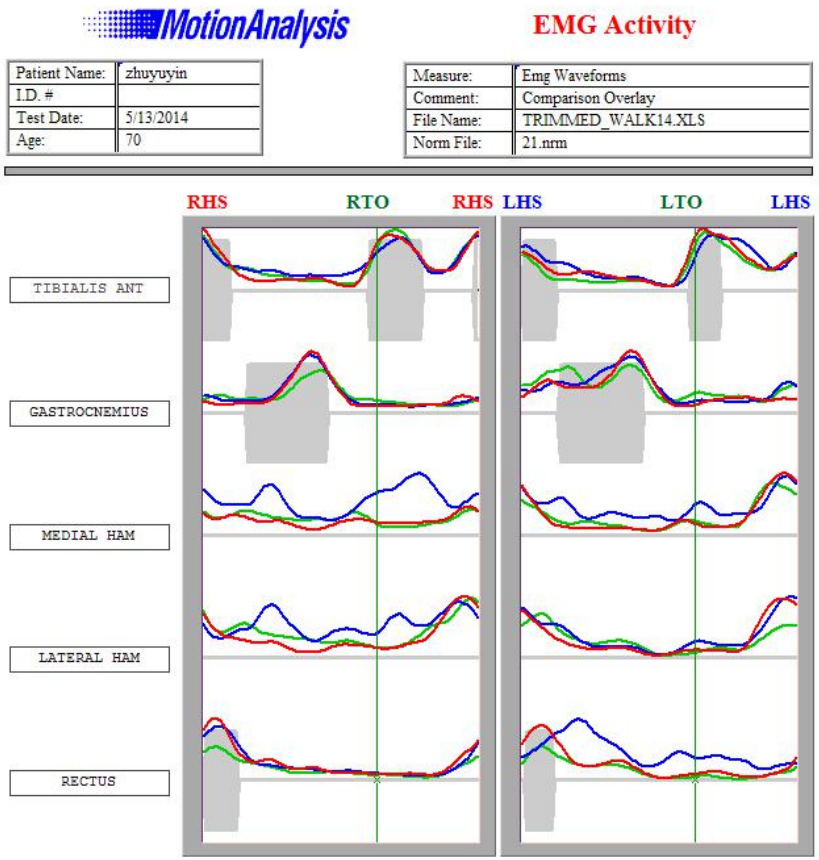


动态肌电图





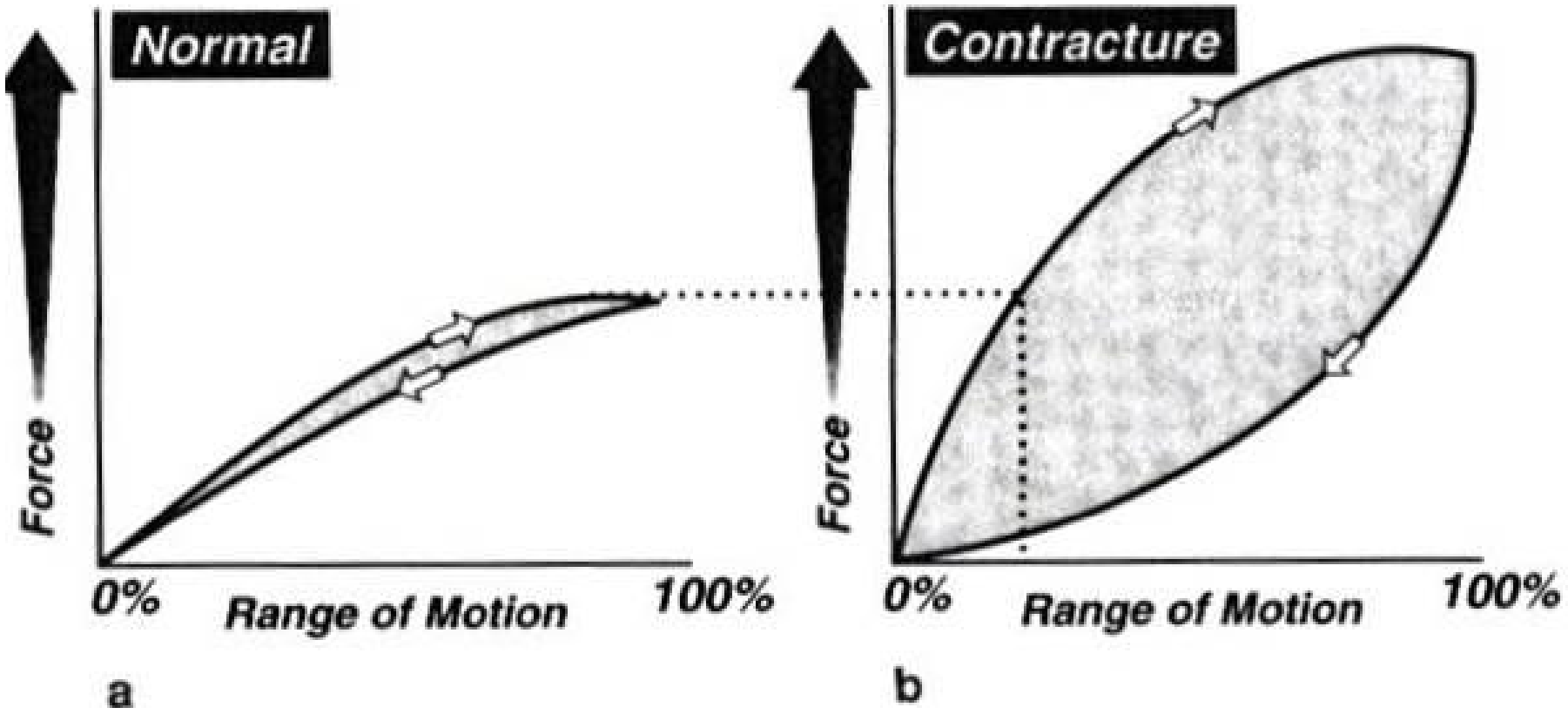
肌电图


MotionAnalysis
EMG Activity
Patient Name: zhuyuyin
I.D. #
Test Date: 5/13/2014
Age: 70
Measure: Emg Waveforms
Comment: Comparison Overlay
File Name: TRIMMED_WALK14.XLS
Norm File: 21.nrm
RHS
RTO
RHS
LHS
LTO
LHS
TIBIALIS ANT
GASTROCNEMIUS
MEDIAL HAM
LATERAL HAM
RECTUS

氧耗量

- 氧价（Oxygen Cost，OC）是一种定量评估运动能量消耗的指标
- 以运动时单位体重、单位距离消耗的氧气量来表示
- 单位为ml/(kg·m)
- OC = VO2 / Kg / meter
  - VO2（ml/min）

关节挛缩对步行能量消耗的影响



用药量减少后能量消耗评价

Derived Measure Summary

Pred. and Index based on K4 Data

	Actual	Pred	Index	Low Ind	Hi Ind
O2 Cost	0.308	0.176	1.834	-0.773	1.572
VO2 (Rest)	6.572	4.715	0.518	-1.895	2.018
VO2 (Walk)	21.343	13.280	1.532	-1.457	2.308

1.834

Derived Measure Summary

Pred. and Index based on K4 Data

	Actual	Pred	Index	Low Ind	Hi Ind
O2 Cost	0.256	0.185	0.997	-0.773	1.572
VO2 (Rest)	4.675	4.984	-0.086	-1.895	2.018
VO2 (Walk)	17.701	13.619	0.776	-1.457	2.308

0.997

Derived Measure Summary

Pred. and Index based on K4 Data

	Actual	Pred	Index	Low Ind	Hi Ind
O2 Cost	0.412	0.245	2.329	-0.773	1.572
VO2 (Rest)	8.146	6.914	0.343	-1.895	2.018
VO2 (Walk)	24.922	16.052	1.685	-1.457	2.308

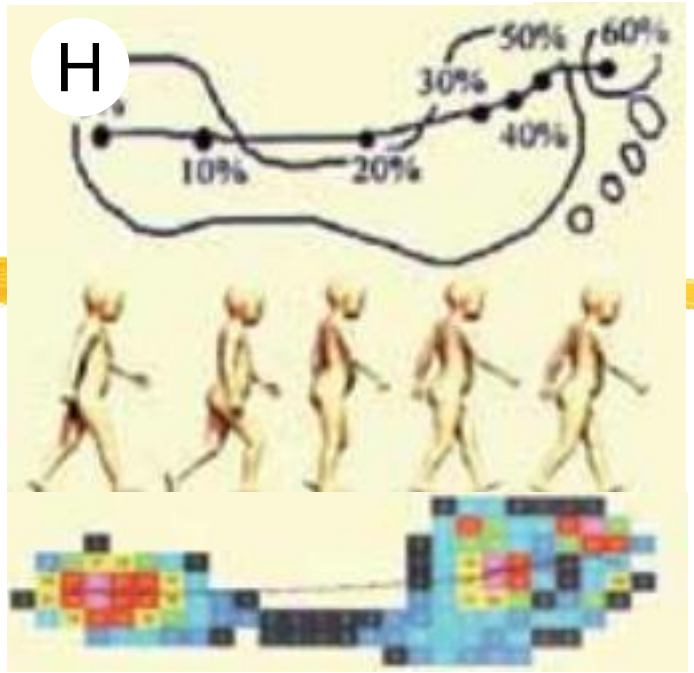
2.329

2011.6 巴氯酚剂量减少后

2011.12 骨科手术3年后

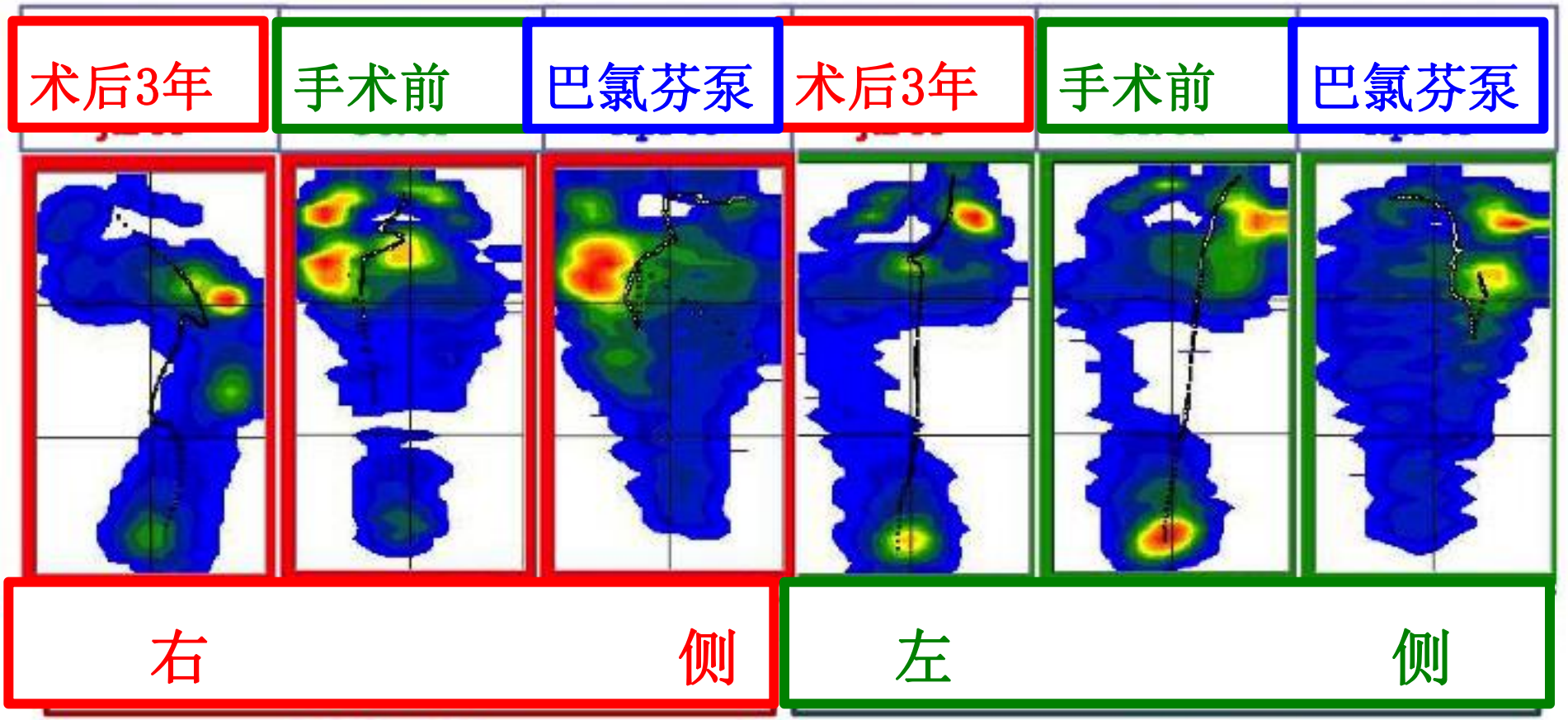
2007.10 骨科手术前巴氯酚应用后

足底压力

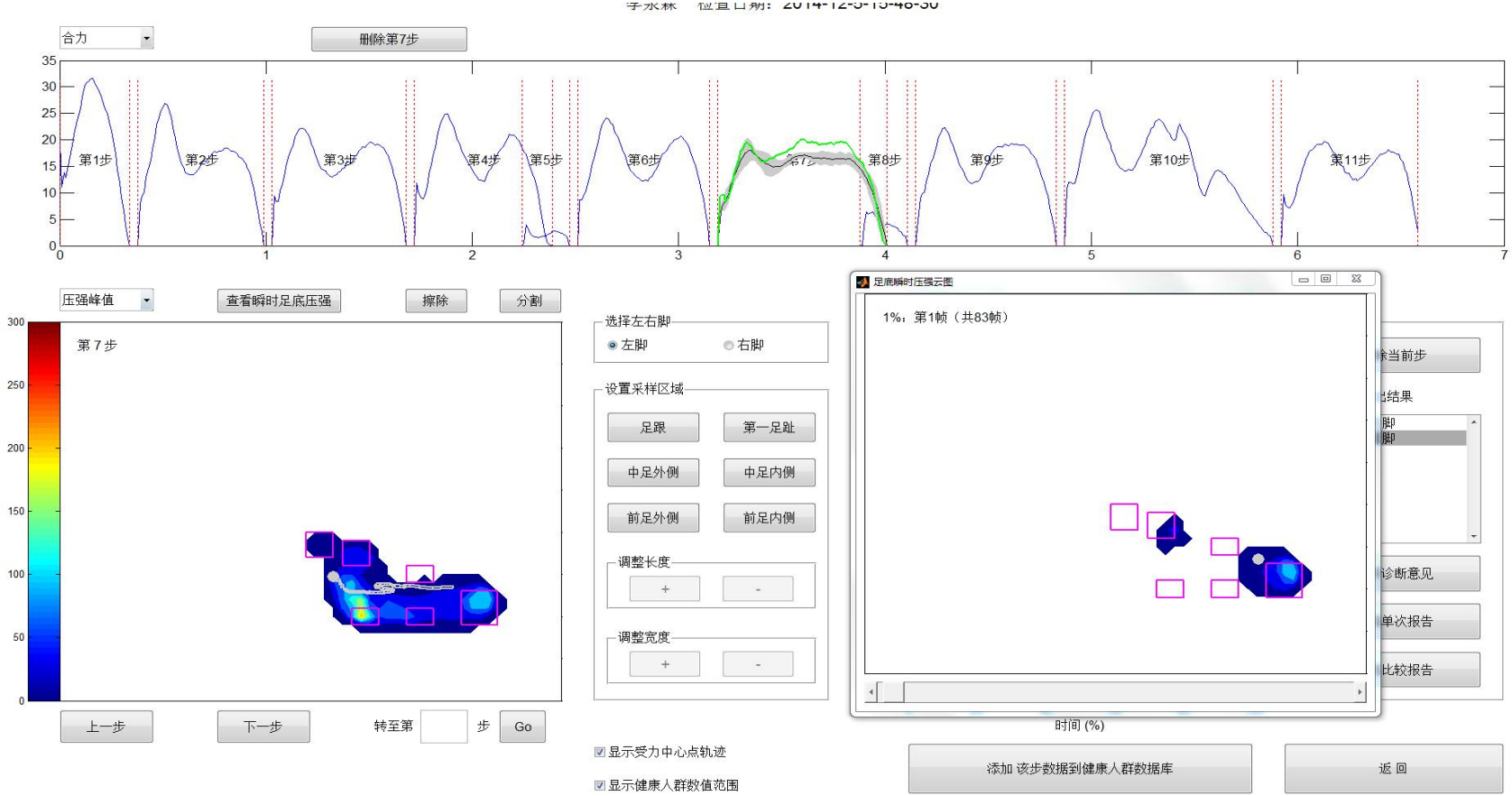


- 静止状态
  - 足压力分布
  - 足接触面积
- 步行时
  - 足底压力分布、接触面积、时间关系
  - 重心移动轨迹

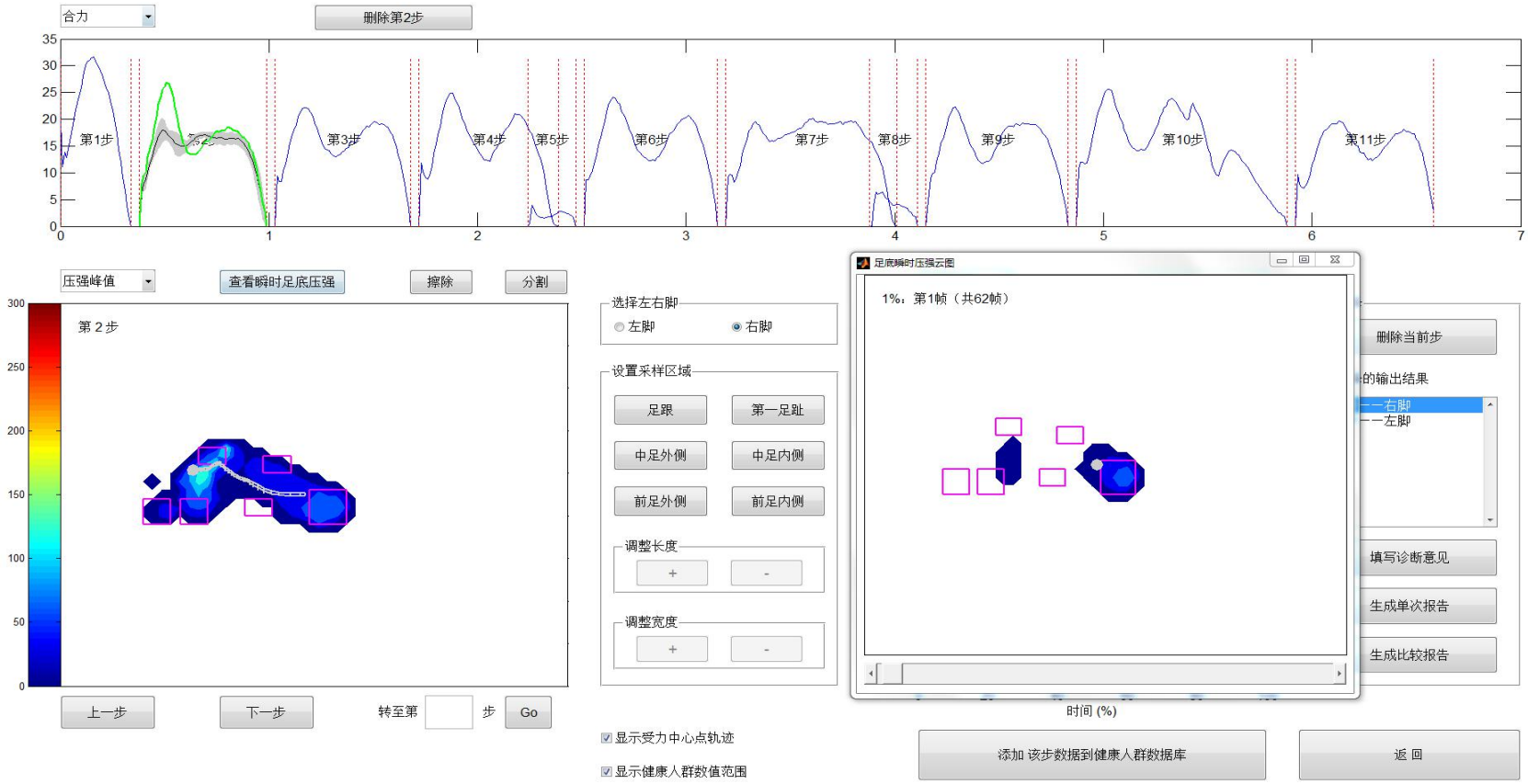
骨科手术3年后 / 手术前 / 巴氯芬泵治疗前



非足跟着地模式


合力
删除第7步
第1步
第2步
第3步
第4步
第5步
第6步
第7步
第8步
第9步
第10步
第11步
压强峰值
查看瞬时足底压强
擦除
分割
第 7 步
选择左右脚
左脚
右脚
设置采样区域
足跟
第一足趾
中足外侧
中足内侧
前足外侧
前足内侧
调整长度
调整宽度
上一步
下一步
转至第
步
Go
显示受力中心点轨迹
显示健康人群数值范围
足底瞬时压强云图
1%：第1帧（共83帧）
时间 (%)
添加 该步数据到健康人群数据库
返 回

非足跟着地模式


合力
删除第2步
第1步
第3步
第4步
第5步
第6步
第7步
第8步
第9步
第10步
第11步
压强峰值
查看瞬时足底压强
擦除
分割
第 2 步
上一步
下一步
转至第
步
Go
选择左右脚
左脚
右脚
设置采样区域
足跟
第一足趾
中足外侧
中足内侧
前足外侧
前足内侧
调整长度
调整宽度
显示受力中心点轨迹
显示健康人群数值范围
足底瞬时压强云图
1%：第1帧（共62帧）
时间 (%)
删除当前步
的输出结果
右脚
左脚
填写诊断意见
生成单次报告
生成比较报告
添加 该步数据到健康人群数据库
返 回

评估：重心偏移及平衡控制能力