QUALITY FOR LIFE

Alignment:
Relation between statics and clinical outcome

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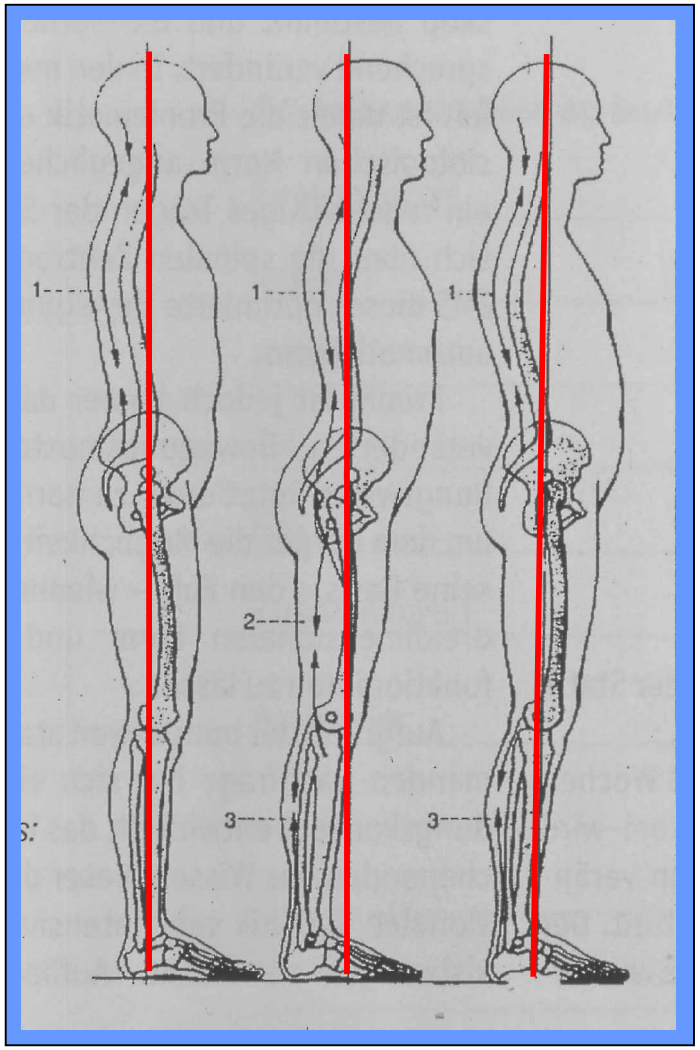
Why is static important

Correct Static

-

Foundation for proper Fitting

Literature



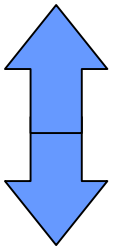
Physiological standing

Center of gravity at
normal foot (left)
hyper active foot (middle)
weak foot (right)

L. Aich:
Orthopädieschuh-
technik 7/8 2001 S.31

Problem

forces and moments are not visible with the naked eye

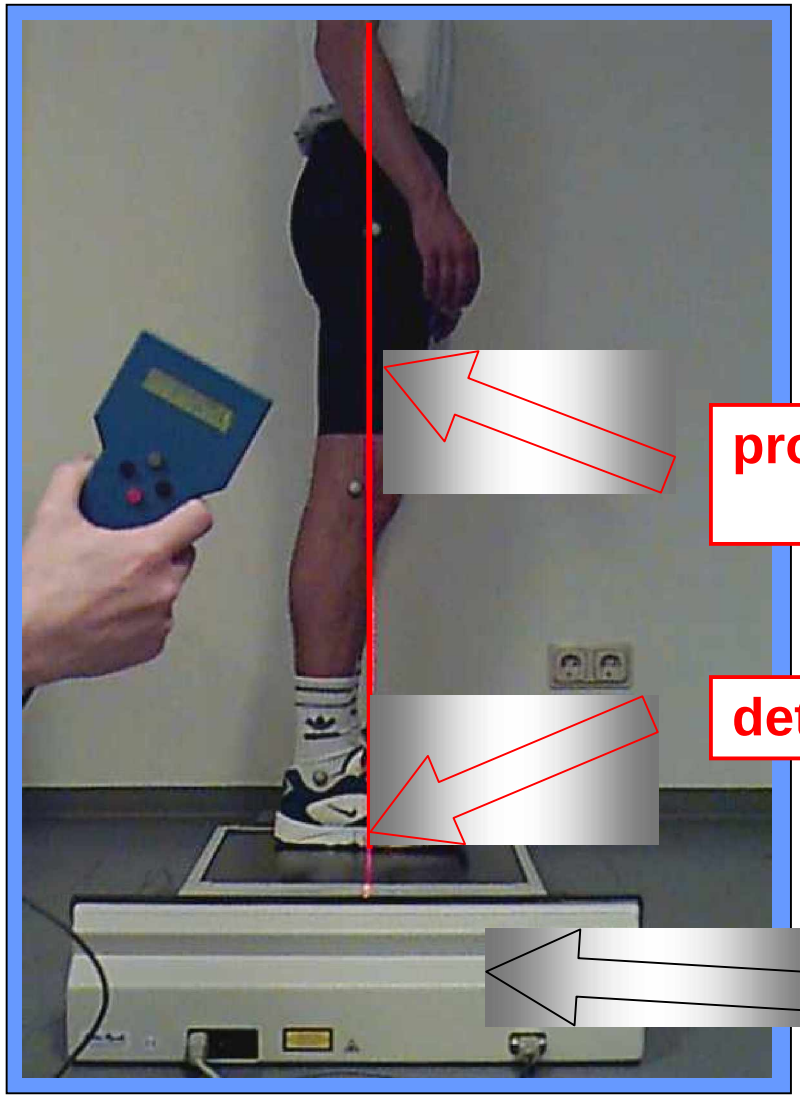


forces and moments determine the mechanical function

Alignment system L.A.S.A.R.* Posture

* Laser assisted static alignment reference

L.A.S.A.R. Posture



Main function

projects ground reaction force (vertical component)

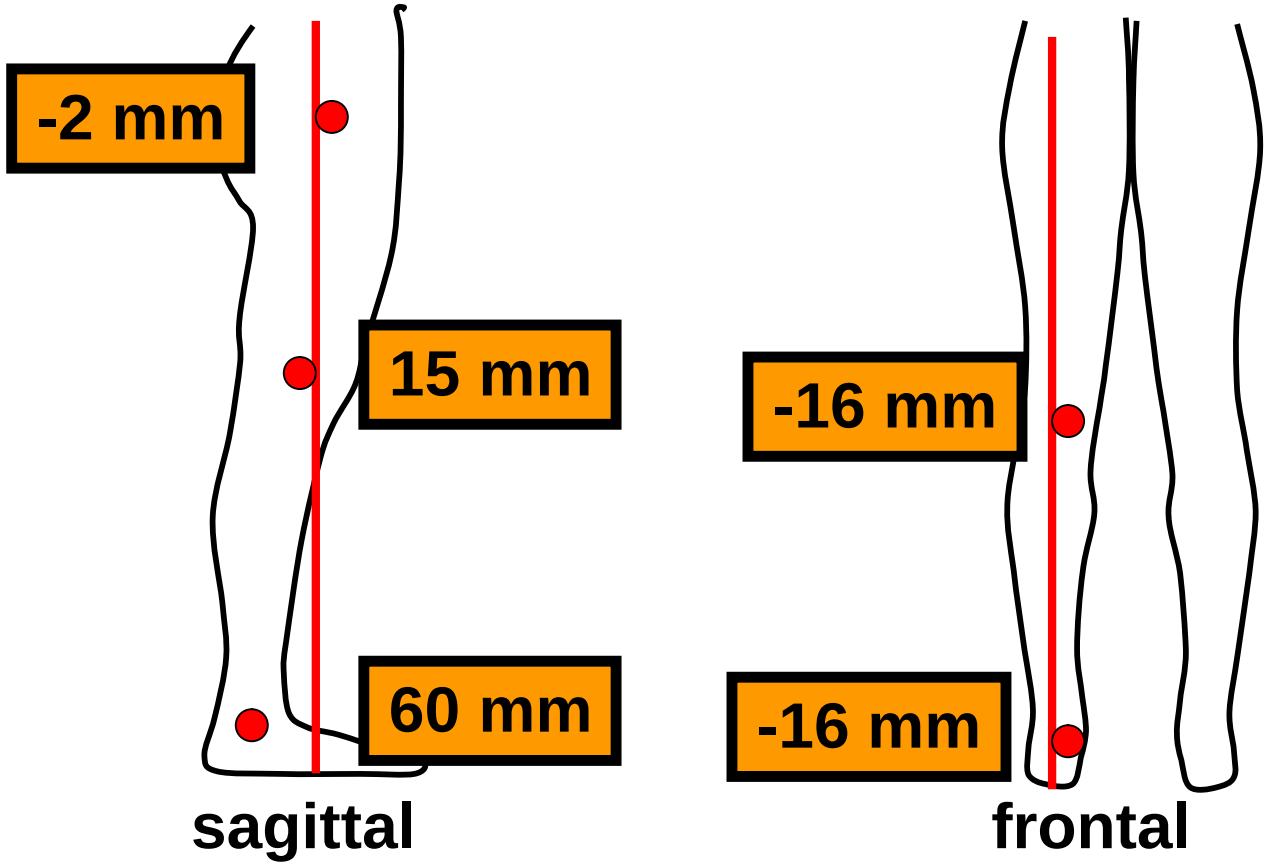
determines force application point

L.A.S.A.R. Posture

Static standing

static standing

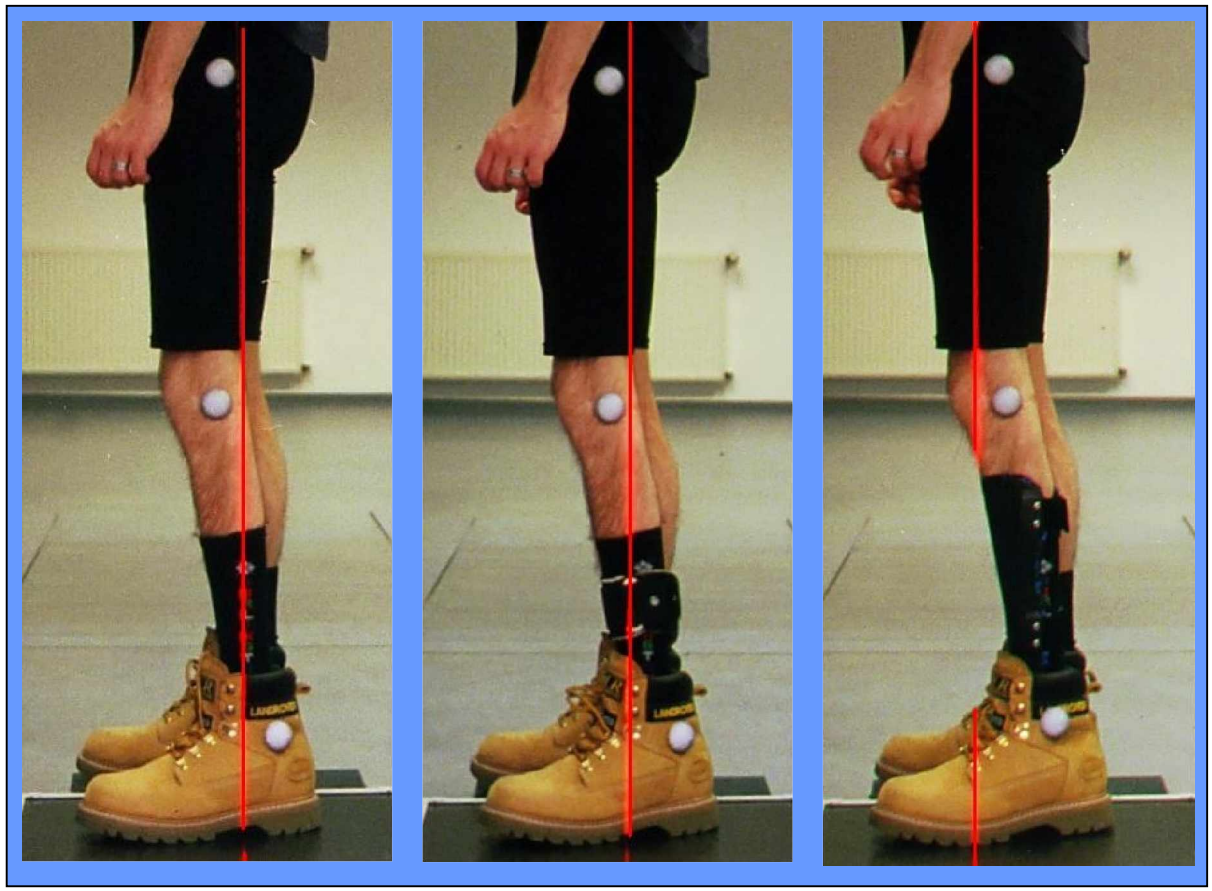
140 normal subjects



Orthotic fitting

Examples Orthotics

Lesion of N.ischiadicus



Example

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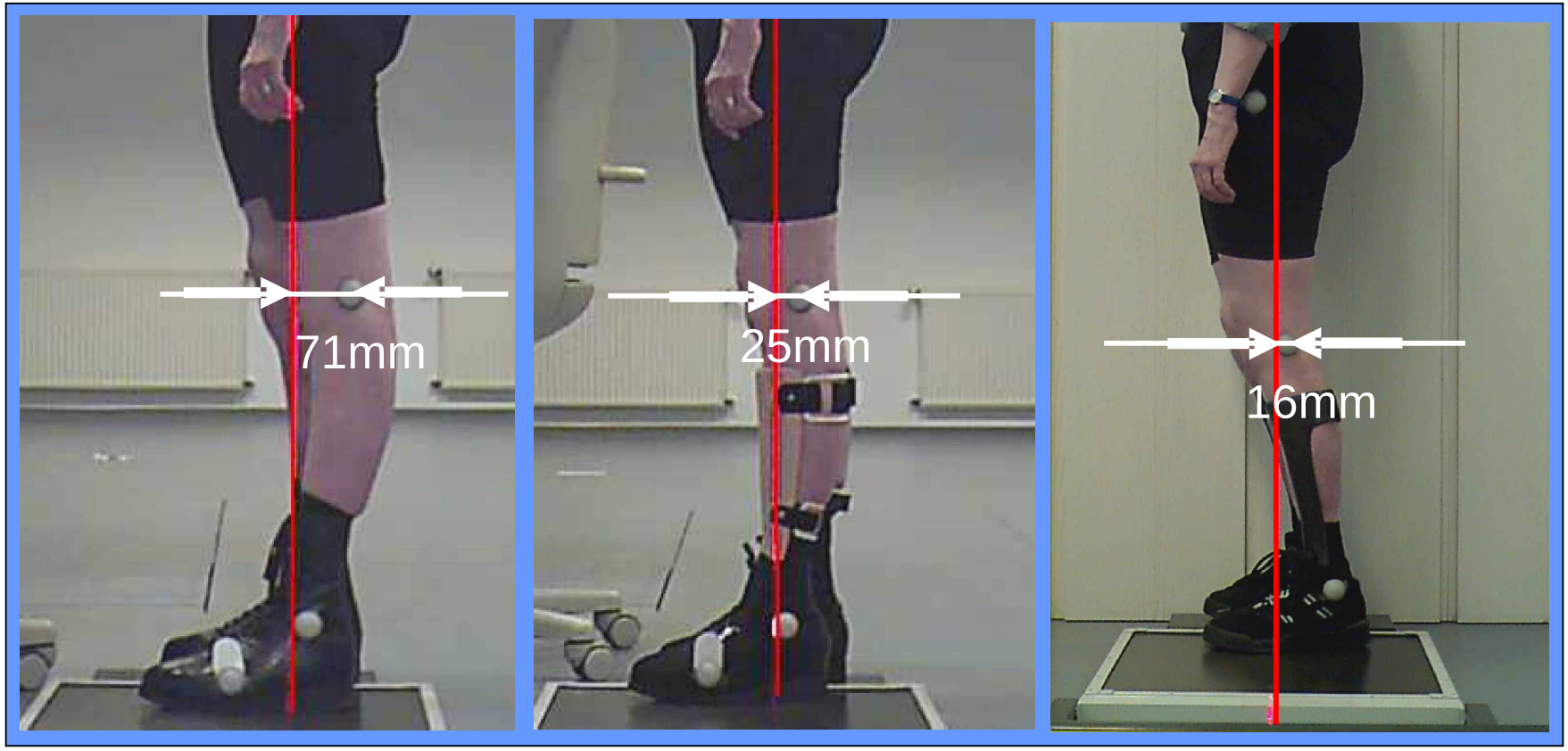
Neural muscle atrophy



Transtibial amputee

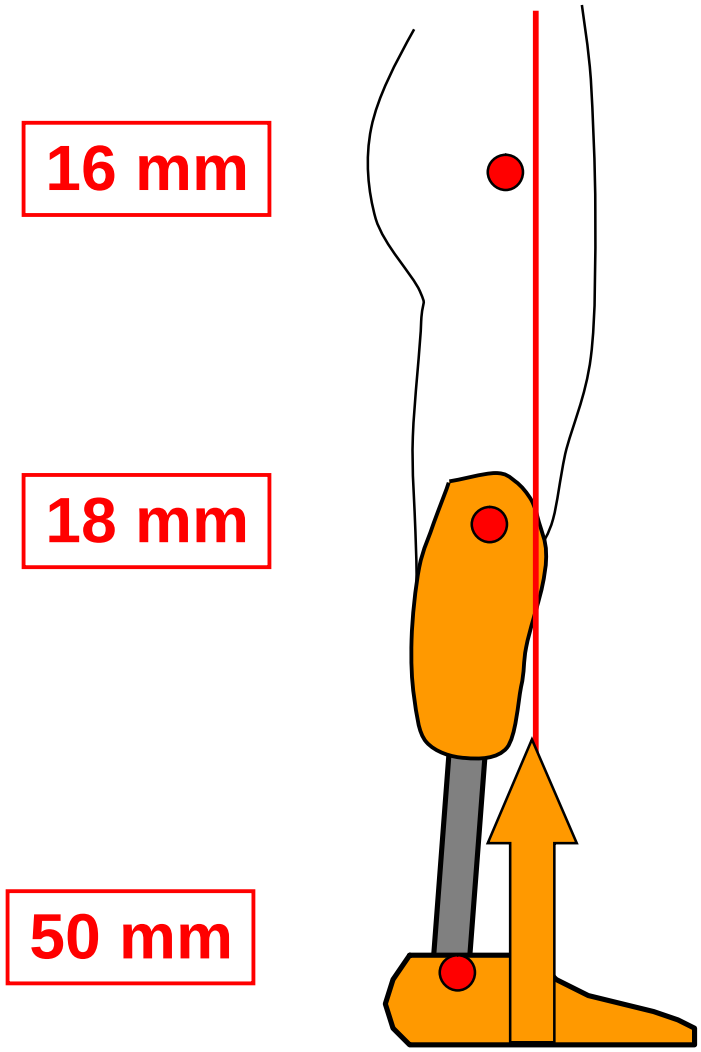
Physiological knee function

Transtibial amputees

Influencing parameters

- è **properties of prosthetic foot**
- è **prosthetic alignment**

Alignment transtibial amputee



Static standing
18 TT amputees

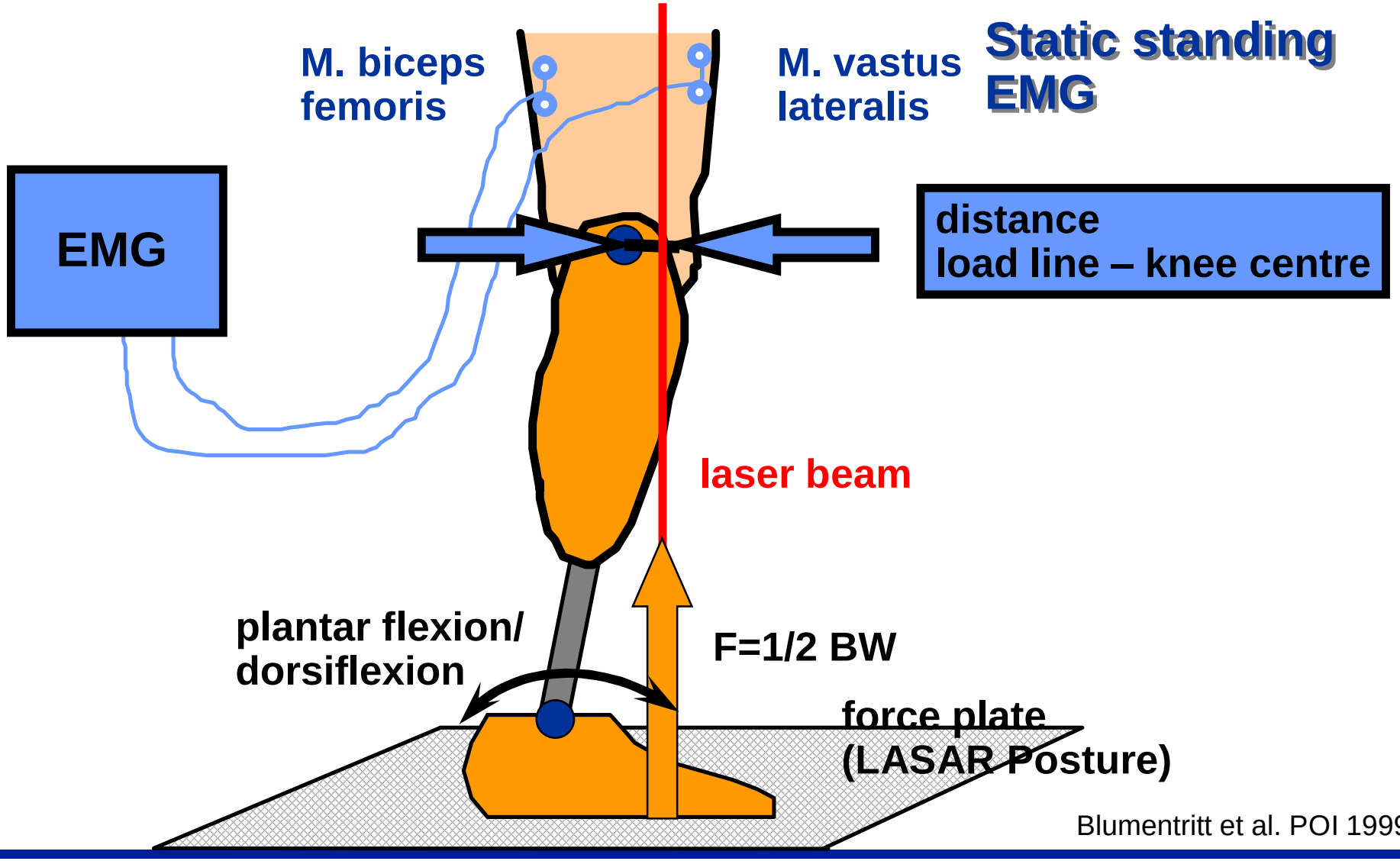
definitive prosthesis
è at least for half a year

distance knee centre to load line
è mean 18 mm

distance knee centre to load line
è independent of foot type

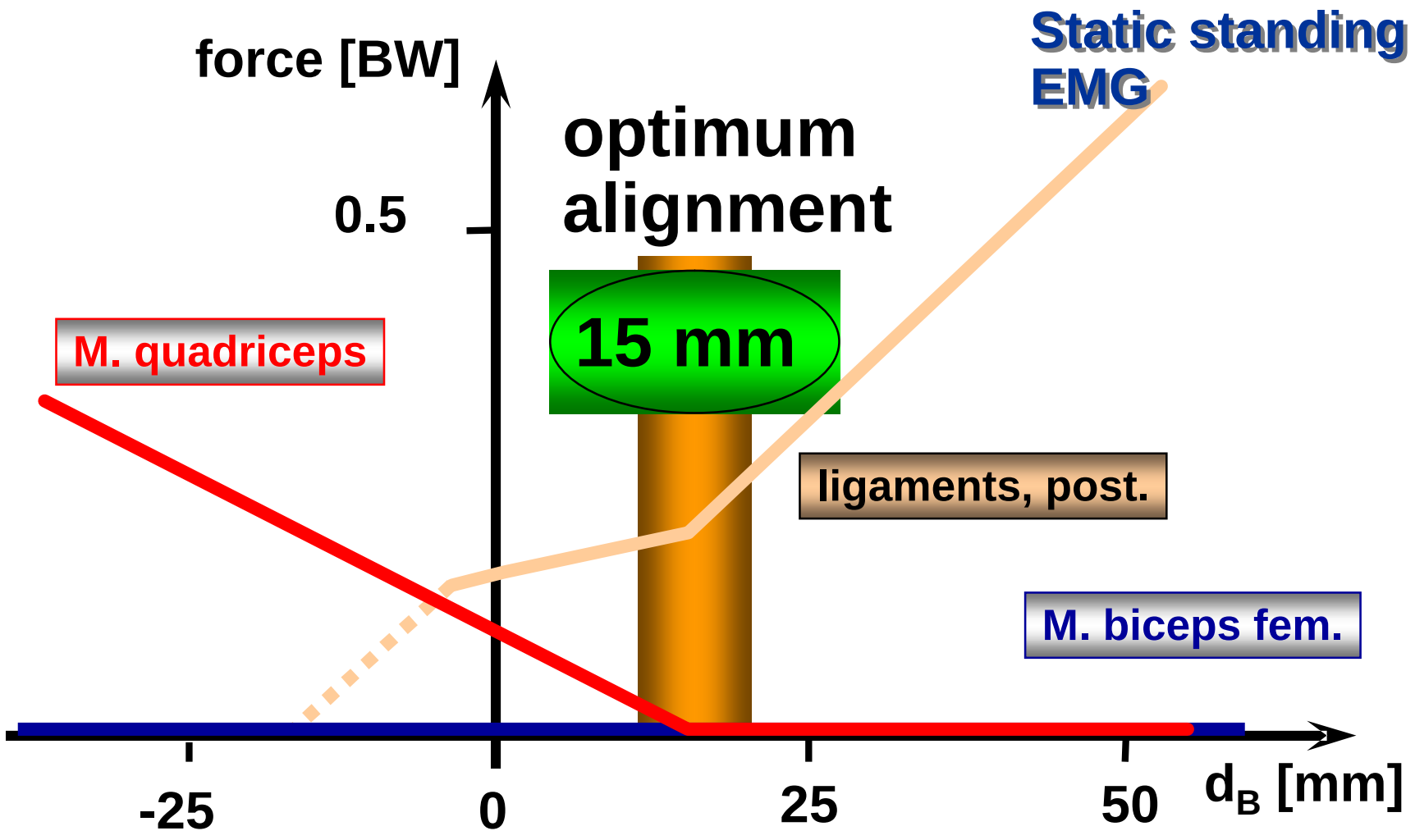
Blumentritt et al. POI 1997

Alignment transtibial amputee



Blumentritt et al. POI 1999

Alignment transtibial amputee



Blumentritt et al. POI 1999

Alignment transtibial amputee

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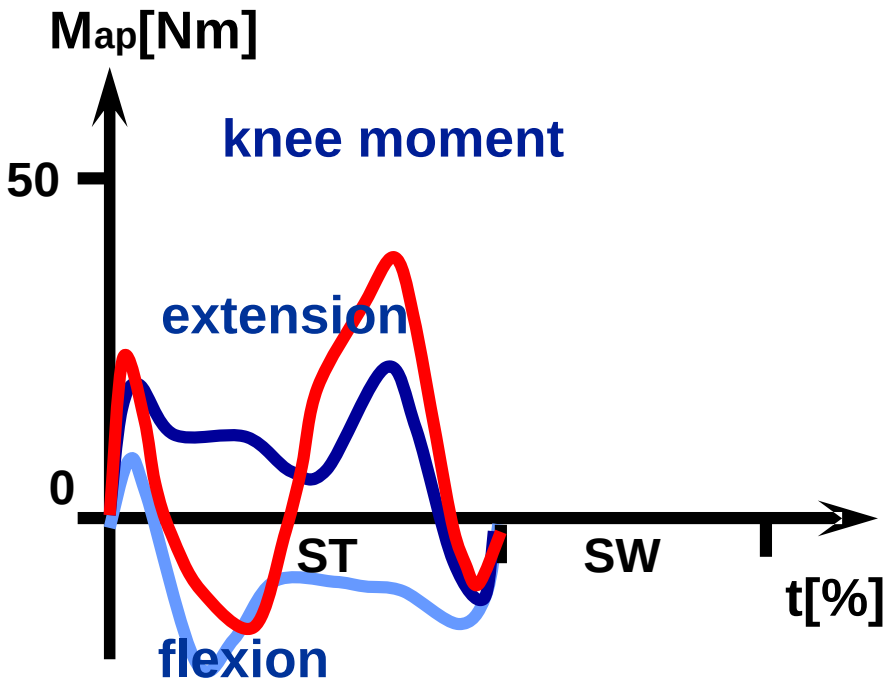
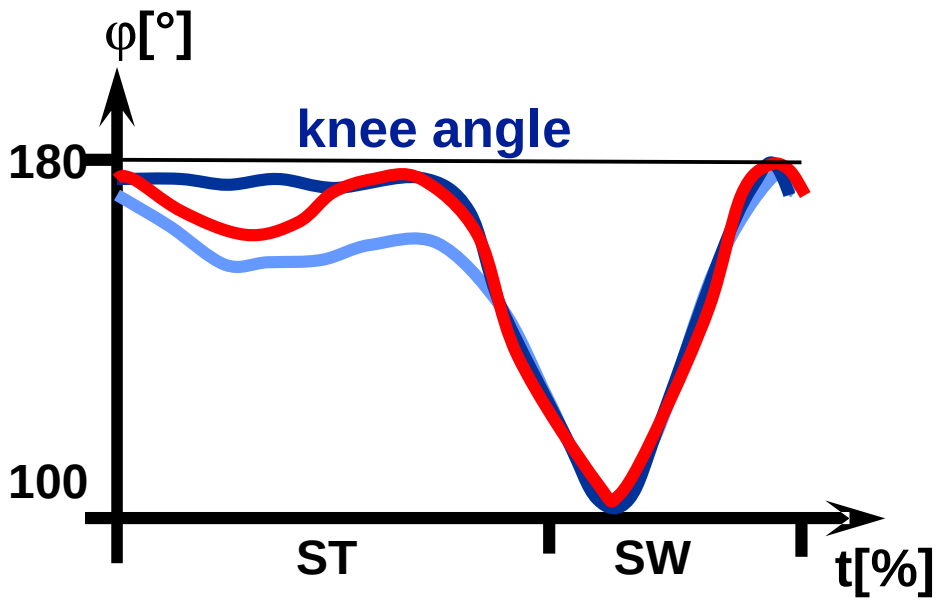
knee moment
è the knee motion

Gait analysis
13 TT amputees



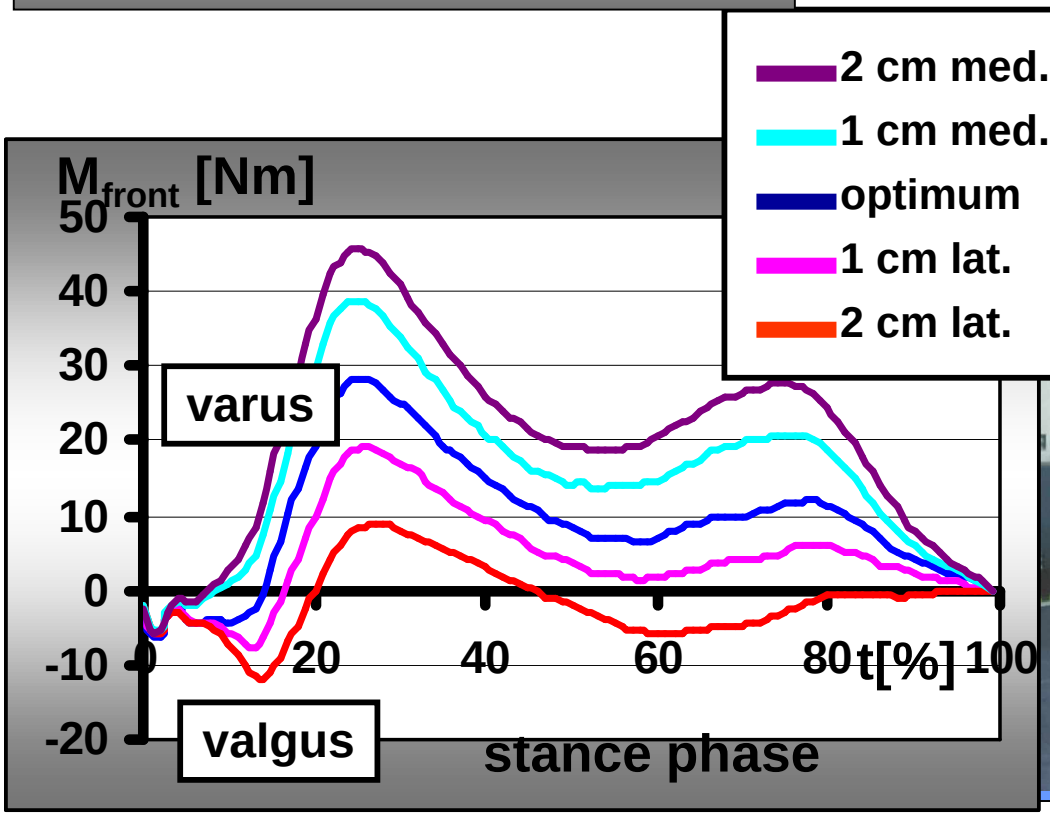


Blumentritt et al. Orthopäde 2001

Alignment transtibial amputee

m-l foot position

è knee varus moment



Gait analysis
6 TT amputees

Blumentritt et al. Orthopäde 2001

Alignment transtibial amputee

Gait analysis
7 TT amputees

static alignment

è **knee moment, knee motion, muscle activity**

a-p foot position

è **stance flexion angle**

plantar flexion angle

è **start time for stance extension**

m-l foot position

è **knee varus moment**

Blumentritt et al. Orthopäde 2001

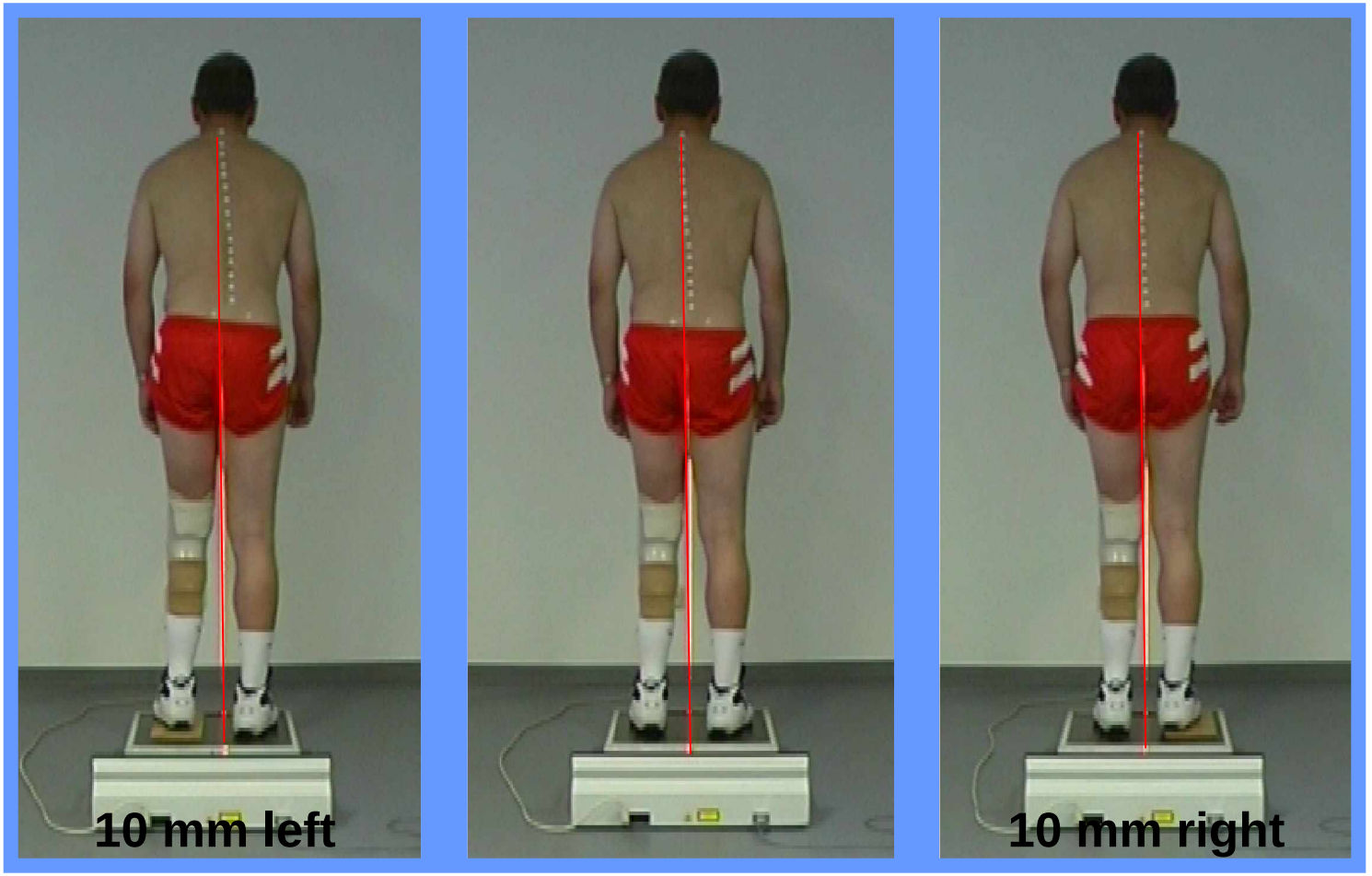
Alignment transtibial amputee

Effective use LASAR Posture

- **Frontal plane**
  - 1. prosthesis length
- **Transversal plane**
  - 2. outside rotation
- **Sagittal plane**
  - 3. plantar flexion
- **Frontal plane**
  - 4. foot position
  - 5. eversion/inversion
- **Sagittal plane**
  - 6. foot position

Alignment transtibial amputee

Prosthesis length



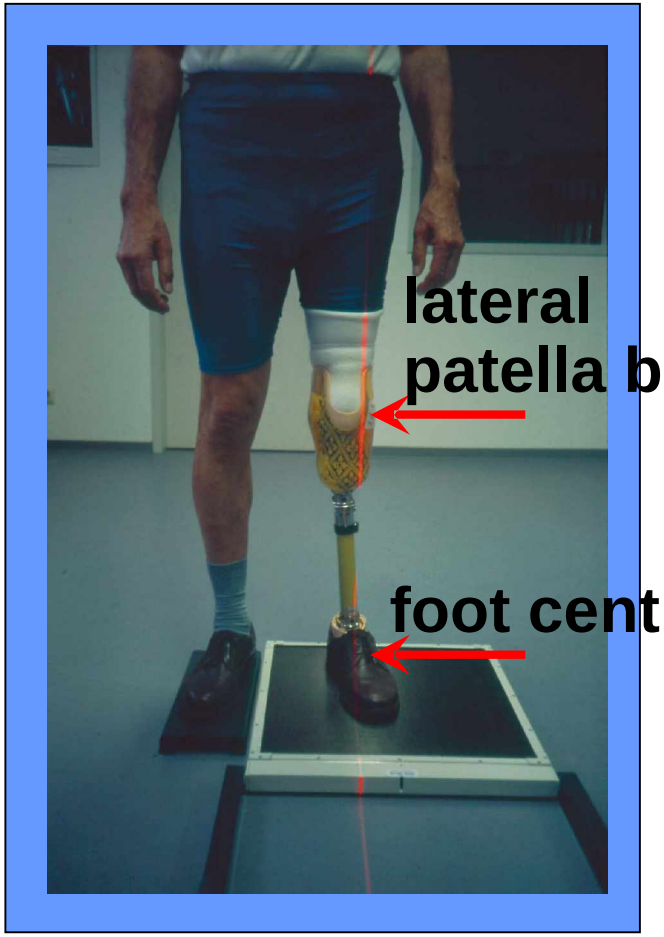
Alignment transtibial amputee

Plantar flexion

LASAR Posture

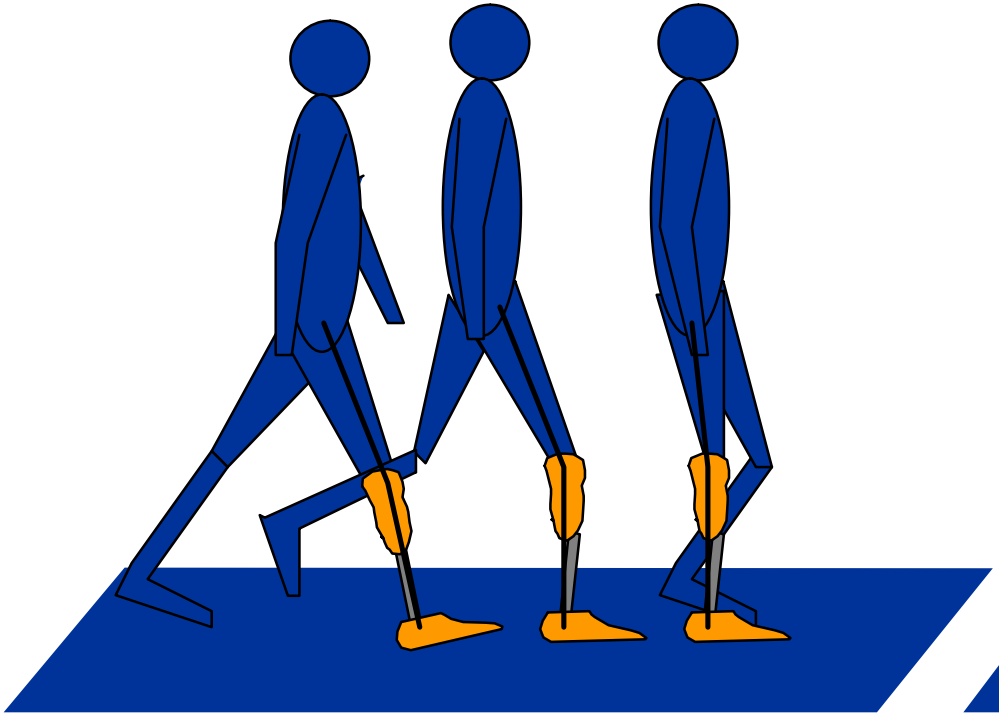
Alignment transtibial amputee

m-l foot position, eversion/inversion

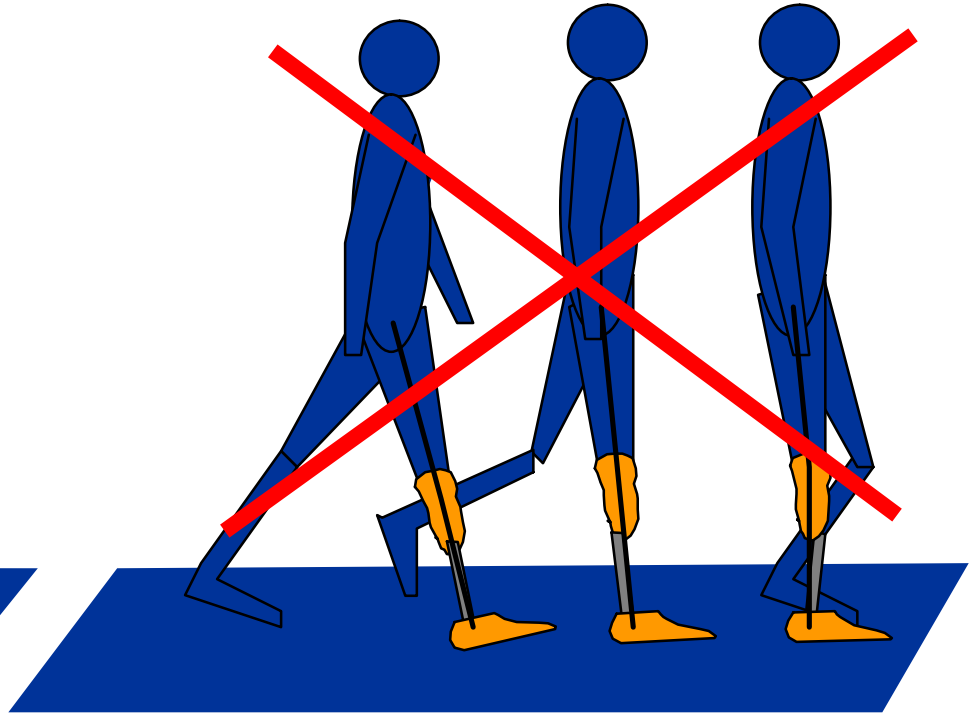


Alignment transtibial amputee

a-p foot position

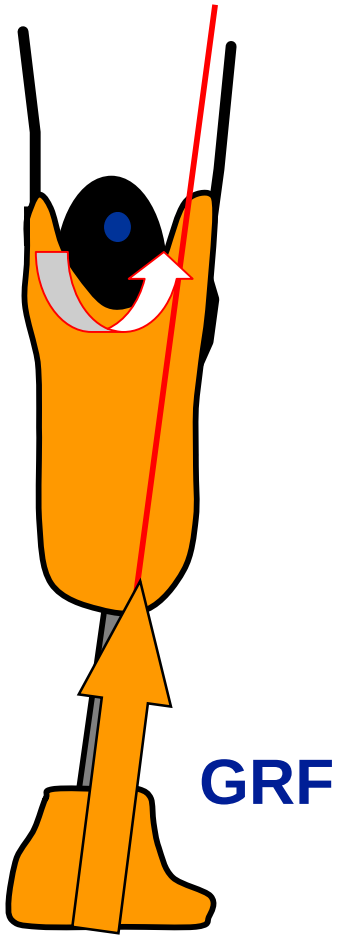


knee flexion at loading response



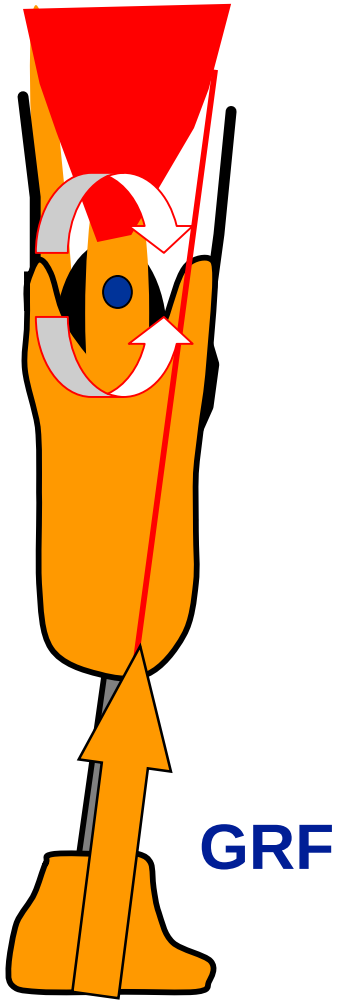
avoid knee extension, or hyperextension

Alignment transtibial amputee



GRF causes varus moment

Alignment transtibial amputee



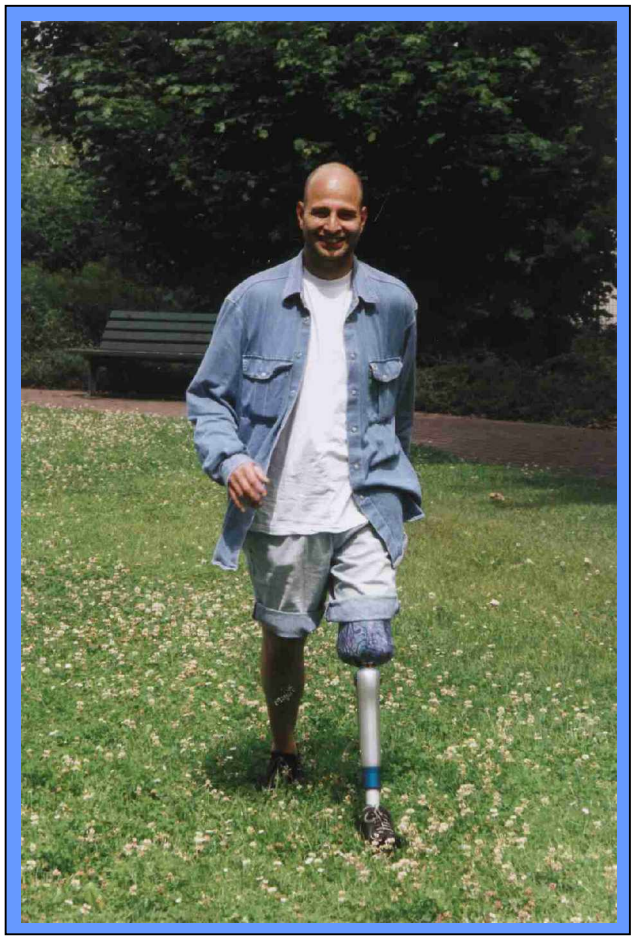
GRF causes varus moment

balanced by the moment of
M. Quadiceps and
tractus iliotibialis

Transfemoral amputee

Safe knee function

Transfemoral amputee



influencing parameters

- è **stump motor activity**
- è **properties of prosthetic parts (knee and foot)**
- è **prosthetic alignment**

Alignment transfemoral amputee

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History

until 1920	**less systematic**
1919	**plumb alignment, contralateral anatomy (Schede, Görlach)**

è **alignment based on anatomy unsuccessful**

1928	**plumb alignment, load stool (Görlach)**
1934	**alignment by balancing (Franke)**

è **frontal alignment good, sagittal unsuccessful**

1969	**pyramid system, modular prosthesis (Glabiszewski, Näder)**

è **dynamic alignment possible, high variability**

1997	**LASAR Posture, load line (Blumentritt)**

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Literature

Question: How variable is prosthetic alignment ?

Methods: 10 Bk amputees
10 Ak amputees
quadrilateral socket, monocentr. knee, SACH,
3 CPOs aligned the prosthesis several times
by subjective optimization

Results: wide range of alignment,
e.g. range of socket flexion 17 degrees,
socket shift relating to the foot 148 mm
alignment is specific to each CPO

Zahedi et al. 1986

Alignment transfemoral amputee

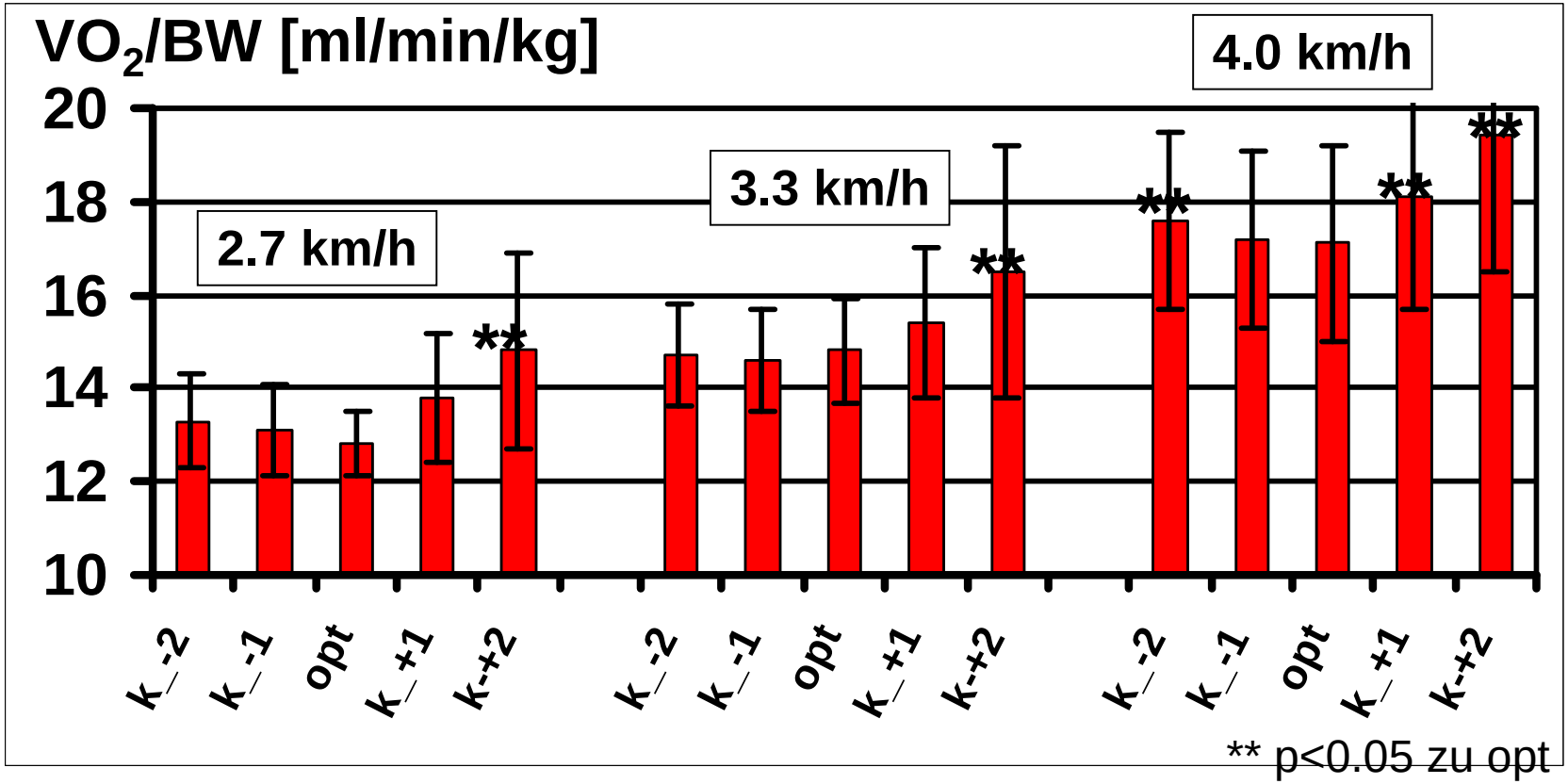
Energy consumption

knee position

gait analysis

Alignment transfemoral amputee

Energy consumption



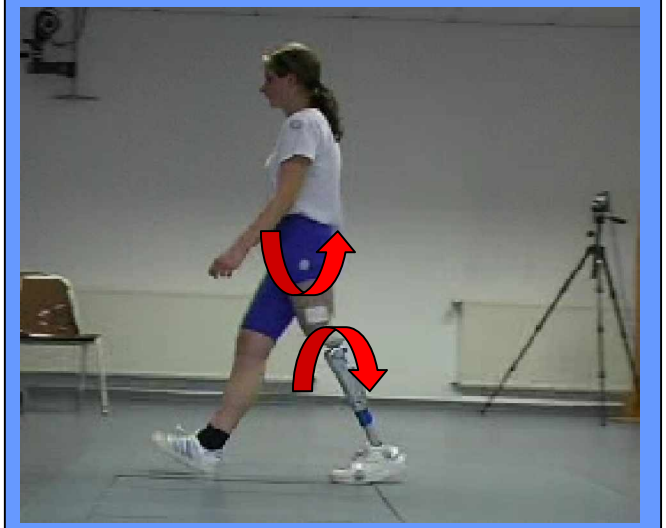
Schmalz et al. Gait Posture 2002

Alignment transfemoral amputee

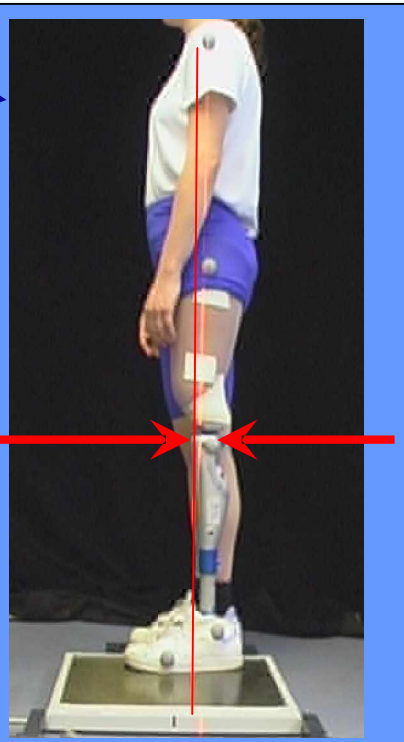
Study design

assembly

3. subjective assessment



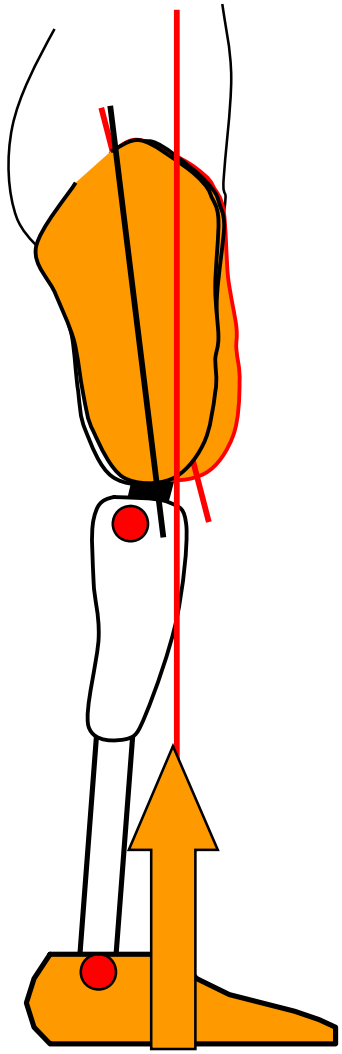
1. gait analysis



2. statics/standing

Alignment transfemoral amputee

Socket flexion

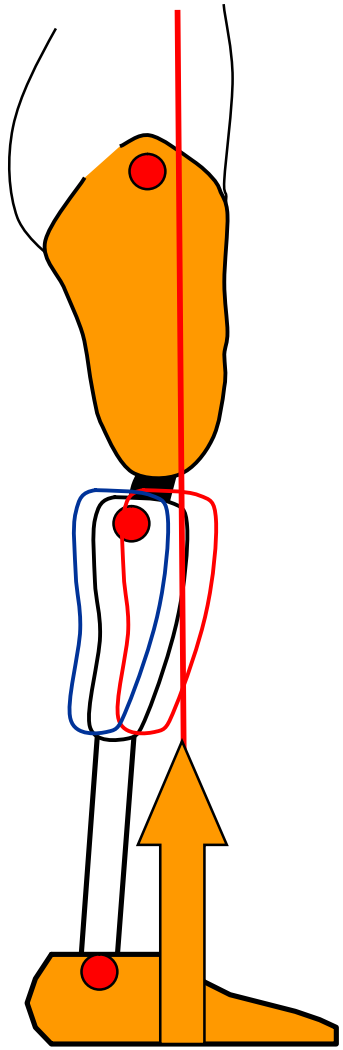


- **fitting experience**
  flexion angle 3 - 5 degree

- **if hip extension is insufficient, additional socket flexion of 5 - 10 degree referring to contracture,**
  depends on expected step length

Alignment transfemoral amputee

Sagittal knee position

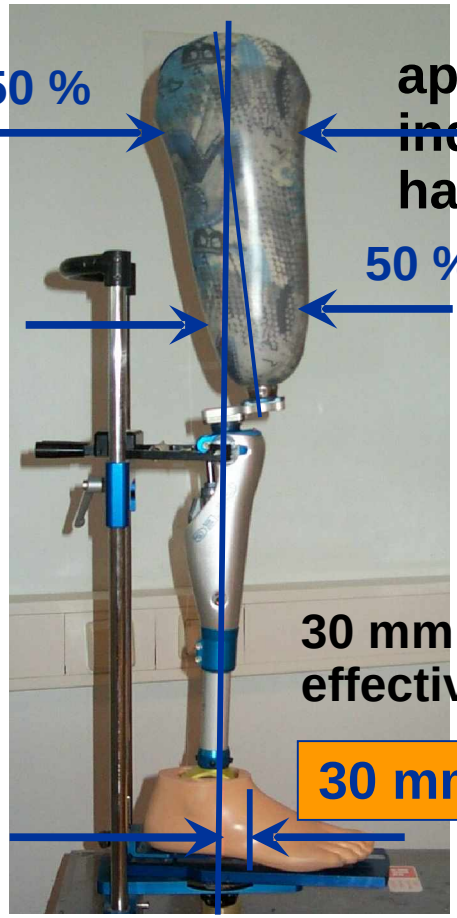


optimum

- stance phase safety
- initiation of swing phase

è **depends on knee mechanism**

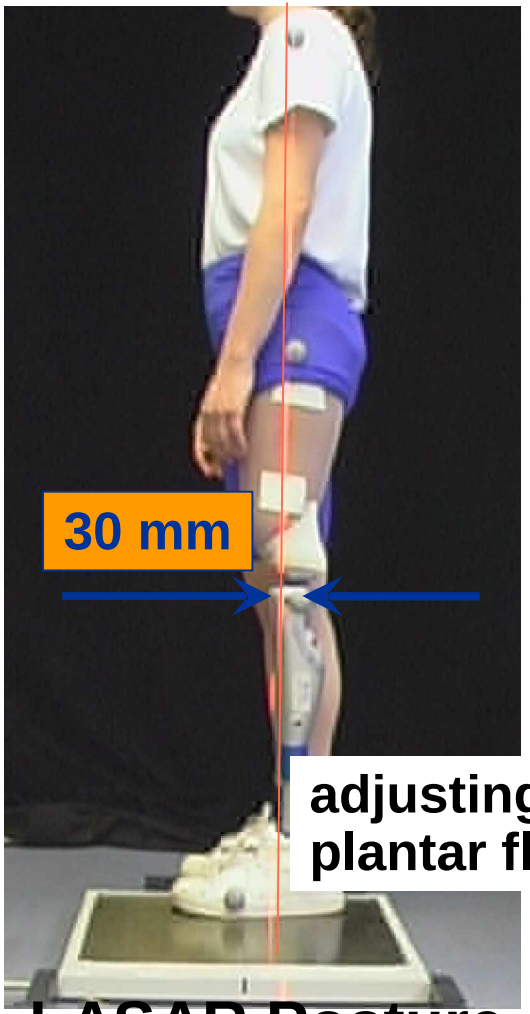
Prosthetic alignment - recommendation



approx. 4° flexion,
individual situation
has to be considered

30 mm anterior,
effective heel height + 5 mm

1. sagittal assembly

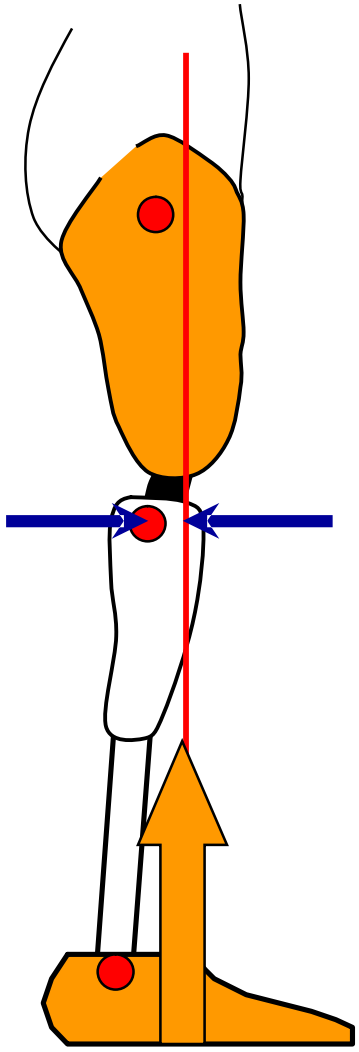


adjusting
plantar flexion

2. LASAR Posture

Prosthetic alignment - recommendation

distance depends on knee mechanism



Knee distance

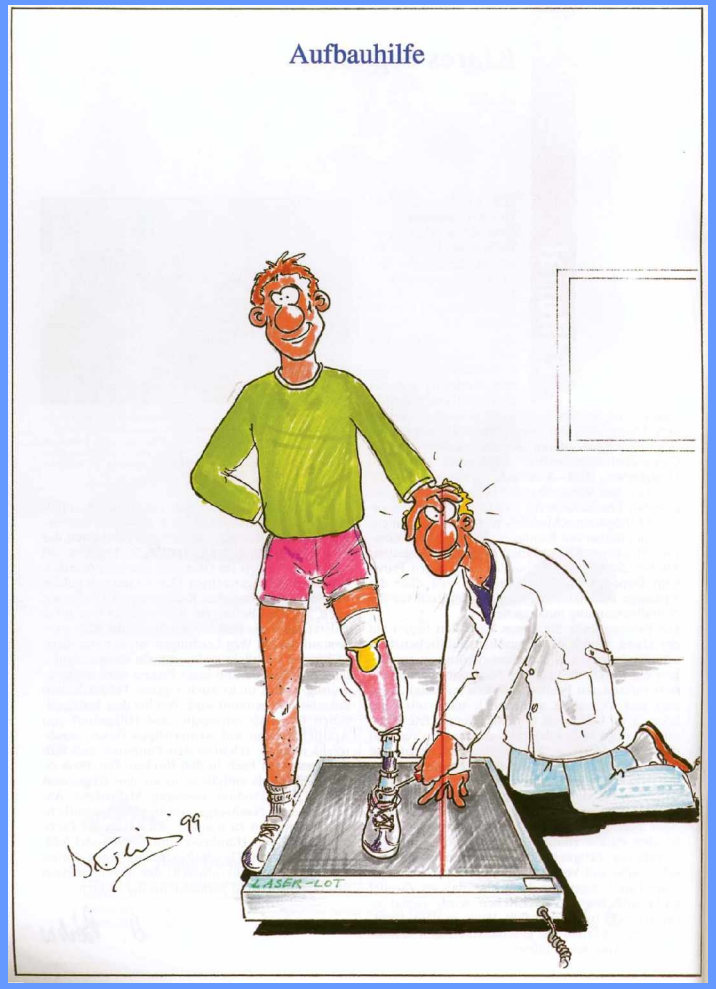
3R40/41	**45 mm**
3R15/49	**40 mm**
3R90/92	**40 mm**
3R95	**45 mm**
3R60	**10* mm**
3R20/36	**35 mm**
3R106	**35 mm**
3R80	**35 mm**
C-**Leg**	**30 mm**

Why is static important

Correct Static

-

Foundation for proper Fitting



Thank you !

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