

Biomechanical Aspects of the Helix^{3D}- Hip Joint System

Academy



Quality for life

Aims



Aims

How does effect **different alignment configurations** the gait with the Helix^{3D} Hip Joint System

Are there **functional differences** between the hip joint 7E7 and the Helix^{3D} Hip

Is the **combination with other knee joints** beside the C-Leg possible?

Structure

- 1. Methods**
2. Results – Prosthetic Alignment –
3. Results – Joint Comparison –
4. Combination with different knee joints
5. Summary

Methods

Patients

Alignment, functional differences Different kneejoints (3R60/ 3R106) in combination with the Helix^{3D}Hip

- 6 hip disarticulation amputees
 - 2 women
 - 4 men
- 6 hip disarticulation amputees
 - 3 women
 - 3 men
- MG 3
- age: 27 – 66 years
- Wearing prostheses since : 8 - 62 years

Methods

Prosthetic components



- 7E7 ↔ Helix^{3D}Hip (7E10)
- Shifting adapter
- C-Leg
- C-Walk

Methods

Different prosthetic alignment configurations

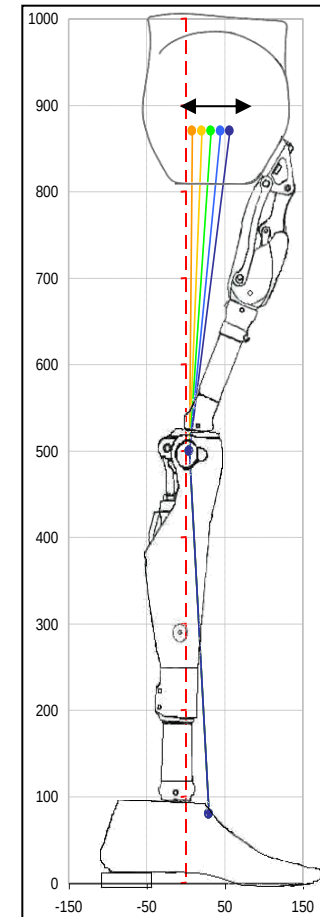
neutral

12mm_anterior

24mm_anterior

12mm_posterior

24mm_posterior



Methods

Prosthetic alignment

1. bench alignment

L.A.S.A.R. Assembly



2. Static alignment check under load

L.A.S.A.R. Posture

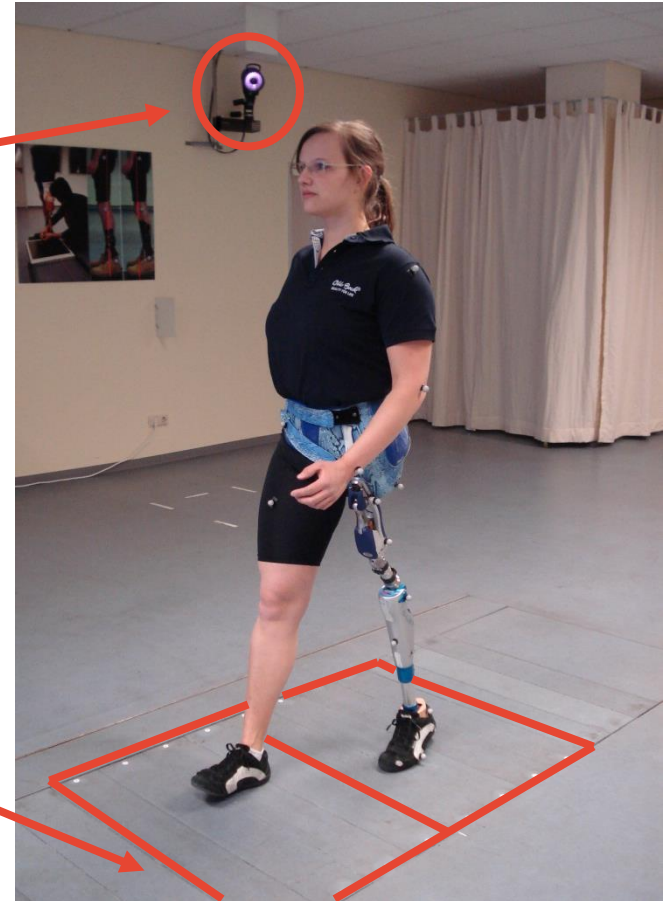


Methods

Gait analysis

Kinematics

Kinetics



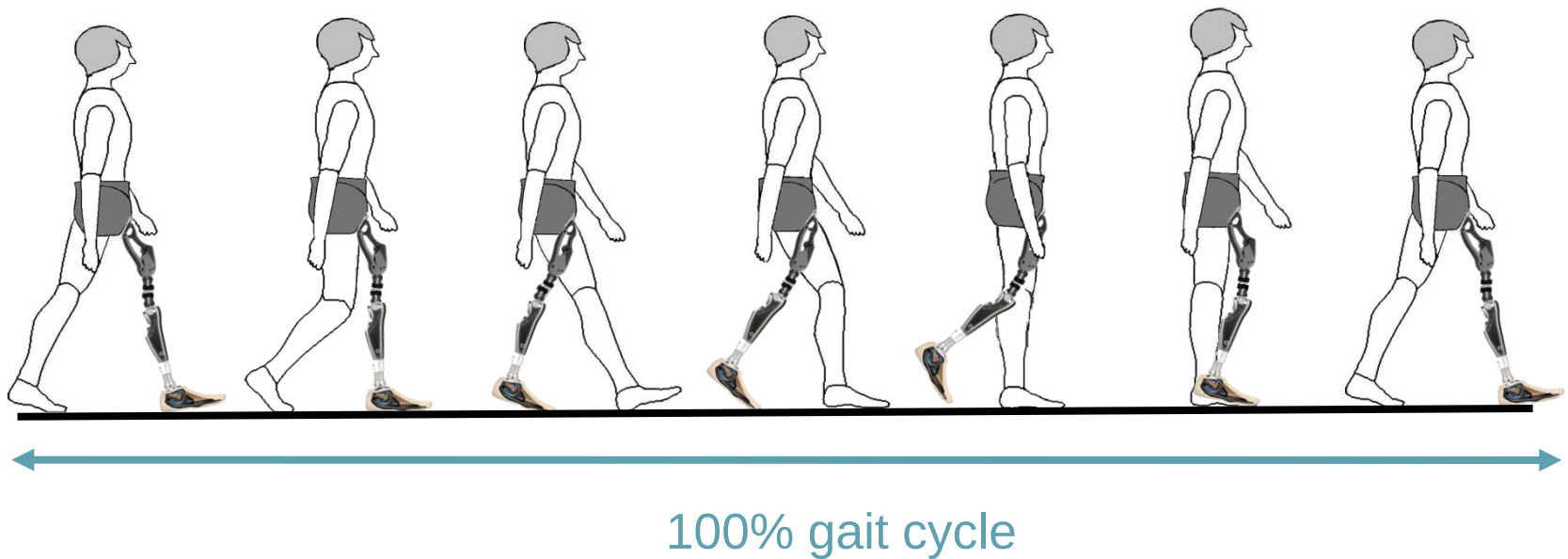
Afterwards:

Subjective evaluation of the different prosthetic alignment configurations

Structure

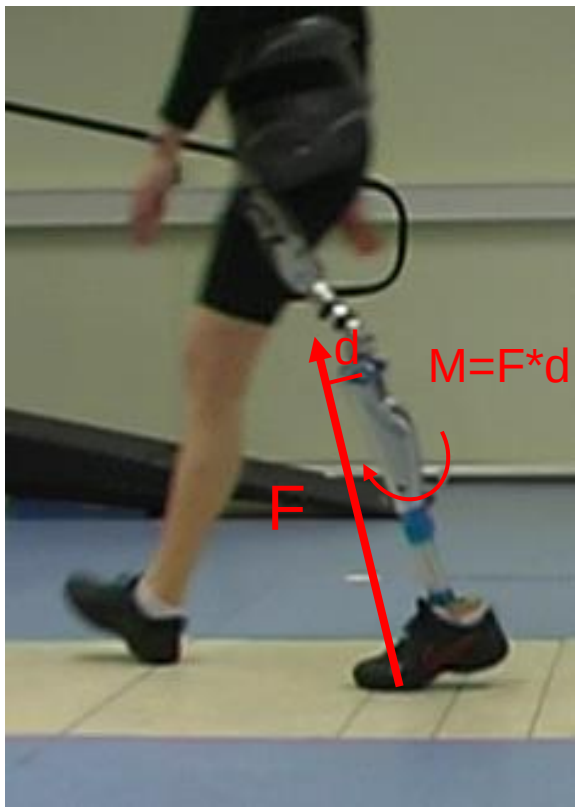
1. Methods
- 2. Results – Prosthetic Alignment –**
3. Results – Joint Comparison –
4. Combination with different knee joints
5. Summary

Results – Prosthetic Alignment –



Results – Prosthetic Alignment –

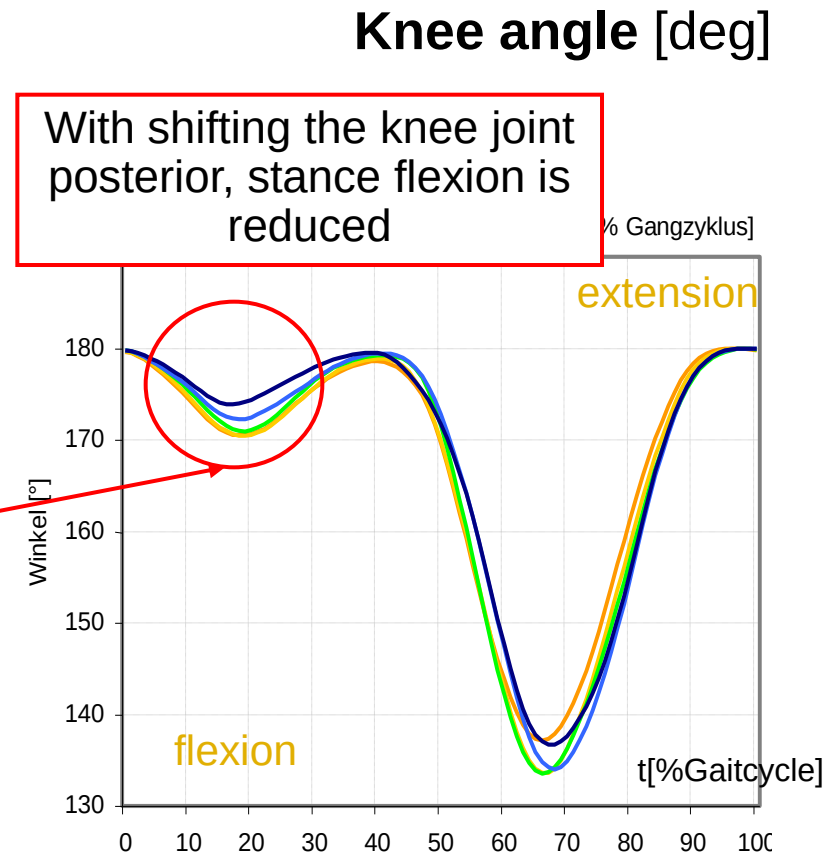
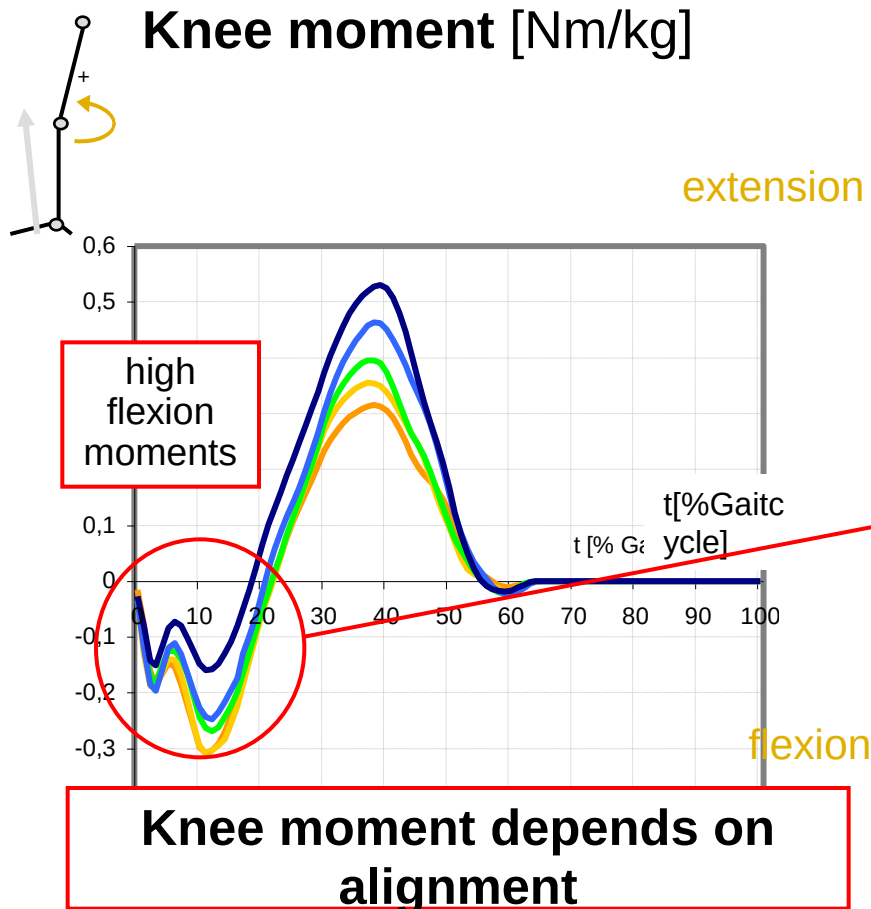
Knee moment



Knee angle

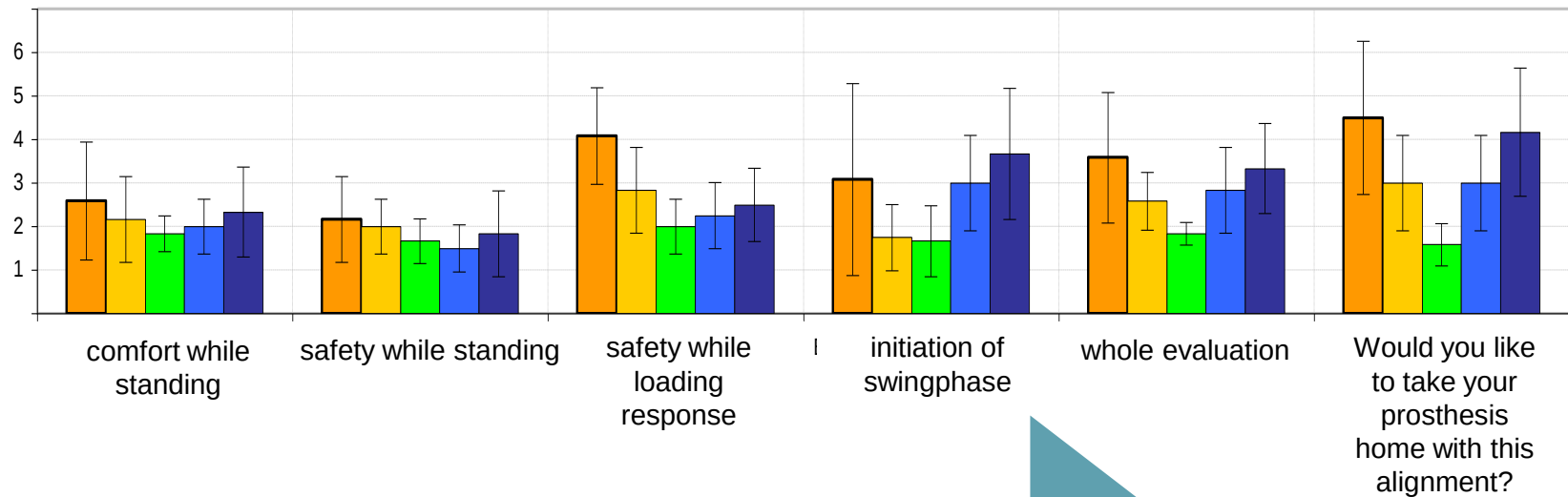


Results – Prosthetic Alignment – Knee



Results –Prosthetic Alignment –

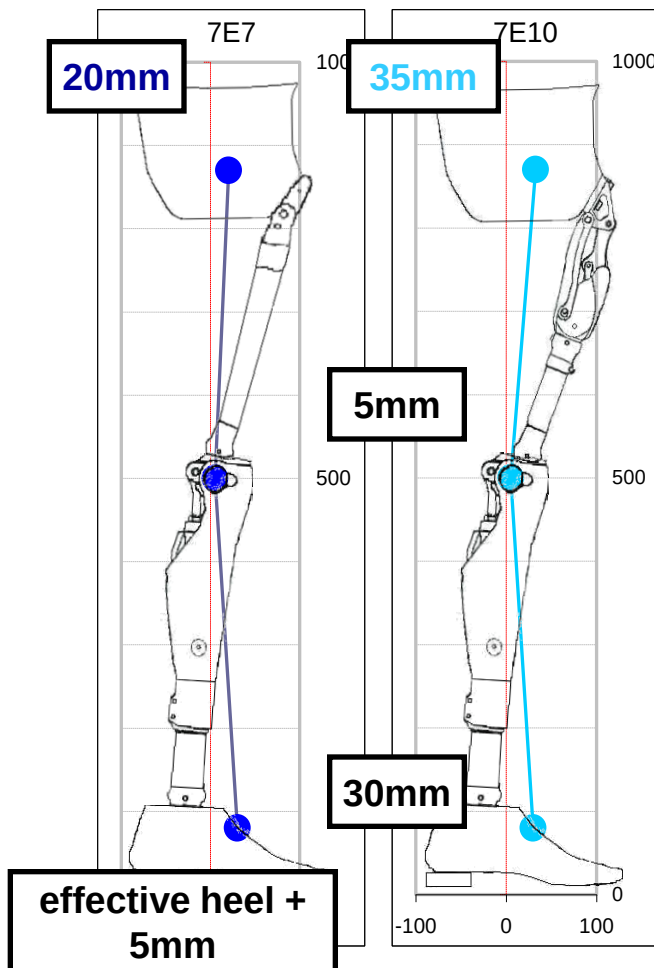
Subjective evaluation with school grades



Structure

1. Methods
2. Results – Prosthetic Alignment –
- 3. Results – Joint Comparison –**
4. Combination with different knee joints
5. Summary

Results - Joint Comparison -



For the Helix^{3D} Hip the socket reference line is more anterior



shank (C-Leg und C-Walk) is more posterior compared to the 7E7

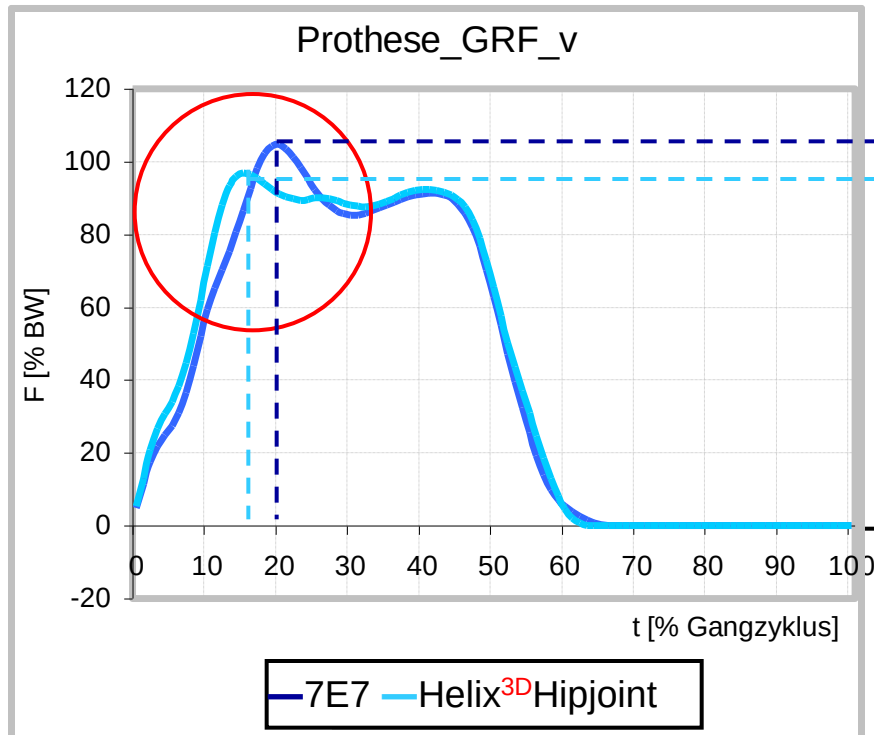
PU elements

- Easier initiation of the swing phase

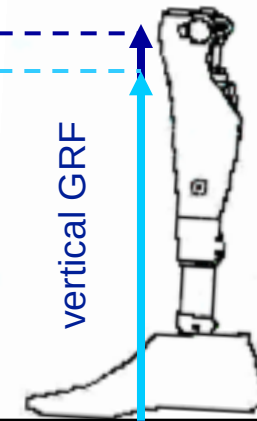
Stance Phase Resistance

- Knee flexion moment is provoked

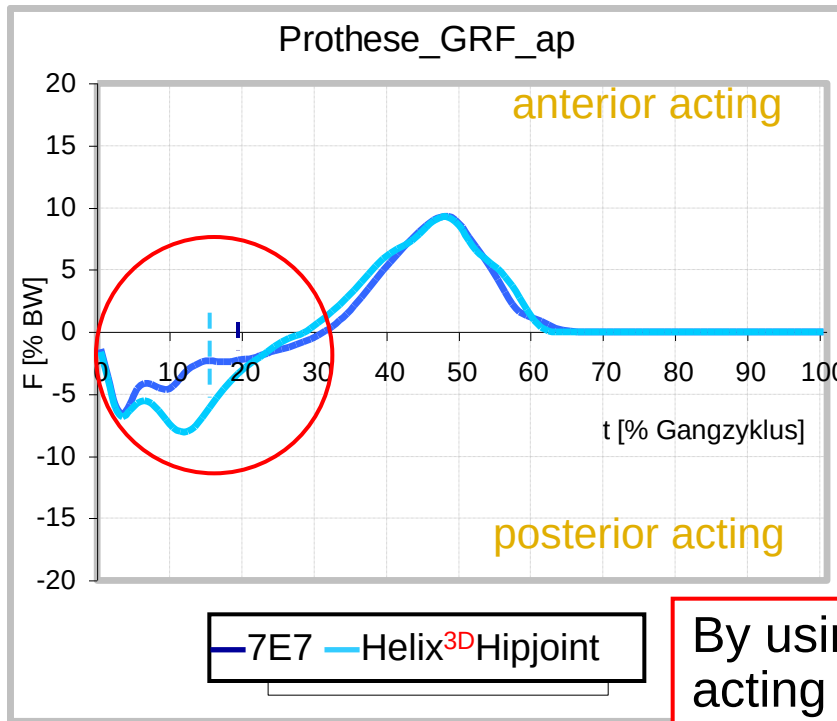
Results - Joint Comparison - Vertical GRF



By using the 7E7, the first maximum of the vertical force is enlarged



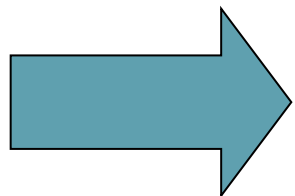
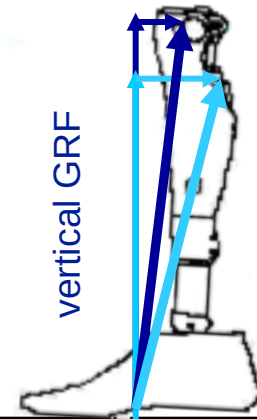
Results - Joint Comparison - Horizontal GRF



By using the Helix^{3D} Hip, the force acting in posterior is enlarged

horizontal GRF

vertical GRF

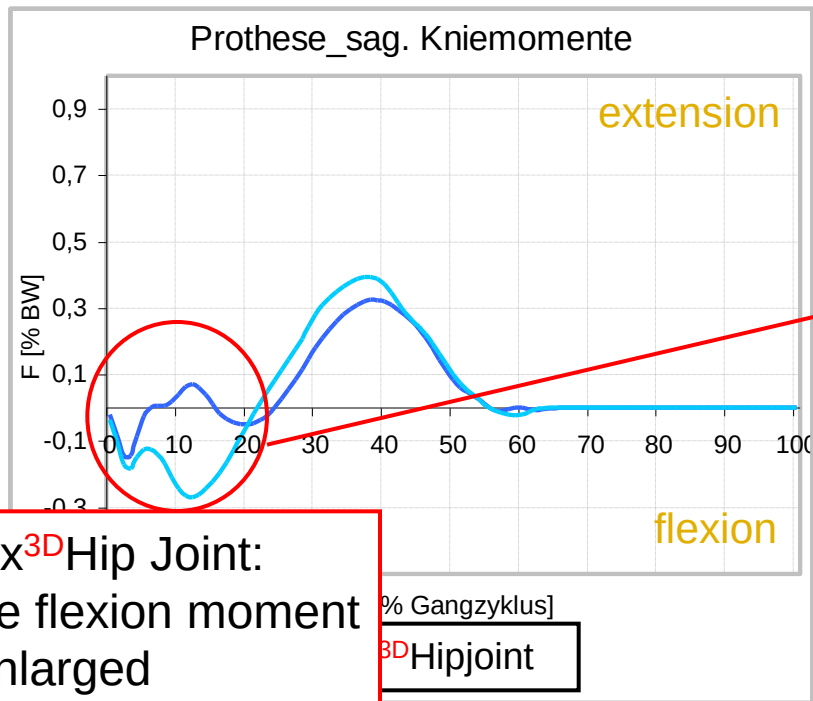


Knee lever arm is longer by using the Helix^{3D} Hip, that knee flexion moment will be enlarged

Results - Joint Comparison -

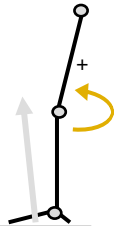
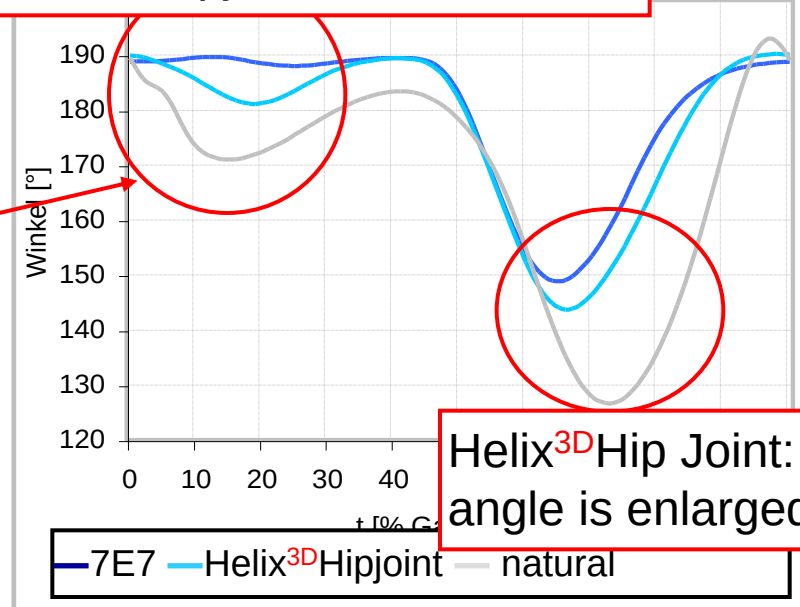
Knee

Sag. Knee moment



Sag. Knee angle

7E7: **no** stance phase flexion
Helix^{3D} Hipjoint: **10°**



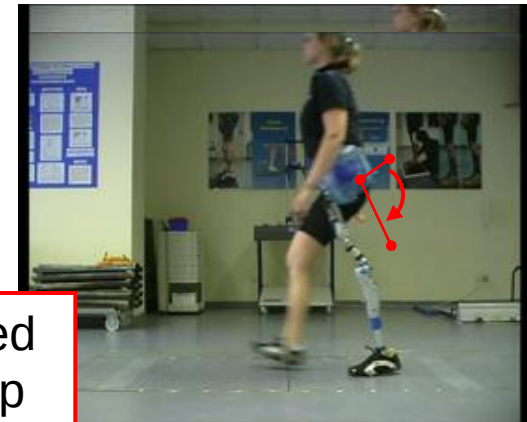
More natural knee angle for the Helix^{3D} Hip Joint

Results - Joint Comparison - Hip angle

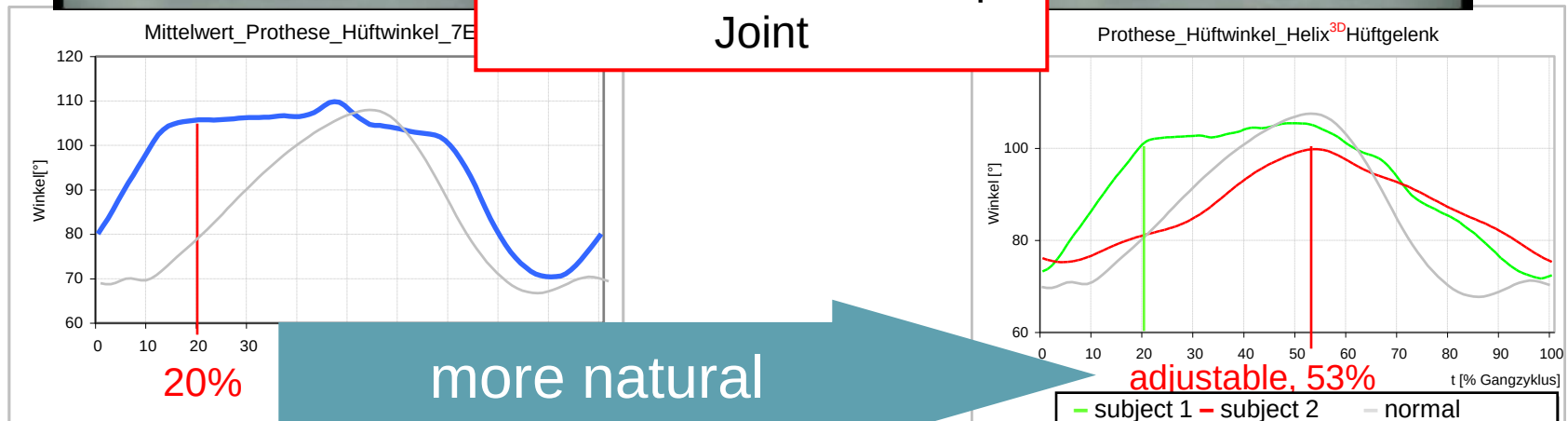
7E7



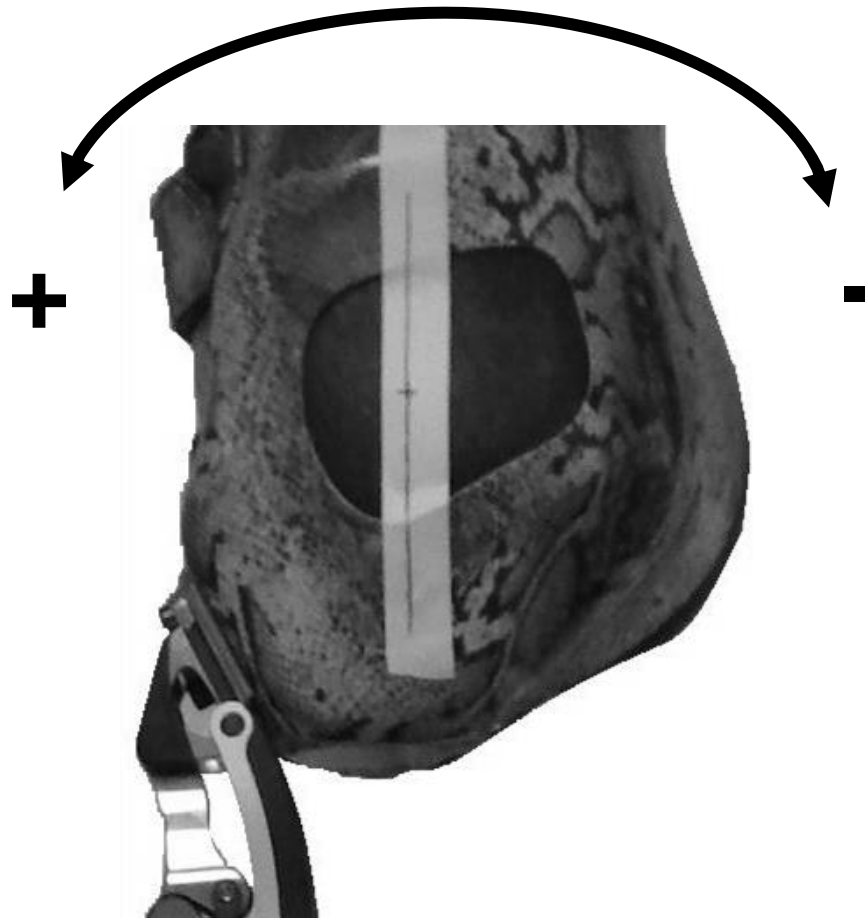
Helix^{3D} Hip joint



The extension is reached
later with the Helix^{3D} Hip
Joint



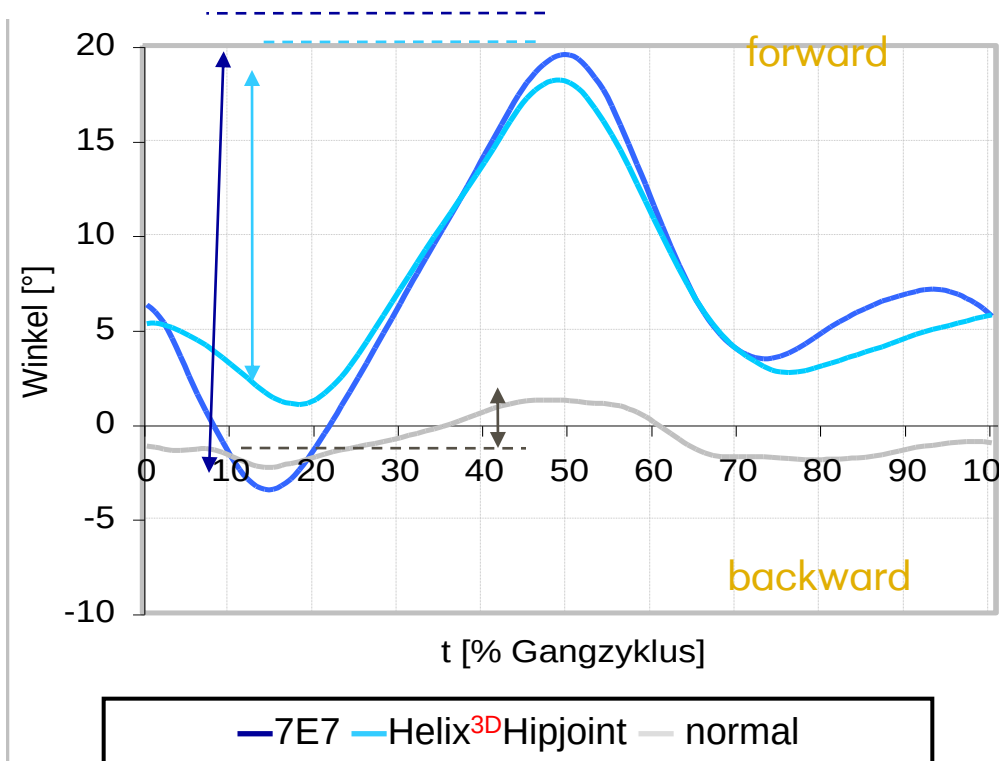
Results - Joint Comparison - Pelvic tilt



Results - Joint Comparison - Pelvic tilt

range:

- normal: 4°
- 7E7: 25°
- Helix^{3D}Hipjoint: 20°



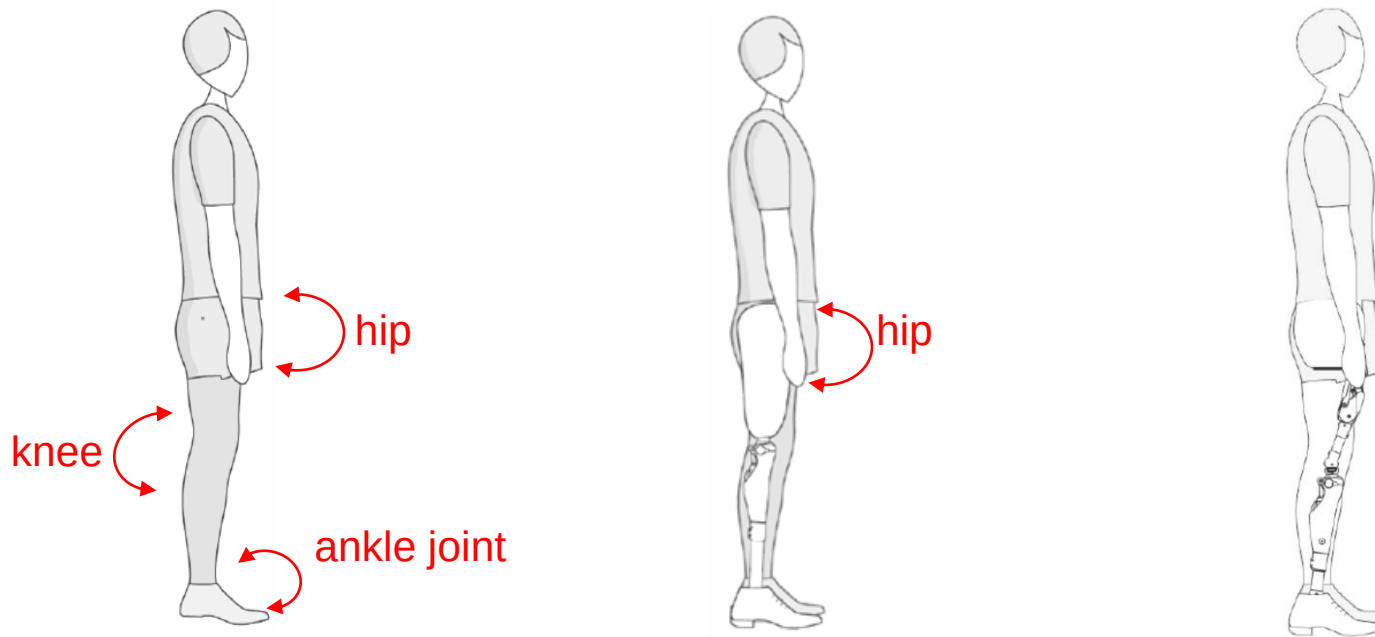
Pelvic tilt is reduced for the Helix^{3D}Hip Joint

Structure

1. Methods
2. Results – Prosthetic Alignment –
3. Results – Joint Comparison –
- 4. Combination with different knee joints**
5. Summary

Combination with different knee joints

Muscular controllable motion of the big joints of the lower extremity



Especially for HD and HP: maximum safety against uncontrollable kneeflexion during stance phase

Combination with different knee joints

HD- or HP- amputee with Helix^{3D} Hip Joint



Compensation of the
missing hip **flexion**
muscles:



**Easier initiation of the
swing phase**

&

maximum safety against
uncontrollable kneeflexion
during stance phase

Integrated PU elements



prosthesis loaded

- PU elements are strained
- storage of energy

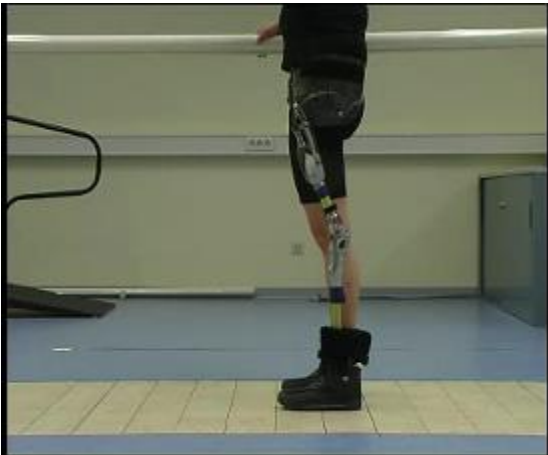
prosthesis unloaded

- releasing of energy
- hip joint flexes

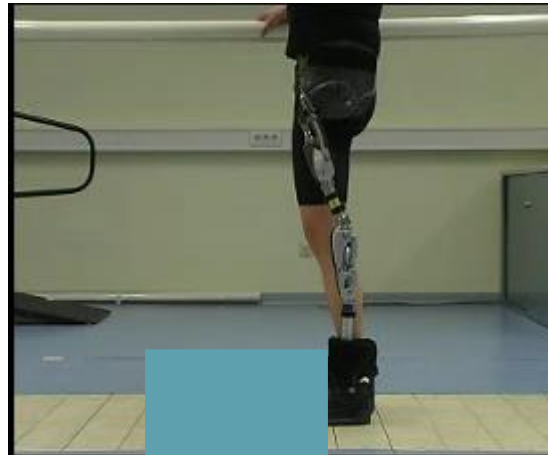
Combination with different knee joints

Helix^{3D} Hipjoint in combination with

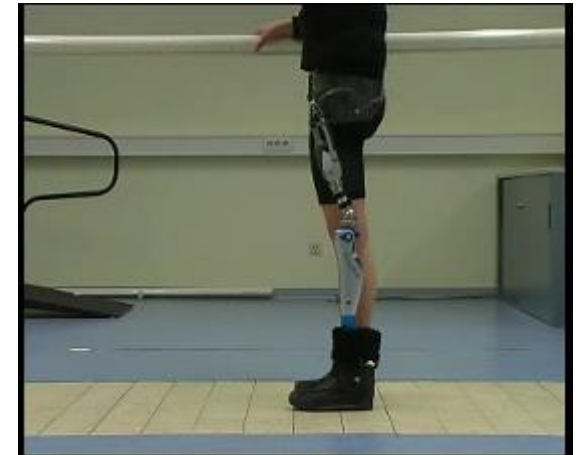
3R106



3R60



C-Leg



⇒ prosthesis is loaded

⇒ prosthesis is unloaded

⇒ foot has still contact with the earth

⇒ the load of a slightly preflexed knee joint results in a collapse except for the C-Leg

⇒ PU-elements flex the hip

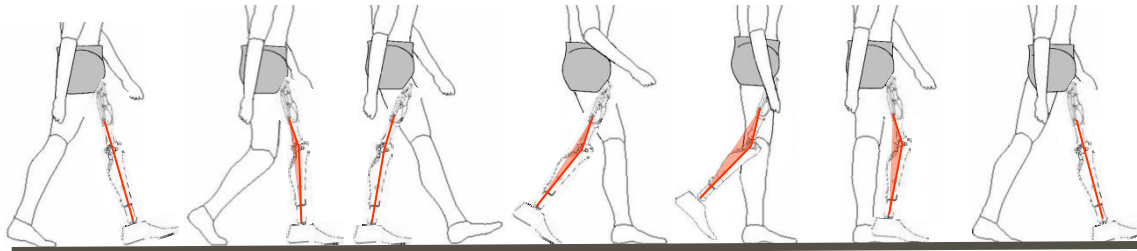
⇒ Only with the C-Leg is it possible that the knee joint will be flexed

to curve and to make little steps on the spot

Combination with different knee joints

Helix^{3D} Hipjoint in combination with C- Leg compact

How does effect the decrease of the Yielding Extension Damping the knee angle characteristics?

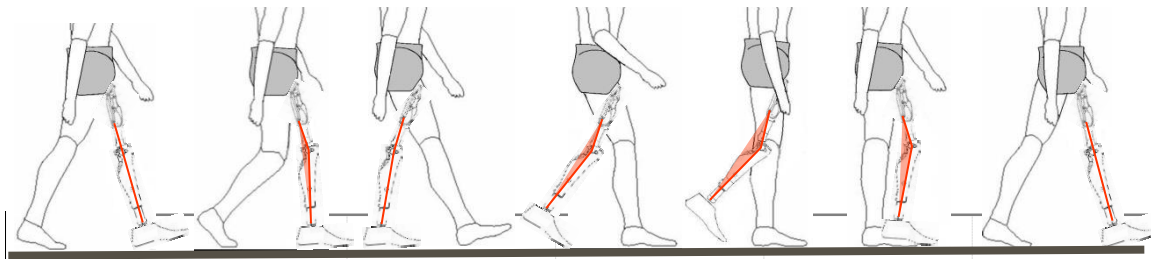


C- Leg with Yielding Extension Damping= 80

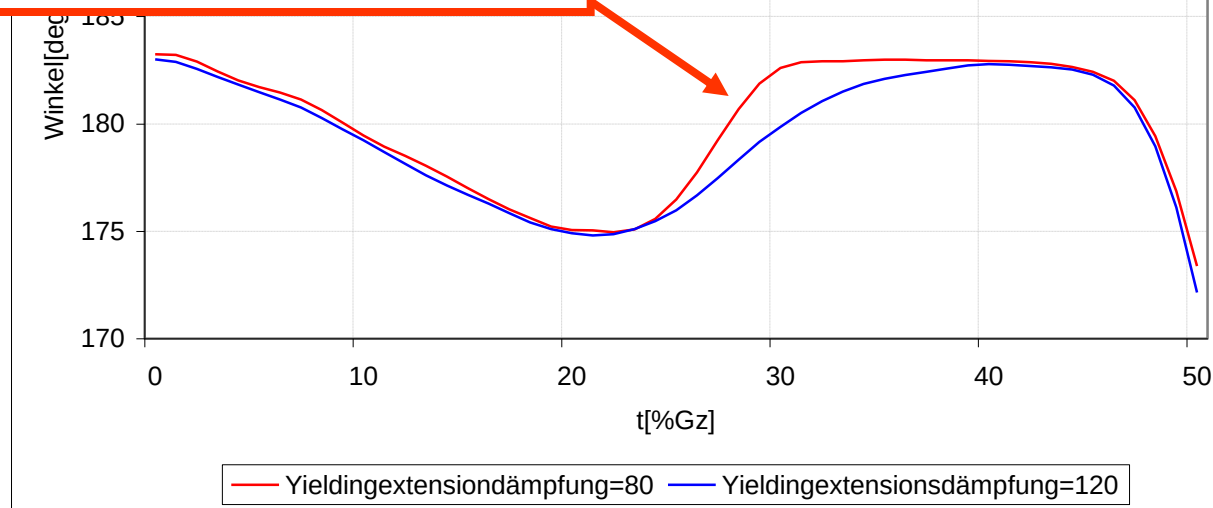
C- Leg with Yielding Extension Damping= 120 (maximal)

Combination with different knee joints

Helix^{3D} Hipjoint in combination with C- Leg compact

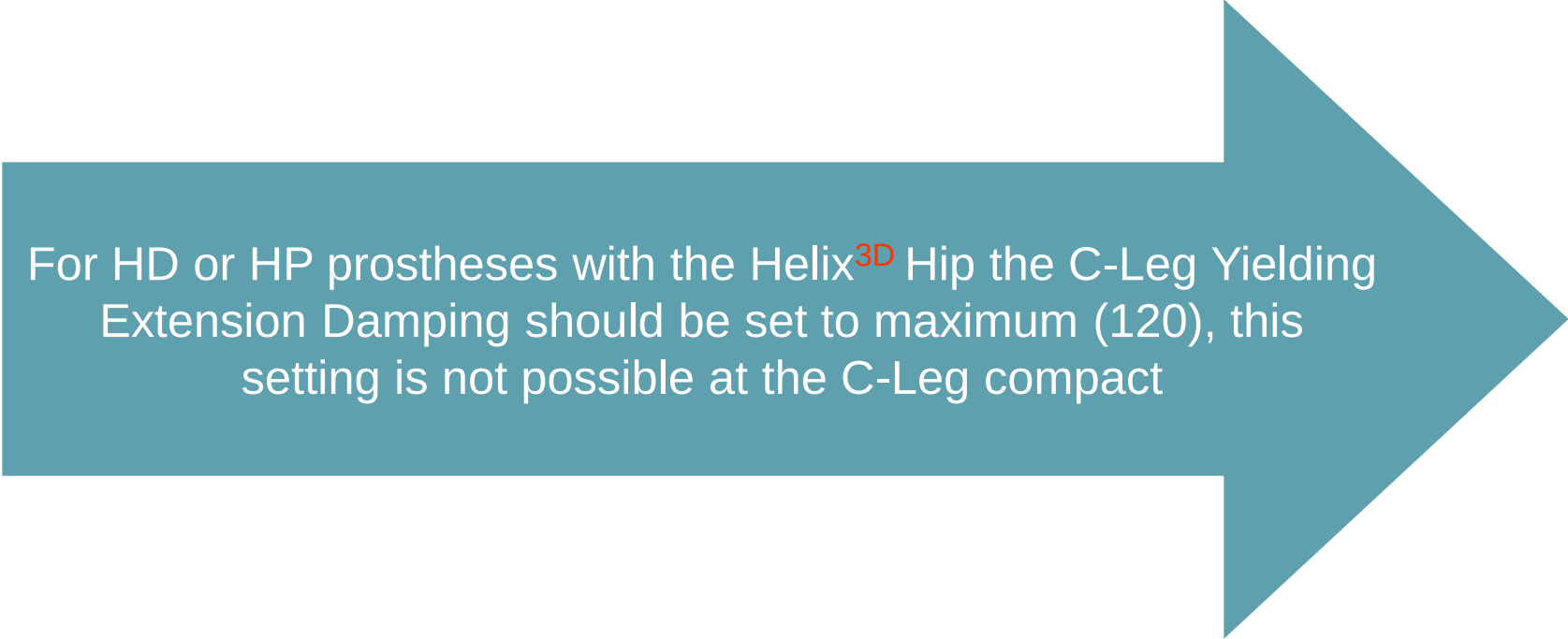


Strong stance extension impact :
Insecure feeling for the amputee



Combination with different knee joints

Helix^{3D} Hipjoint in combination with C- Leg compact



For HD or HP prostheses with the Helix^{3D} Hip the C-Leg Yielding Extension Damping should be set to maximum (120), this setting is not possible at the C-Leg compact

Structure

1. Methods
2. Results – Prosthetic Alignment –
3. Results – Joint Comparison –
4. Combination with different knee joints
- 5. Summary**

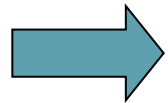
Summary

Optimized alignment is different for both hip joints

- For the Helix^{3D} Hip the socket reference line is more anterior

Key benefits of the Helix^{3D} Hip:

- More natural hip angle
- Knee flexion during stance phase
- Pelvic tilt is reduced



The gait is more natural with the Helix^{3D} Hip

- Only the C-Leg offers the necessary safety and gives the possibility to use all benefits of the Helix^{3D} Hipjoint



Helix^{3D}-Hip Joint System



Discover what moves us!

Referent

Contact details

www.ottobock.com



Quality for life