Gait Analysis Reference

Key Deviations, Biomechanical Causes and Orthotic Responses

Observational gait analysis remains a core clinical tool in podiatric biomechanics assessment. This reference covers the gait cycle phases, key observable deviations, their common biomechanical causes, and the orthotic modifications and strategies used to address them.

1 Gait Cycle Quick Reference

Phase	% Gait Cycle	Key Biomechanical Events	Orthotic Relevance
Initial Contact (Heel Strike)	0–2%	Calcaneus contacts ground; STJ begins to pronate; tibial internal rotation initiated	Rearfoot posting and heel cup control calcaneal position at contact
Loading Response	0–12%	Rapid STJ pronation; shock attenuation; knee flexes; tibial internal rotation	Cushioning and rearfoot control most influential here
Midstance	12–31%	STJ approaches neutral; arch loads; tibia advances over foot; single limb support	Arch support and STJ control through midstance
Terminal Stance	31–50%	Heel rises; STJ begins to supinate; windlass mechanism activates; 1st MTPJ loads	1st ray modifications critical; forefoot posting and Morton's/reverse Morton's
Pre-Swing (Toe-Off)	50–62%	Push-off via 1st ray; STJ supinated; final propulsion	Forefoot stiffness and propulsive modifications
Initial Swing	62–75%	Foot clears ground; ankle dorsiflexes; toe extension	Minimal direct orthotic influence
Mid/Terminal Swing	75–100%	Limb advances; foot prepares for heel strike	Orthotic affects position foot is in at contact

2 Key Gait Deviations: Clinical Reference

Deviation	When in Gait Cycle	Common Cause(s)	Associated Pathologies	Orthotic Response
Excessive Calcaneal Eversion (Pronation)	Heel contact through midstance	Forefoot varus deformity; flexible flat foot; ligamentous laxity; tibialis posterior weakness	Plantar fasciitis, PTTD, MTSS, PFPS, hallux valgus	Medial heel skive; rearfoot varus post; medial arch support; consider medial flange

Deviation	When in Gait Cycle	Common Cause(s)	Associated Pathologies	Orthotic Response
Delayed / Absent Resupination	Late midstance through propulsion	Forefoot varus; STJ hypermobility; inadequate windlass activation; peroneal/tibialis posterior imbalance	FHL, hallux valgus, propulsive insufficiency, abductory twist	Forefoot varus post; reverse Morton's/kinetic wedge; rigid or semi-rigid shell
Abductory Twist	Heel lift / toe-off	Delayed resupination; forefoot varus; FHL; tight Achilles	FHL, hallux valgus, 1st MTPJ loading issues	Reverse Morton's extension; forefoot varus post; heel raise if equinus contributing
Early Heel Rise	Mid-to-late midstance	Equinus (gastrocnemius/osseous); tight Achilles; pain avoidance	Insertional Achilles, forefoot overload, met stress fractures	Heel raise to reduce dorsiflexion demand; address equinus
Antalgic Gait (shortened stance phase)	Throughout stance on affected limb	Pain anywhere in lower limb; protective guarding	Any painful pathology	Pain source-specific — offloading modifications to affected region
Trendelenburg Gait / Contralateral Pelvic Drop	Midstance (single limb support)	Hip abductor weakness (gluteus medius); leg length discrepancy	GTPS, ITBS, PFPS, LBP	LLD correction (heel raise to short limb); cannot replace hip strengthening — orthotic role is adjunctive
Excessive Foot Progression Angle (Out-toeing)	Throughout stance	External tibial torsion; external femoral position; STJ supination; peroneal dominance	Lateral metatarsalgia; peroneal tendinopathy; lateral ankle instability	Lateral modifications if driven by supinated foot; address rotational causes above the foot
Reduced Foot Progression Angle (In-toeing)	Throughout stance	Internal tibial torsion; femoral anteversion; STJ pronation driving tibial internal rotation	MTSS, PFPS, medial knee pain	Medial rearfoot and forefoot corrections to reduce STJ pronation and tibial internal rotation
Calcaneal Varus (Lateral Heel Contact)	Heel contact	Pes cavus; forefoot valgus; peroneal weakness; idiopathic	Lateral ankle instability, peroneal tendinopathy, 5th met stress fracture	Lateral heel skive; lateral rearfoot post; lateral flange; forefoot valgus post
High-Stepping Gait / Foot Drop	Swing phase	Neurological — foot drop; L4/L5 nerve root; peroneal nerve palsy	Neurological pathology	Orthotic: AFO or ankle-foot management — refer appropriately; not a standard podiatric orthotic indication
Stiff Propulsion / Reduced 1st MTPJ Dorsiflexion	Pre-swing / toe-off	Hallux rigidus; FHL; 1st MTPJ arthrosis	Hallux rigidus, sesamoiditis, submetatarsal pain	Morton's extension (rigidus); reverse Morton's (FHL); rocker-bottom footwear adjunct

Deviation	When in Gait Cycle	Common Cause(s)	Associated Pathologies	Orthotic Response
Excessive Midfoot Loading / Flat Contact	Loading response through midstance	Severe flexible flat foot; ligamentous laxity; pes planus	PTTD, plantar fasciitis, midfoot arthritis	Rigid control orthotic; medial arch support; casting in STJ neutral

3 Observational Gait Analysis: Systematic Approach

OBSERVE FROM MULTIPLE PLANES

Posterior: calcaneal eversion/inversion, pelvic obliquity, knee alignment. Lateral: foot progression, heel rise timing, trunk posture, ankle dorsiflexion. Anterior: foot progression angle, knee tracking, pelvic tilt. Each plane reveals different components of the gait deviation.

OBSERVE FOOTWEAR WEAR PATTERN FIRST

Wear patterns offer rapid insight: medial heel wear = excessive pronation; lateral forefoot wear = propulsive avoidance or cavus pattern; central forefoot wear = equinus or tight Achilles. Assess before the patient walks.

VIDEO AT NORMAL WALKING SPEED

Many gait features — abductory twist, foot progression, calcaneal eversion — are too fast to capture reliably at normal speed with the naked eye. Slow-motion video (even from a smartphone) significantly improves observational accuracy. Treadmill gait analysis improves repeatability.

Gait analysis informs but does not replace assessment. The same deviation can have multiple causes — excessive pronation may be driven by forefoot varus, equinus, ligamentous laxity, tibialis posterior weakness, or a combination. Always correlate gait findings with static measurements, patient history, and pathology before determining the orthotic prescription.