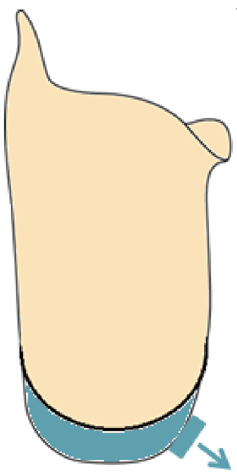
Principles For Socket Design After Transfemoral Amputations

Quality for life

Agenda

General principles of TF - prosthetic sockets

Suction Socket

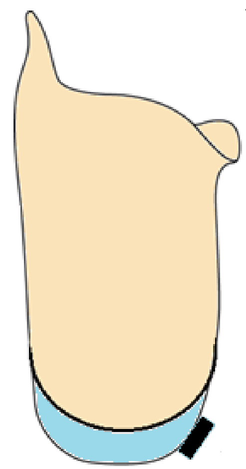


Excess pressure exhausts through expulsion valve

Adherence by vacuum

CAUTION:
Risk of Edemas

„Adhesion" Socket



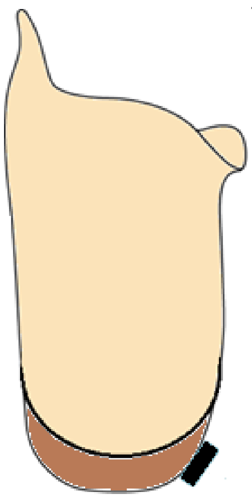
Excess pressure exhausts through manual expulsion valve

Adherence by *reduced* vacuum

CAUTION:
Risk of Edemas

General Principles of TF - Prosthetic Sockets

„Adhesion“- Contact Socket

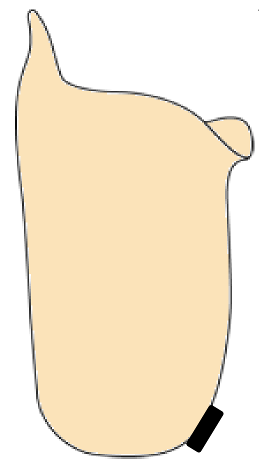


Molded cushion grants soft stump end contact

Previous step to
Full - Contact - Socket

Advantage:
End contact minimizes the risk of edema formation

Full-Contact-Socket



Entire residual limb surface stays in contact with the socket

Contemporary standard fitting

Advantages:

- Very low risk of edema formation
- Better load transmission, control and proprioception

Consideration of residual limb flexion

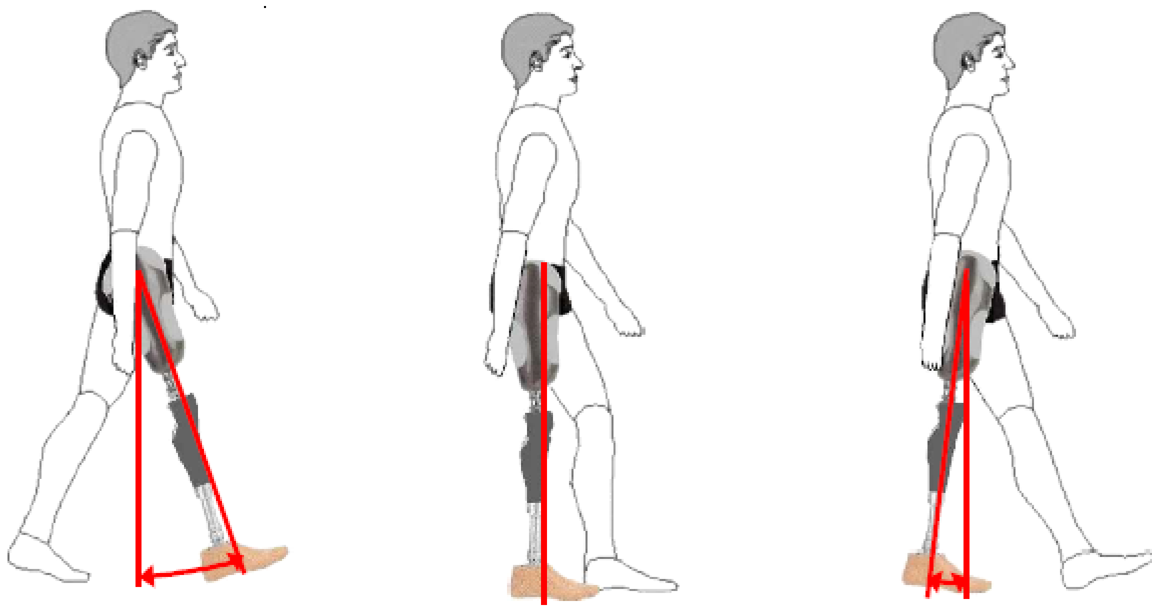
What causes a flexion / contracture?

- Arthrosis
- Inflammation
- Malposition in the hip joint
- Pathologic changes in the spine
- Wrong positioning
- Muscular unbalance

Consideration of residual flexion

Stance phase

Initial contact | Mid stance | Terminal stance



30° Hip flexion | Neutral position | 10° Hip extension

Ca. 40°

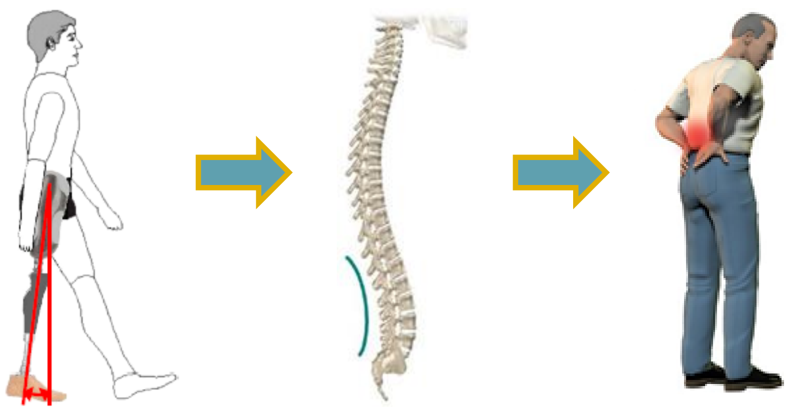
Consideration of residual limb flexion

Flexed position of the residual limb

Without flexion contracture

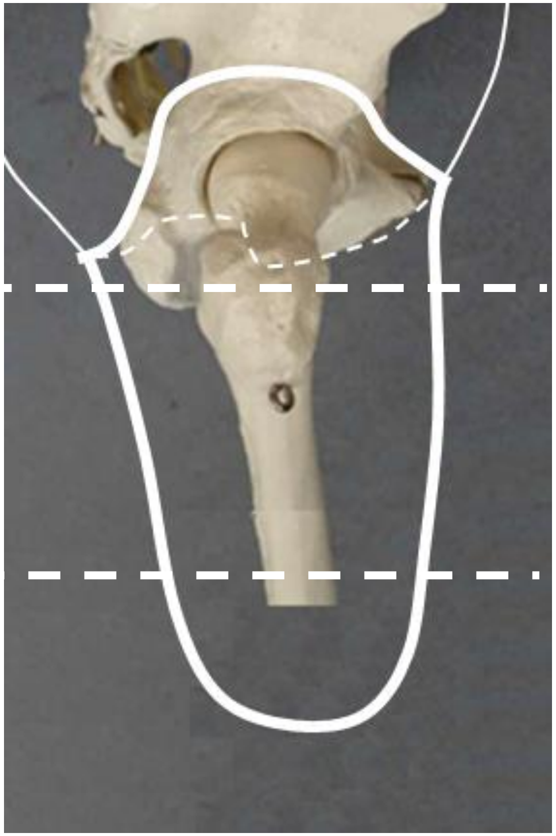
according to clinical surveys **3° to 5° pre-flexion of the socket** is recommended

With flexion contracture



Measure contraction angle and increase socket flexion by **5° to 10°.**
This facilitates terminal stance without provoking compensation movements in the spine **(Hyperlordosis)**

Functional sections of a socket according to Hepp/Elle



- Socket entry level
- Control level
- Stump end level

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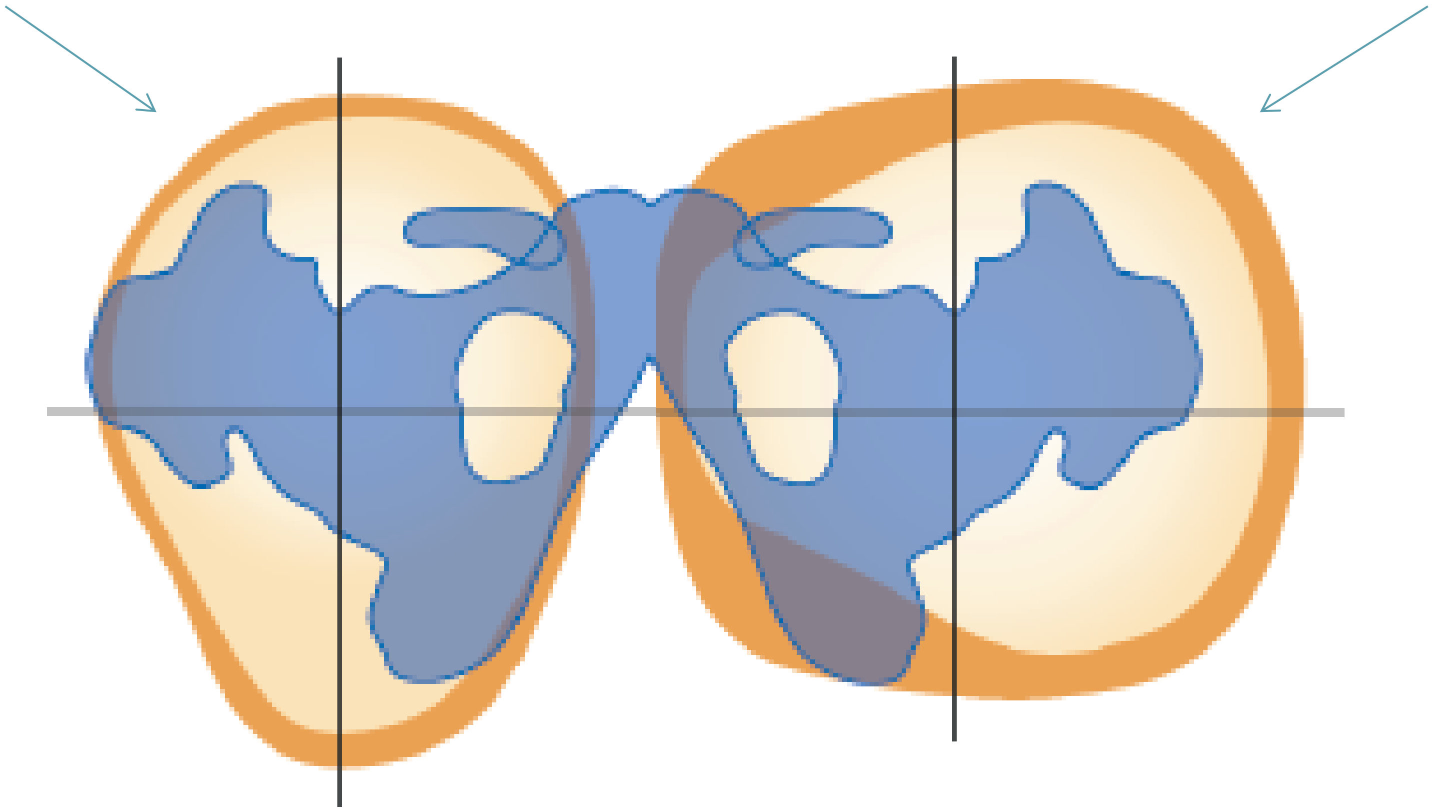
Socket form

Ischial Containment vs. Ischial Support

„Narrow Medio Lateral“

„Quadrilateral“



Socket form

Ischial Containment – “Narrow Medio Lateral”

Advantages at socket entry level:

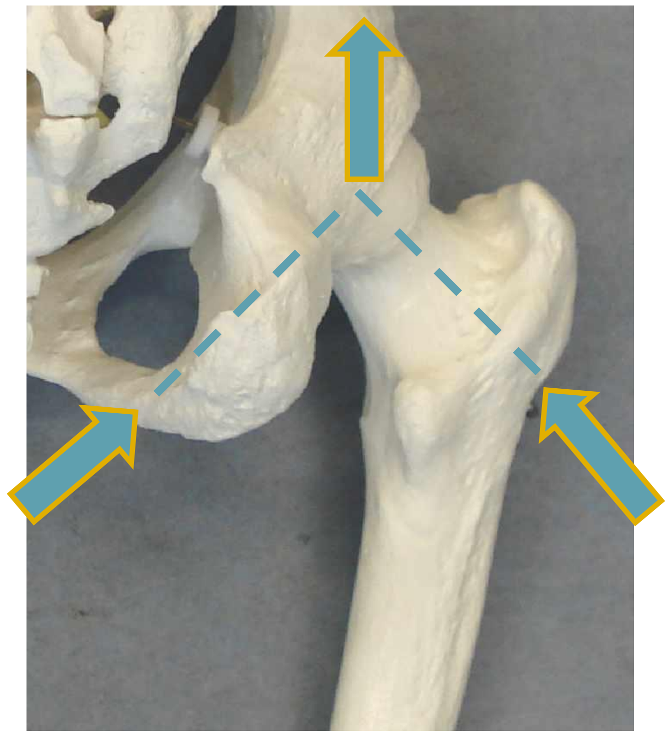
- Hip joint is the physiologic center of rotation
- Reduced pressure at „Scarpar`s“ triangle
- No medial shifting of tuber as it is embedded
- No forward tilt of pelvis while standing

Disadvantages at socket entry level:

- Acceptance on users accustomed to ischial support

Socket form

Ischial Containment – “Narrow Medio Lateral”



Hip Center of Rotation

Embedding

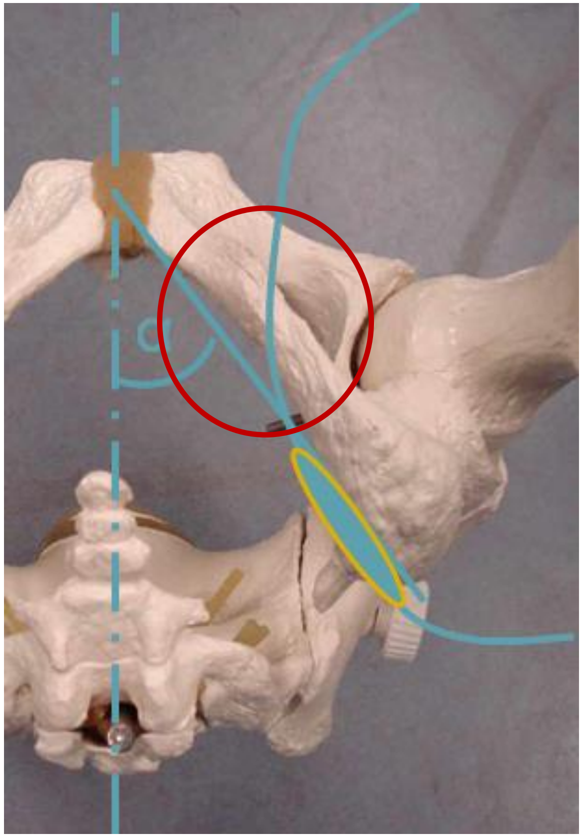
Trochanter major

„Bony lock“

Socket form

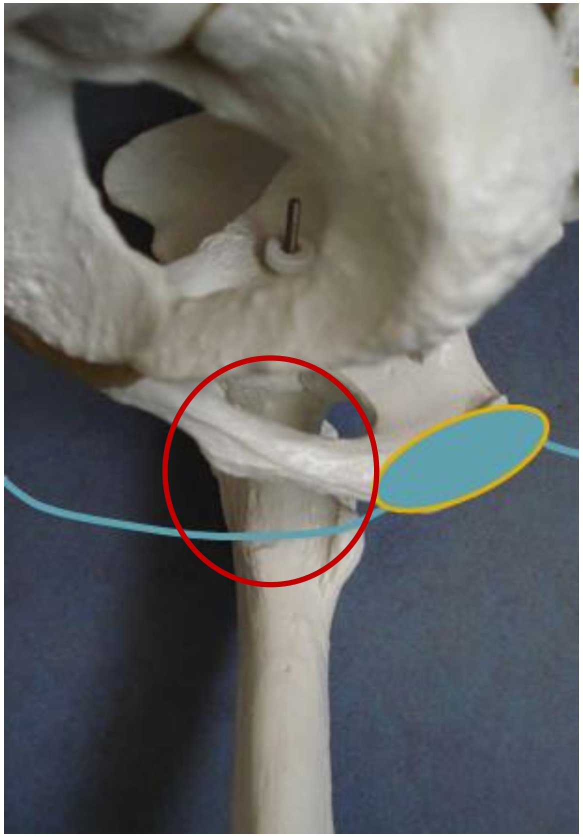
Position of tuber embedding and crossing point

Ramus angle



Crossing point

a-p position



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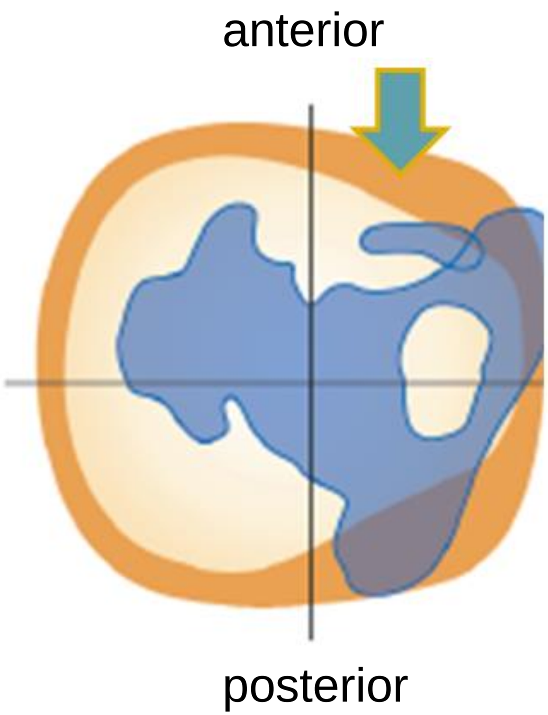
Socket form

Ischial Support – “Quadrilateral“



Advantage:

- Load transmission through Tuber Ossis Isschii when residual limb-end cannot bear load

Disadvantage:

- Incongruent centers of rotation in between hip joint and tuber seat
- Medial „shifting“ of tuber at load response
- High pressures at „scarpar`s“ triangle

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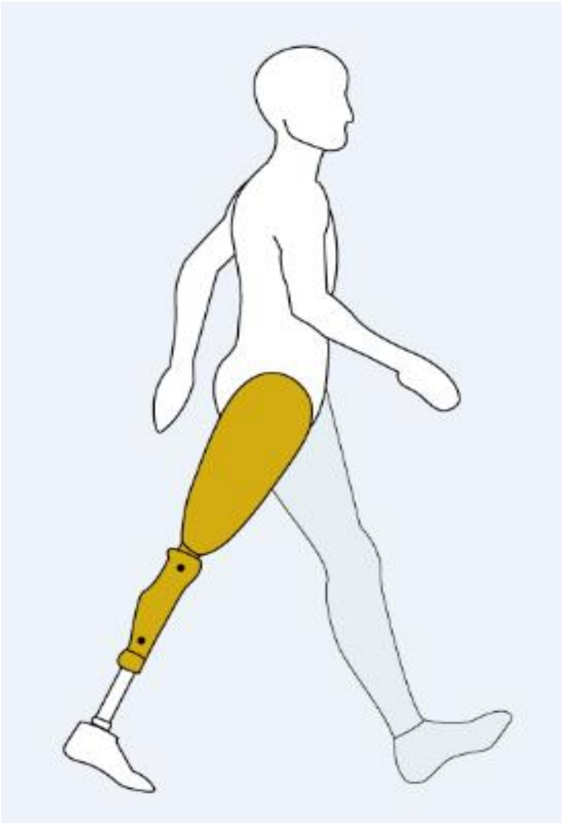
Socket form

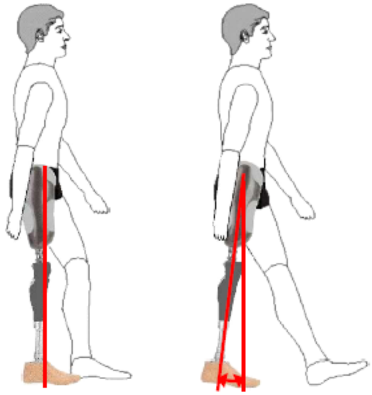
Ischial Support – “Quadrilateral“



Disadvantages at pre swing:

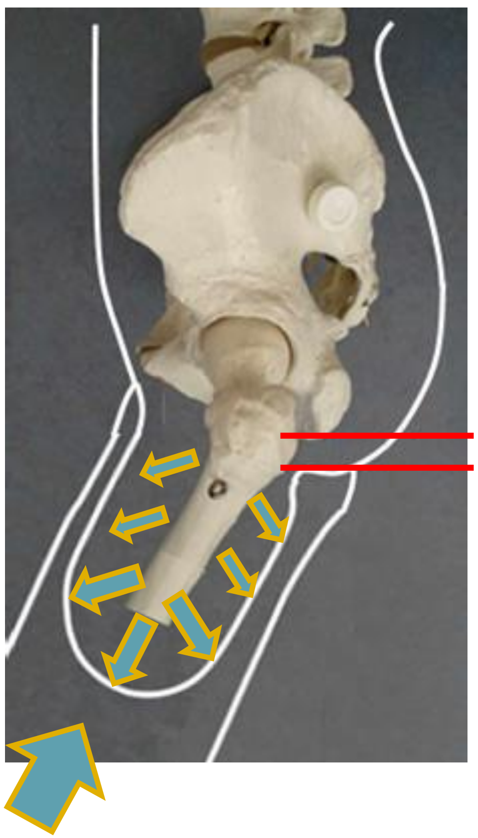
- Pelvis tilts forward while standing
- Force transmission area starts shifting backward from mid stance onwards

→ might lead to loss of knee safety



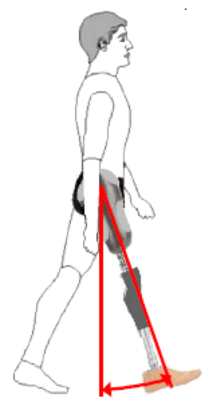
Socket form

Ischial Support – "Quadrilateral"



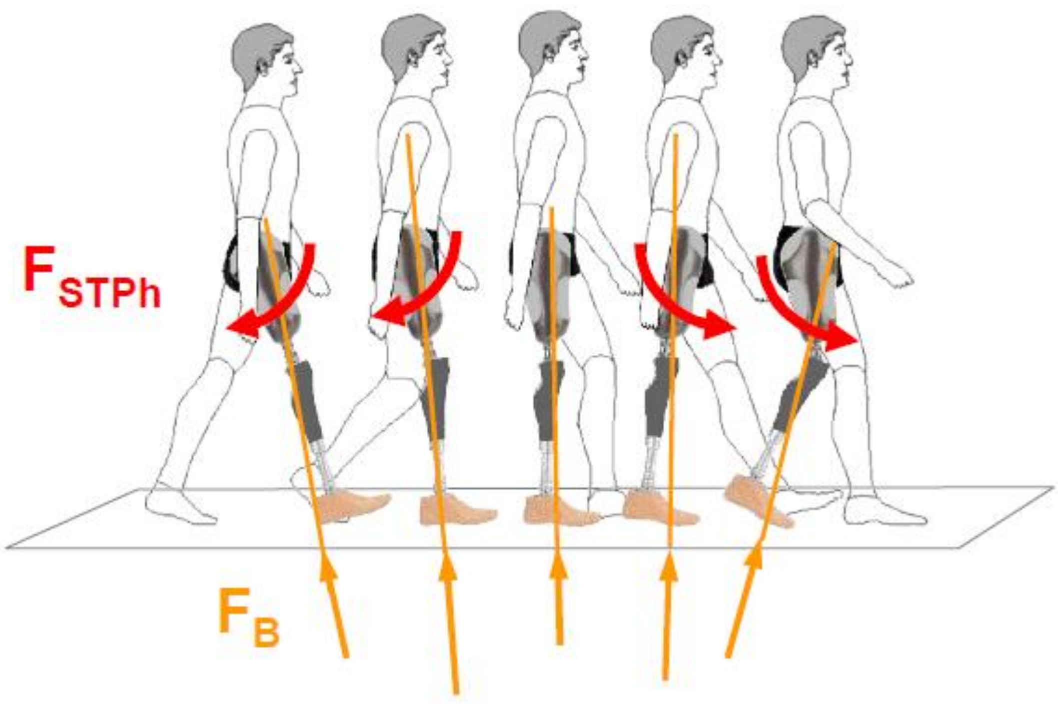
Disadvantages at initial contact:

- No contact in between socket and tuber before initial contact, therewith no force transmission through bones



Stump activity during stance phase

Which support areas are used for force transmission in between residual limb and socket?



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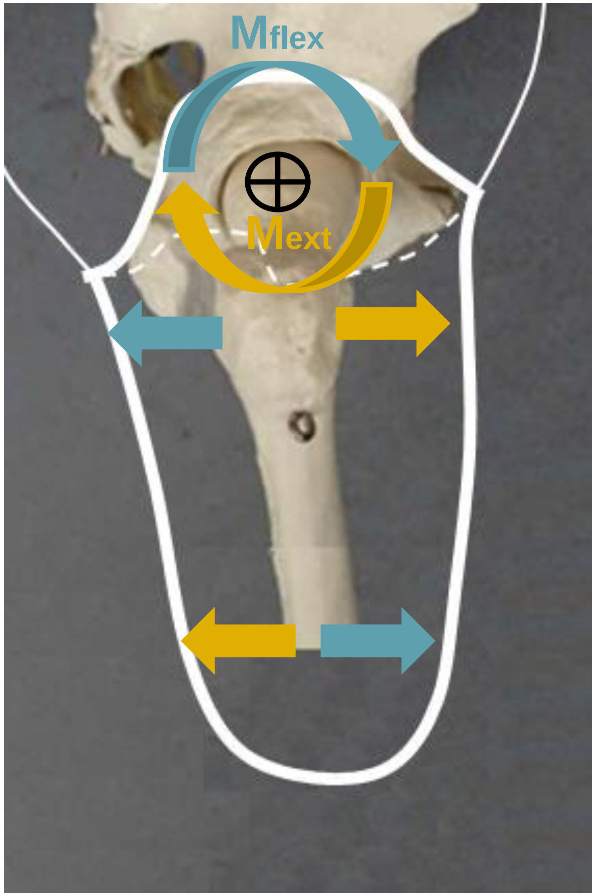
Residual limb activity during stance phase

Forces acting during stance phase (sagittal plane)

Initiation of swing phase



Load acceptance and mid stance

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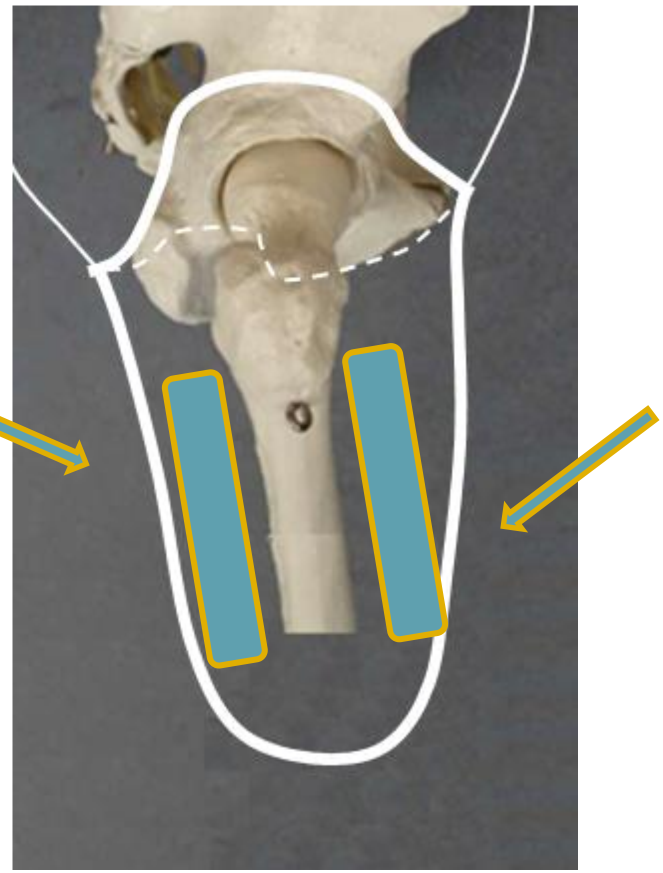
Principles in ischial containment sockets

Separate femur clamp

Limitation of movements posterior

(Load acceptance to mid stance)

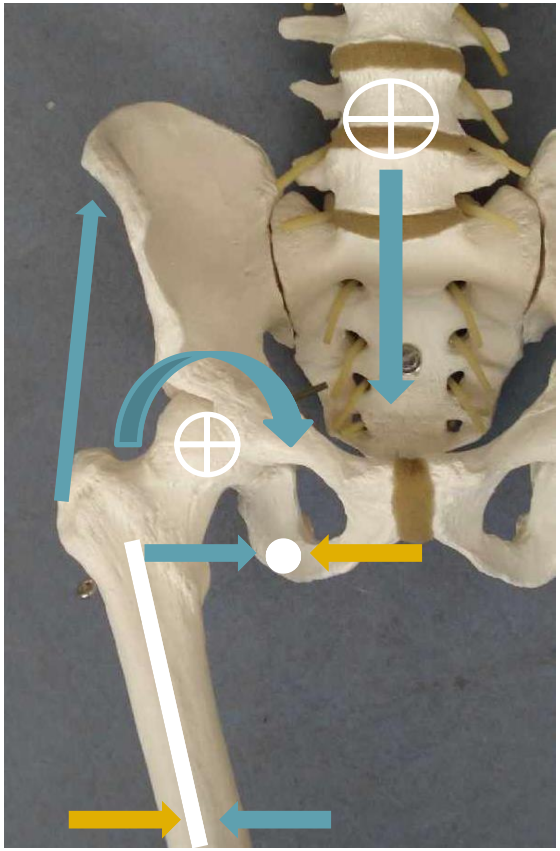


Limitation of movements posterior

(Pre swing to mid swing)

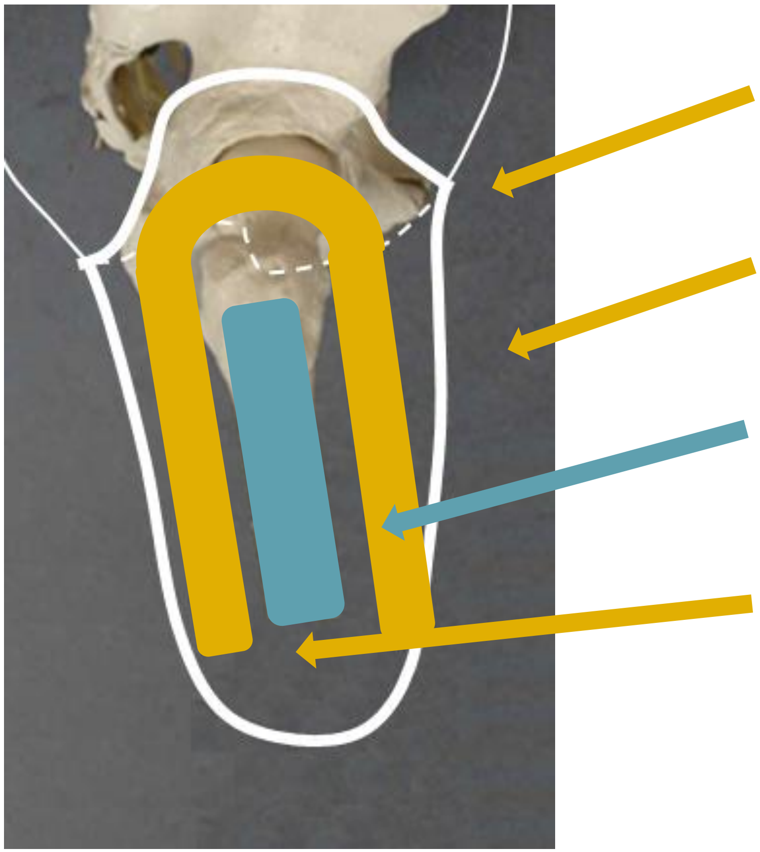
Principles in ischial containment sockets

Forces acting during stance phase (frontal plane)



Principles in ischial containment sockets

Femur clamp and lateral support



Pre tension of abductors
(Stabilisation during stance phase)

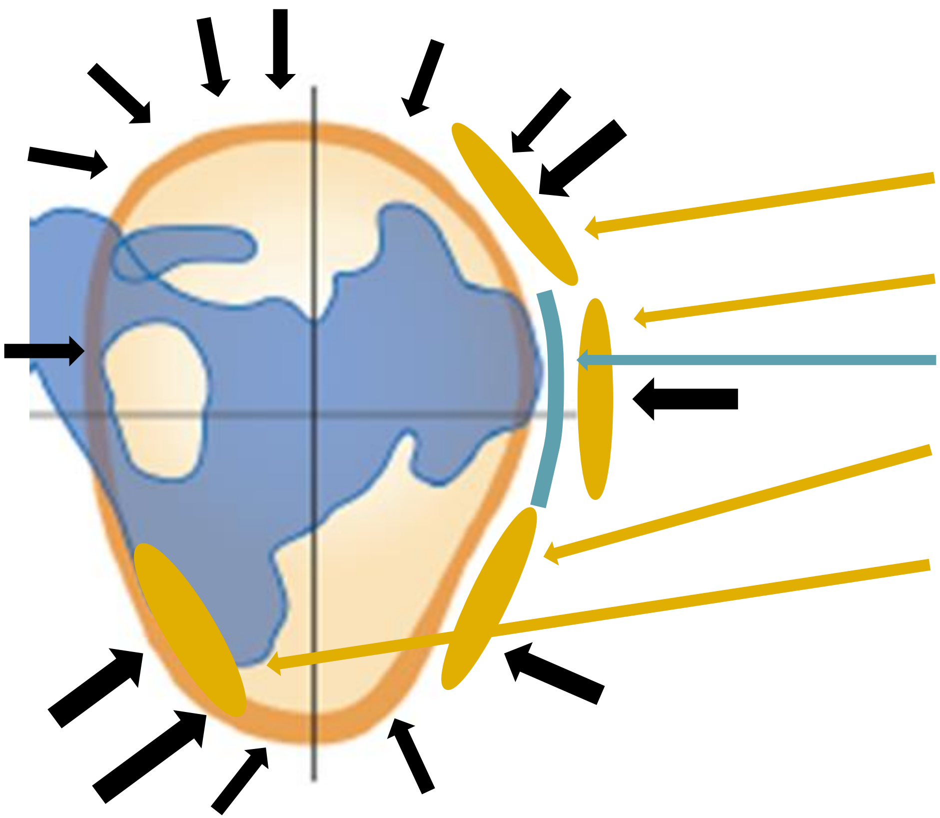
Limitation of anterior movements
(Pre swing to mid swing)

Femur support for adduction
(Stabilisation during stance phase)

Limitation of posterior movements
(Load response to mid stance)

Principles in ischial containment sockets

Socket entry level



Femur clamp anterior

Lateral support

Femur clamp posterior

Abductor pre tension

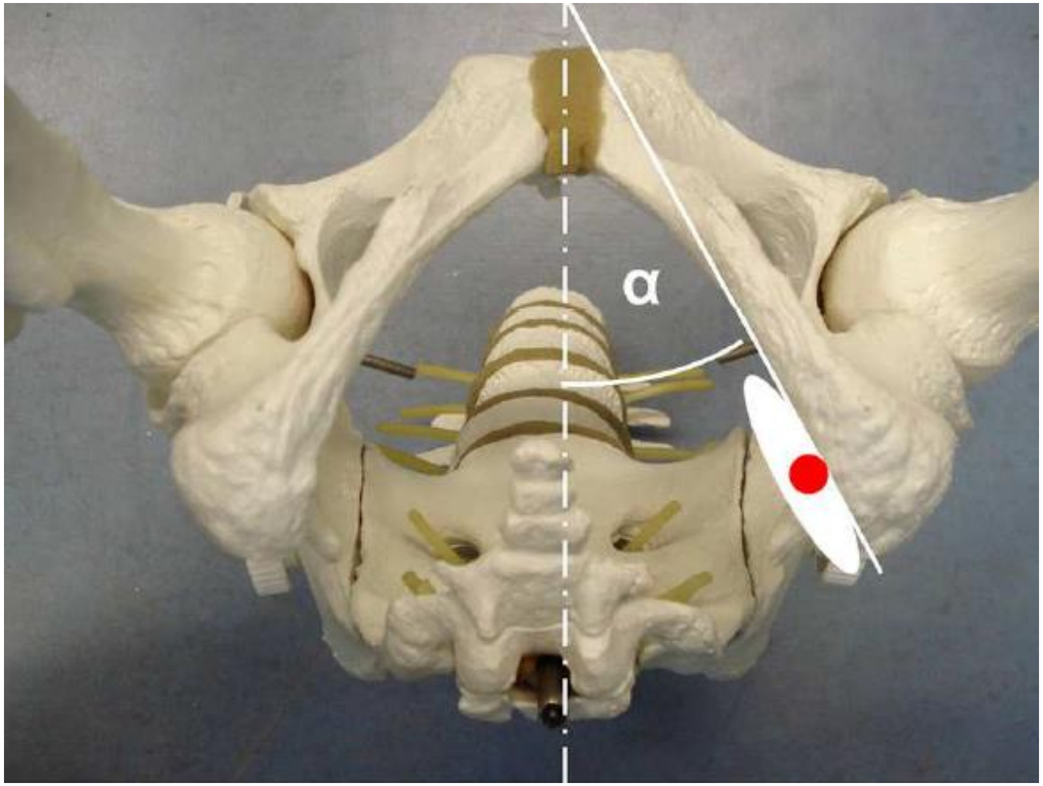
Tuber embedding

Rotation stability through socket shape

→ use torsion adapter or multi axial foot

Principles of ramus embedding

Ramus angle



Principles of anatomica design

Aspired improvements

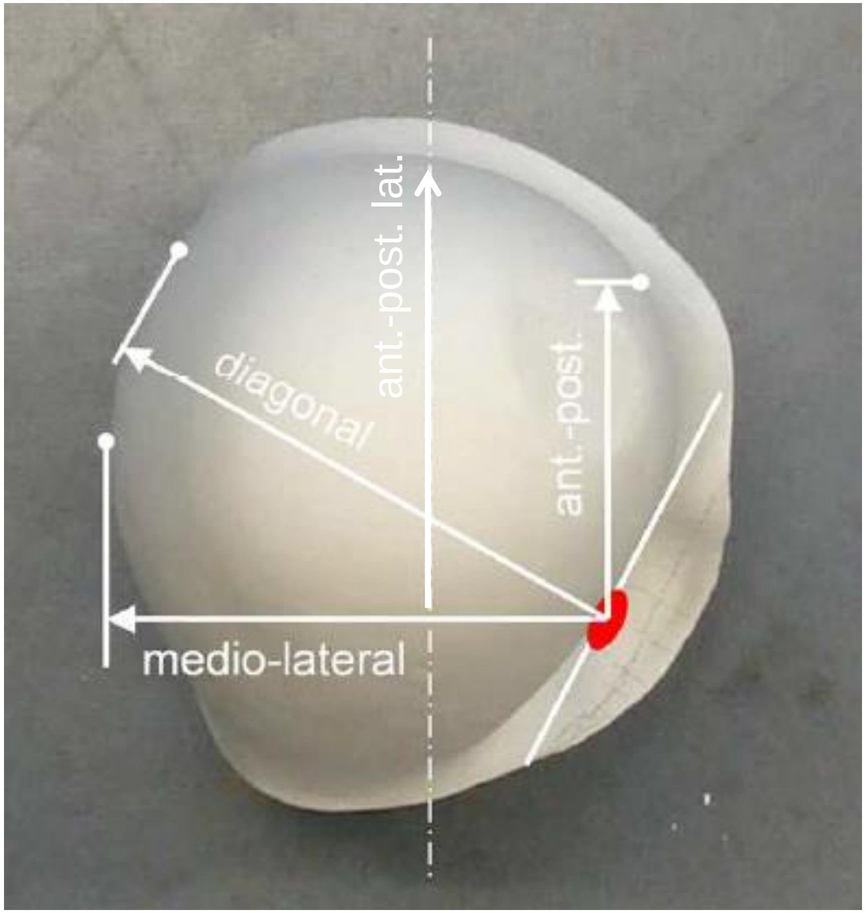
- Sitting comfort – glutaeus left free
- Higher range of movement due to lower trim lines
- Better cosmetic appearance
- Improved control of the prosthesis

Additional functional aspects:

- Relieve of perineum area due to lower brim and muscular pre tension via hypomochleon.
- Hypomochleon also relieves medial tuber / ramus

Principles of ramus embedding

4 measurements



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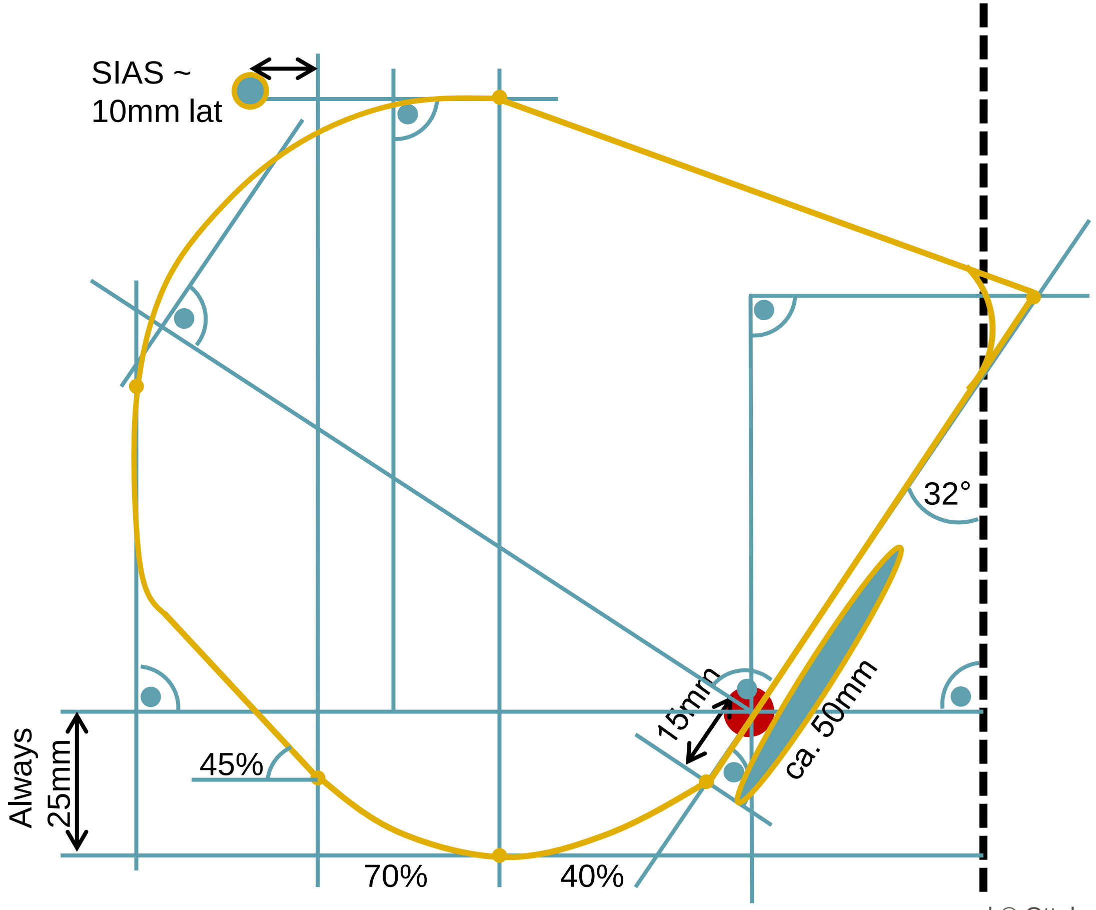
Principles of ramus embedding

Construction of socket form at control level

α	32°
A-Pm	7cm
A-Pl	10,5cm
M-L	10,5cm
M-Ld	12cm



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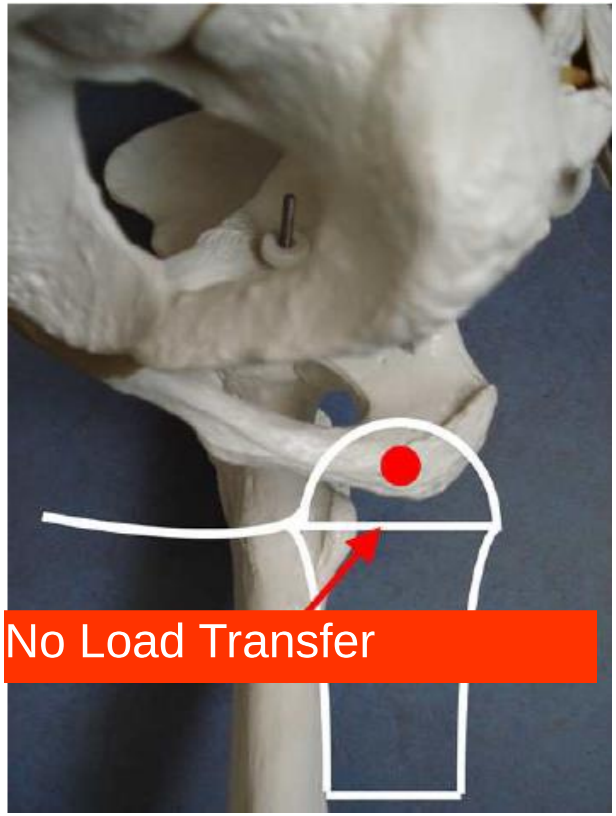
Ischial containment vs. Ramus containment

Forces during stance phase (frontal plane)

Ischial Containment
Narrow Medio Lateral

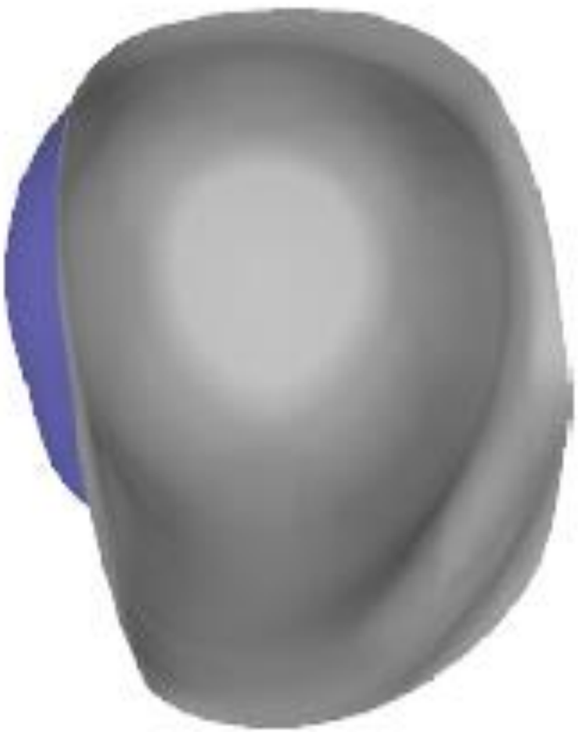
?

Ramus Containment
Anatomica



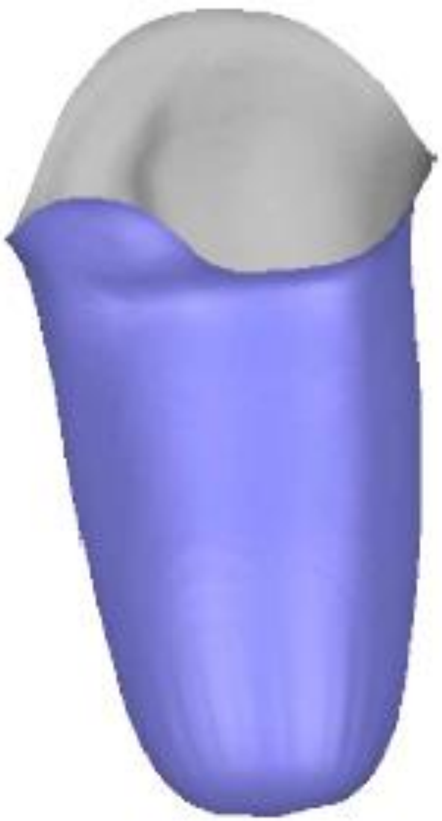
Ischial containment vs. Ramus containment

Proximal view



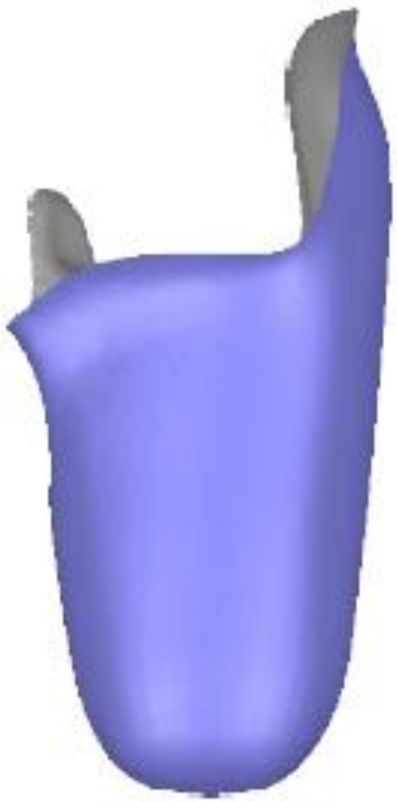
Ischial containment vs. Ramus containment

Medial view



Ischial containment vs. Ramus containment

Anterior view



Ischial Containment vs. Ramus Containment

Lateral view

Ischial Containment vs. Ramus Containment

- Easier manufacturing
  (less complex in casting etc.)
- More comfortable to wear
- Hip flexion only to aprox. 90°
- Higher trim lines

- Requires precise knowledge and experience
  (Steep learning curve)
- Much better M-L guidance
- Better control of socket and prosthesis
- Higher sitting comfort as glutaeus is cut completely free
- Higher range of motion due to lower trim lines

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Discover what moves us!

Quality for life