ALPS

VIP™ and Pin-Lock

Explore how these two systems impact ease of use, gait dynamics, muscle activation, and overall walking efficiency. This comparison will help us understand why the VIP System offers significant advantages over the traditional PIN System.

COMPARATIVE STUDY

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CASE DETAILS

Case: J. Nakanishi
Left: Transtibial Amputation, Right: Intact
Foot: BioStep EVO (ALPS South)
Socket: TSB Type (Total Surface Bearing)
MoCap: August 3, 2024

EASE OF ALIGNMENT

The alignment process is crucial for the comfort and functionality of a prosthetic limb. The VIP* System simplifies this process, offering easier alignment compared to the PIN System.

*VIP: Vacuum Integrated Pump

A

PIN SYSTEMS

While pin systems provide secure suspension, they often require precise alignment, which can lead to issues like point pressure and difficulty in fitting. The pin mechanism necessitates exact linear alignment, which can be challenging and time-consuming. Additionally, the need for precision can lead to complications if adjustments are necessary post-fabrication. In prosthetic pin locks, any required alignment changes are often limited, creating potential discomfort and reduced functionality.

B

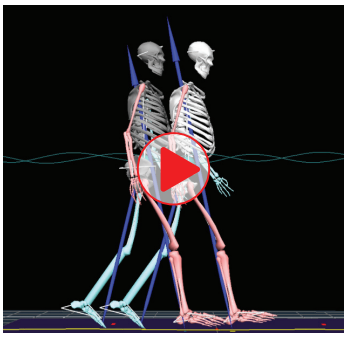
VACUUM SYSTEMS

On the other hand, the VIP System excels with a dynamic fit, better pressure distribution, and reduced pistoning. This system allows for easier donning and doffing, making it more user-friendly. Moreover, it provides greater flexibility during the fitting process, accommodating adjustments without compromising the overall alignment and comfort.

1 Visual Comparison

Professor Yamamoto's lab conducted a gait analysis using both VIP™ and Pin systems, examining walking speed on flat surfaces, stair walking, and slope walking. The results are visually striking and speak volumes about the differences between the two.

Click the video to look at the comparative gait analysis between the VIP and PIN systems.

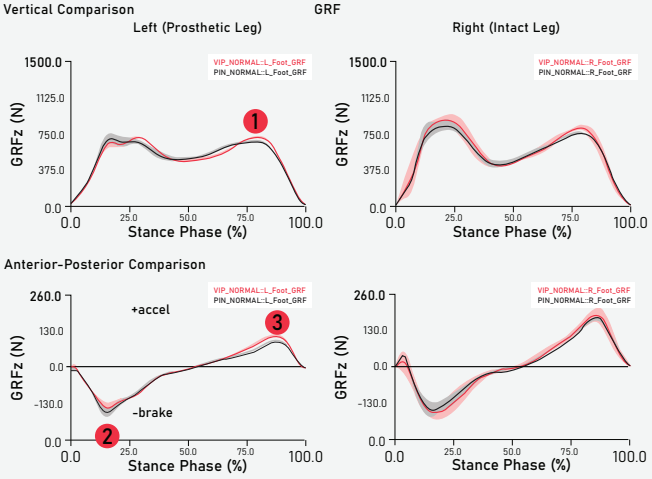


CLICK TO WATCH

2 Natural Gait

One of the most notable advantages of the VIP System is its ability to mimic the natural gait of an intact limb. The gait achieved with the VIP system closely resembles the natural walking pattern, as evidenced by the bimodal waveform that mimics the shape of the intact leg. This is crucial for amputees as it reduces the mechanical feel of walking and enhances the overall experience. The VIP System also allows for lower deceleration and higher acceleration of the prosthetic leg, contributing to a smoother and more natural walking experience.

① Clear bimodal waveform
② PIN: Large brake component
③ VIP: Large acceleration component

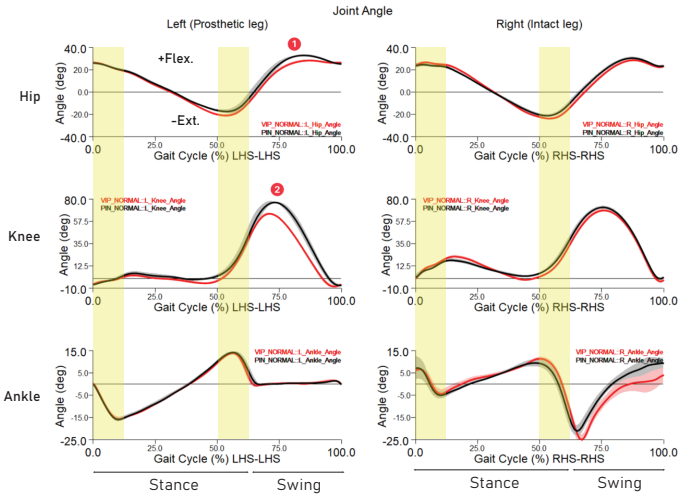


3 More Balanced Walking

The VIP System promotes more balanced walking. It minimizes compensatory movements, as seen in the reduced knee and hip flexion angles. With the PIN System, amputees often exhibit greater knee and hip flexion, leading to imbalances that can cause discomfort and additional strain on the body. The VIP System's design minimizes these compensations, promoting a more balanced and efficient walking pattern.

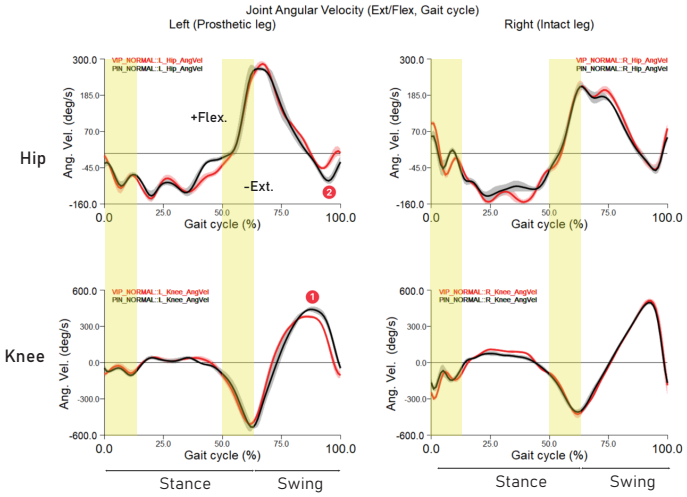
PIN
① Large hip flexion during the middle phase of the swing leg
② Large knee flexion

* Yellow highlight: Double limb support phase



4 Pin: Lack of Followability

One of the significant drawbacks of the PIN System is the increased effort required to move the leg forward and swing it back. This lack of followability means that amputees with the PIN System must exert more energy during walking, leading to faster fatigue and less efficient movement.



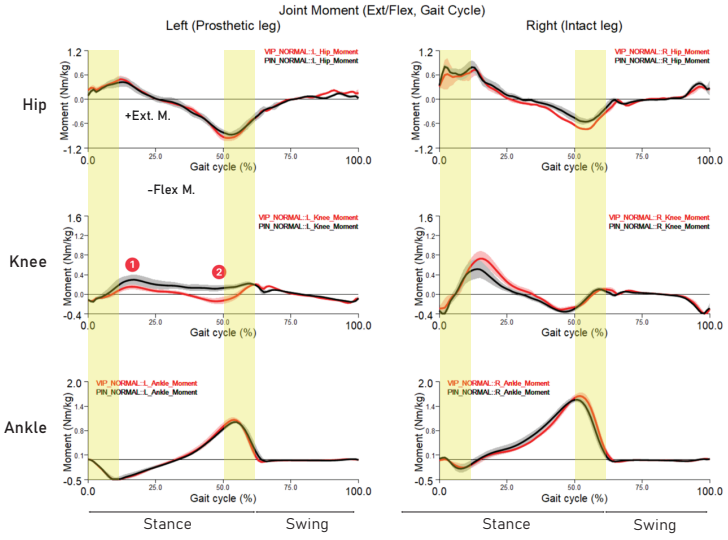
PIN
① Large extension velocity at the knee joint in the middle phase of the swing leg.
② Large hip flexion speed at the end of the swing leg: swing the leg back

* Yellow highlight: Double limb support phase

5 Balanced Muscle Activation

The VIP System's design ensures balanced muscle activation during walking. Both the anterior thigh muscles during extension and the posterior thigh muscles during flexion are activated in a way that mirrors natural leg movement. This balanced activation reduces the risk of muscle overuse and contributes to a more efficient and comfortable gait.

Joint Moment = Muscle Activation



* Yellow highlight: Double limb support phase

6 Stride Improvement

The advantages of the VIP System culminate in stride improvement. With enhanced stride characteristics, including increased speed, length, and step balance, the VIP System outperforms the PIN System in every aspect. This improvement is not just about numbers; it translates into a more comfortable, natural, and less strenuous walking experience for the user.

① Speed: +0.08 m/s ② Stride Length: +4.3cm
③ Left Step Length+1.7cm ④ Right Step Length: +2.5cm

Temporal and Distance Metrics