Orthotic Modifications Reference

A Comprehensive Clinical Guide to Orthotic Modifications

Orthotic modifications alter the mechanical environment of the foot and lower limb by changing the direction, magnitude, and timing of ground reaction forces (GRF), influencing joint moments, muscle activity, and tissue loading. This reference covers the most clinically relevant modifications — their location, biomechanical mechanism, gait and loading effects, primary indications, and contraindications/cautions.

1 Rearfoot Modifications

1. Medial Heel Skive (Kirby Skive)

Aspect	Detail
Location	Medial aspect of heel cup, ground surface of shell
Biomechanical Effect	Creates a laterally directed GRF vector beneath the medial heel; supinatory moment about the subtalar joint (STJ); reduces STJ pronation moments
Gait Influence	Reduces calcaneal eversion at heel strike; limits midstance pronation; may reduce abductory twist
Loading Changes	Reduces load on medial plantar structures; increases lateral column loading
Primary Indications	Excessive pronation, PTTD/adult acquired flat foot, plantar fasciitis (medial), medial tibial stress syndrome, hallux valgus progression
Contraindications / Cautions	Supinated foot type; lateral instability; peroneal tendinopathy

2. Lateral Heel Skive

Aspect	Detail
Location	Lateral aspect of heel cup, ground surface of shell
Biomechanical Effect	Creates a medially directed GRF beneath lateral heel; pronatory moment about STJ; reduces supination moments
Gait Influence	Reduces calcaneal inversion; encourages midstance pronation; improves lateral weight transfer
Loading Changes	Reduces lateral column and peroneal loading; increases medial column load
Primary Indications	Pes cavus, rigid supinated foot, lateral ankle instability, peroneal tendinopathy, 5th metatarsal stress fractures
Contraindications / Cautions	Hypermobile flat foot; PTTD; medial instability

3. Heel Raise (Heel Lift)

Aspect	Detail
Location	Beneath the heel section of the orthotic (intrinsic) or as an extrinsic heel raise
Biomechanical Effect	Reduces ankle dorsiflexion demand; shortens effective gastrocnemius/soleus length; reduces Achilles tendon tensile load; reduces subtalar joint compression
Gait Influence	Earlier heel lift; reduced tibial advancement; may increase forefoot loading
Loading Changes	Reduces Achilles and plantar fascia tensile load; increases forefoot plantar pressure
Primary Indications	Insertional Achilles tendinopathy, mid-portion Achilles (adjunct), leg length discrepancy (short limb), equinus deformity
Contraindications / Cautions	Forefoot pathology; metatarsalgia; bilateral raises needed if unilateral LLD correction

4. Deep Heel Cup

Aspect	Detail
Location	Elevated walls of the heel cup (medial, lateral and posterior)
Biomechanical Effect	Encapsulates heel fat pad; improves heel fat pad containment and shock absorption; increases STJ control through soft tissue compression
Gait Influence	Improved heel strike cushioning; reduced calcaneal motion in early stance
Loading Changes	Redistributes plantar heel pressure; reduces focal calcaneal loading
Primary Indications	Heel fat pad syndrome, calcaneal stress fracture (recovery), plantar fasciitis, elderly patients with fat pad atrophy, heel pain in general
Contraindications / Cautions	Bony heel prominences (Haglund's); calcaneal exostoses — may increase pressure

5. Rearfoot Valgus Post (Lateral Rearfoot Post / Lateral Wedge)

Aspect	Detail
Location	Lateral rearfoot, ground surface
Biomechanical Effect	Tilts calcaneus into valgus (eversion); pronatory STJ moment; reduces lateral GRF at rearfoot
Gait Influence	Reduces calcaneal inversion; improves medial weight transfer at heel contact
Loading Changes	Reduces lateral heel loading; shifts load medially
Primary Indications	Pes cavus, rigid supinated foot, lateral ankle instability, ITBS (adjunct), knee OA medial compartment (lateral wedge effect)
Contraindications / Cautions	Hypermobile flat foot; medial tibial stress syndrome

6. Rearfoot Varus Post (Medial Rearfoot Post / Medial Wedge)

Aspect	Detail
Location	Medial rearfoot, ground surface
Biomechanical Effect	Tilts calcaneus into varus (inversion); supinatory STJ moment; increases medial GRF at rearfoot
Gait Influence	Reduces calcaneal eversion; limits midstance pronation
Loading Changes	Increases medial heel loading; reduces lateral column load
Primary Indications	Excessive rearfoot pronation, flexible flat foot, medial tibial stress syndrome, patellofemoral pain (adjunct)
Contraindications / Cautions	Supinated foot; pes cavus; lateral knee OA

22. Heel Cushioning Pad

Aspect	Detail
Location	Beneath the heel section of the orthotic, added to the undersurface or as a top cover addition within the heel cup
Biomechanical Effect	Attenuates heel strike impact forces; improves shock absorption at initial contact; reduces peak calcaneal plantar pressure; complements deep heel cup containment
Gait Influence	Softer heel strike; reduced impact transient; may slow initial loading response
Loading Changes	Reduces peak heel pressure at initial contact; distributes impact forces over a larger calcaneal area; reduces calcaneal bone stress
Primary Indications	Heel fat pad syndrome/atrophy, calcaneal stress fracture (transition phase), plantar fasciitis (adjunct), elderly patients with reduced heel fat pad, generalised heel pain with impact sensitivity
Contraindications / Cautions	Excessive softness can reduce proprioception and STJ control — balance cushioning with required control level; Poron or Poron XRD preferred over EVA for longevity
Materials	Poron (standard), Poron XRD (impact-specific), Plastazote Grade 1 (total contact/diabetic), PPT

23. Horseshoe Heel Pad

Aspect	Detail
Location	U-shaped or horseshoe-shaped pad within the heel cup, open at the centre — surrounds the plantar heel but leaves a central void directly under the most painful area
Biomechanical Effect	Offloads the central plantar heel (calcaneal tubercle) by transferring load to the perimeter of the heel; reduces focal compressive pressure at the calcaneal fat pad centre or specific pain point
Gait Influence	Reduces antalgic heel strike pattern; allows more normal heel contact pressure distribution
Loading Changes	Transfers peak heel pressure to heel perimeter; void must be accurately positioned over the pain focus
Primary Indications	Heel fat pad syndrome with central focal pain, plantar fasciitis with severe calcaneal tubercle tenderness, calcaneal bursitis, post-injection heel soreness, heel ulceration (diabetic — to offload ulcer site)
Contraindications / Cautions	Must be precisely positioned — if the void does not align with the pain point it is ineffective; perimeter must not create edge pressure on adjacent sensitive tissue

24. 5th Ray / 5th Metatarsal Cut-Out

Aspect	Detail
Location	Lateral forefoot — a recess or aperture in the orthotic shell/top cover beneath the 5th metatarsal base or head
Biomechanical Effect	Offloads the 5th metatarsal by creating a void or reducing contact pressure at its plantar surface; reduces lateral forefoot peak pressure at the 5th ray
Gait Influence	Reduces lateral forefoot pain; may improve lateral foot contact comfort and gait symmetry
Loading Changes	Reduces plantar pressure at 5th metatarsal base and/or head; redistributes to adjacent areas
Primary Indications	5th metatarsal stress fracture (Jones fracture recovery — offloading phase), 5th metatarsal base apophysis (Iselin's disease — paediatric), lateral forefoot bursitis, tailor's bunion (bunionette) with plantar pressure sensitivity, chronic 5th met head callosity
Contraindications / Cautions	Adjacent metatarsal pathology; lateral column instability — lateral offloading may destabilise lateral arch; assess peroneus brevis insertion (5th base) separately

2 Forefoot Modifications

7. Forefoot Valgus Post (Lateral Forefoot Post / Lateral Forefoot Wedge)

Aspect	Detail
Location	Lateral forefoot, under 4th and 5th metatarsal heads
Biomechanical Effect	Elevates lateral forefoot; promotes forefoot supination; reduces lateral forefoot loading; may reduce subtalar pronation in late stance
Gait Influence	Reduces lateral forefoot loading in late stance; promotes medial propulsion
Loading Changes	Reduces 4th/5th metatarsal head pressure; increases medial column (1st ray) loading
Primary Indications	Forefoot valgus deformity, lateral metatarsalgia, peroneal tendinopathy, 5th metatarsal stress fractures, lateral ankle instability
Contraindications / Cautions	1st ray pathology; hallux rigidus; sesamoiditis

8. Forefoot Varus Post (Medial Forefoot Post / Medial Forefoot Wedge)

Aspect	Detail
Location	Medial forefoot, under 1st and 2nd metatarsal heads
Biomechanical Effect	Elevates medial forefoot; promotes forefoot pronation; reduces medial forefoot loading; STJ supinatory effect in late stance
Gait Influence	Reduces medial forefoot loading; improves lateral propulsion; reduces abductory twist
Loading Changes	Reduces 1st/2nd metatarsal head pressure and sesamoid load; increases lateral column loading
Primary Indications	Forefoot varus deformity, hallux valgus, sesamoiditis, functional hallux limitus (adjunct), medial metatarsalgia
Contraindications / Cautions	Lateral metatarsalgia; peroneal tendinopathy; pes cavus with rigid forefoot

9. Morton's Extension

Aspect	Detail
Location	Extension beneath 1st metatarsal head and hallux, full length of 1st ray
Biomechanical Effect	Blocks hallux dorsiflexion; reduces 1st MTPJ range of motion; reduces dorsiflexion moment at 1st MTPJ; redistributes propulsive forces
Gait Influence	Reduces hallux dorsiflexion in late stance/propulsion; may alter propulsive mechanics
Loading Changes	Reduces 1st MTPJ dorsiflexion stress; redistributes propulsive load to lesser toes/lateral column
Primary Indications	Hallux rigidus (limits painful dorsiflexion), hallux limitus, turf toe, 1st MTPJ arthritis
Contraindications / Cautions	Functional hallux limitus (opposite effect needed — see Reverse Morton's); lesser toe deformities; metatarsalgia

10. Reverse Morton's Extension (1st Ray Cut-Out)

Aspect	Detail
Location	Recess/cut-out beneath 1st metatarsal head — 1st ray is recessed/dropped relative to lesser metatarsals
Biomechanical Effect	Plantarflexes 1st ray relative to orthotic surface; enhances 1st MTPJ dorsiflexion (windlass mechanism); promotes hallux dorsiflexion
Gait Influence	Facilitates windlass activation in late stance; improves medial propulsion; reduces abductory twist
Loading Changes	Reduces plantar pressure under 1st metatarsal head; increases propulsive hallux loading
Primary Indications	Functional hallux limitus, hallux valgus, excessive pronation (via windlass), forefoot equinus
Contraindications / Cautions	Hallux rigidus (structural — would increase pain); 1st MTPJ pain; sesamoiditis

11. Kinetic Wedge (Functional Kinetic Wedge)

Aspect	Detail
Location	Medial forefoot extension — bevelled wedge beneath 1st and 2nd metatarsal heads, tapering to lateral border
Biomechanical Effect	Combination of Reverse Morton's and medial forefoot wedge effect; promotes 1st ray plantarflexion and windlass activation while offloading medial forefoot
Gait Influence	Promotes normal hallux dorsiflexion and windlass activation; reduces overpronation in propulsion
Loading Changes	Redistributes forefoot load; reduces medial forefoot pressure; improves propulsive efficiency
Primary Indications	Functional hallux limitus, excessive late-stance pronation, hallux valgus, 1st ray hypermobility
Contraindications / Cautions	Hallux rigidus; fixed forefoot valgus; 1st MTPJ pain

3 Forefoot Offloading Modifications

12. Metatarsal Dome / Metatarsal Bar

Aspect	Detail
Location	Proximal to the metatarsal heads (behind the met heads, not under them)
Biomechanical Effect	Redistributes forefoot load proximally; reduces peak plantar pressure under metatarsal heads by spreading load to metatarsal shafts
Gait Influence	Reduces forefoot pain in late stance; may alter toe-off mechanics
Loading Changes	Reduces metatarsal head plantar pressure significantly; increases metatarsal shaft loading
Primary Indications	Metatarsalgia (generalised or specific), Morton's neuroma, plantar plate injury, lesser toe deformities, forefoot fat pad atrophy
Contraindications / Cautions	Incorrect placement is critical — if placed under metatarsal heads rather than proximal to them, plantar pressure increases significantly

13. Dancer's Pad (U-Pad / Sesamoid Off-Load)

Aspect	Detail
Location	U-shaped aperture surrounding the 1st metatarsal head/sesamoids, leaving them unloaded
Biomechanical Effect	Offloads 1st metatarsal head and sesamoid complex by redistributing load to surrounding tissue
Gait Influence	Reduces sesamoid and 1st metatarsal head loading during propulsion
Loading Changes	Significant reduction in sesamoid and 1st MTPJ plantar pressure; increases pressure to adjacent areas
Primary Indications	Sesamoiditis, sesamoid stress fracture, hallux valgus with sesamoid irritation, 1st MTPJ capsulitis
Contraindications / Cautions	Adjacent metatarsal pathology; neuroma at 1st/2nd interspace

14. Neuroma Pad (Intermetatarsal Pad)

Aspect	Detail
Location	Beneath the intermetatarsal space (typically 2nd/3rd or 3rd/4th), proximal to metatarsal heads
Biomechanical Effect	Spreads adjacent metatarsals; reduces intermetatarsal nerve compression; distributes load away from the interspace
Gait Influence	Reduces late-stance pain and altered gait patterns secondary to neuroma pain
Loading Changes	Reduces compressive forces in the intermetatarsal space
Primary Indications	Morton's neuroma (2nd/3rd or 3rd/4th interspace), intermetatarsal bursitis
Contraindications / Cautions	Placement must be in the interspace, not under metatarsal heads — incorrect placement worsens symptoms

15. Plantar Fascial Groove (Fascia Channel)

Aspect	Detail
Location	Medial longitudinal arch area — groove/recess along the path of the plantar fascia
Biomechanical Effect	Reduces direct plantar fascia compression; allows fascia to expand during weight-bearing without impingement on the orthotic
Gait Influence	Reduces mid-stance fascial pain; may improve step length
Loading Changes	Reduces direct compressive load on plantar fascia; primarily a pressure distribution modification
Primary Indications	Plantar fasciitis/fasciosis (adjunct to arch support and heel cushioning), plantar fibroma
Contraindications / Cautions	Must be combined with appropriate arch support — groove alone is insufficient

19. Metatarsal Aperture

Aspect	Detail
Location	A cut-out/aperture in the orthotic shell or top cover directly beneath a specific metatarsal head (most commonly 2nd, 3rd, or 4th)
Biomechanical Effect	Provides focal offloading of a single metatarsal head by creating a void beneath it; pressure redistributes to adjacent metatarsals and shaft rather than concentrating at the head
Gait Influence	Reduces peak pressure at targeted met head during late stance and propulsion; may alter forefoot loading pattern
Loading Changes	Significant focal pressure reduction at targeted met head; adjacent met heads absorb redistributed load — assess for adjacent pathology
Primary Indications	Isolated metatarsal head ulceration (diabetic/neuropathic), discrete metatarsalgia at one head, metatarsal stress fracture (acute offloading phase), plantar plate injury at specific ray
Contraindications / Cautions	Adjacent metatarsal pathology that cannot accommodate redistributed load; ensure aperture is correctly sized and positioned — too small is ineffective, too large creates edge pressure

20. Cuboid Pad

Aspect	Detail
Location	Beneath the plantar surface of the cuboid — lateral midfoot, between heel and 4th/5th metatarsal bases
Biomechanical Effect	Supports the cuboid in its dorsal position; resists plantar displacement; reduces peroneus longus traction force on the cuboid; provides lateral arch support
Gait Influence	Stabilises the lateral column during midstance and propulsion; reduces lateral midfoot pain and the altered gait patterns it causes
Loading Changes	Redistributes load away from the cuboid plantar surface; supports lateral longitudinal arch
Primary Indications	Cuboid syndrome, lateral midfoot pain, lateral column instability, peroneus longus traction issues
Contraindications / Cautions	Confirmed cuboid stress fracture (acute phase — total offloading required instead); lateral bony prominence

21. Navicular Pad

Aspect	Detail
Location	Beneath and medial to the navicular tuberosity — proximal medial midfoot
Biomechanical Effect	Supports the navicular; reduces medial midfoot loading; offloads the navicular tuberosity from direct plantar/medial pressure; contributes to medial longitudinal arch support
Gait Influence	Reduces navicular drop during midstance; may reduce talonavicular stress
Loading Changes	Redistributes pressure away from navicular tuberosity and medial midfoot
Primary Indications	Navicular stress fracture (transition/recovery phase), accessory navicular pain, medial midfoot bursitis, navicular tuberosity prominence, medial arch pain with focal navicular tenderness
Contraindications / Cautions	Acute navicular stress fracture (requires immobilisation first); must be precisely positioned — misplaced pad can increase navicular pressure

4 Flange & Cup Modifications

16. Medial Flange (Extended Medial Wall)

Aspect	Detail
Location	Extended medial wall of the orthotic shell, running from heel to midfoot
Biomechanical Effect	Increases medial STJ control through mechanical blocking; resists calcaneal eversion and talar adduction/plantarflexion
Gait Influence	Reduces midfoot collapse; limits excessive pronation throughout stance
Loading Changes	Increases medial column support; redistributes load from medial soft tissues to orthotic structure
Primary Indications	Severe hypermobile flat foot, PTTD stage I–II, paediatric flat foot, significant calcaneal eversion
Contraindications / Cautions	Footwear width limitations; medial bony prominences; brachymetatarsia

17. Lateral Flange (Extended Lateral Wall)

Aspect	Detail
Location	Extended lateral wall of the orthotic shell, running from heel to midfoot/forefoot
Biomechanical Effect	Resists calcaneal inversion; blocks lateral GRF displacement; improves lateral STJ stability
Gait Influence	Reduces lateral ankle instability episodes; limits calcaneal inversion in late stance
Loading Changes	Increases lateral column support; reduces peroneal loading demand
Primary Indications	Chronic lateral ankle instability, pes cavus with lateral instability, peroneal tendinopathy, lateral ankle sprains (recurrent)
Contraindications / Cautions	Footwear width; lateral bony prominences; 5th metatarsal base sensitivity

5 Shell Geometry Modifications

25. Orthotic Shell Width Modification

Aspect	Detail
Location	Medial and/or lateral borders of the orthotic shell body
Biomechanical Effect	Wider shell: more contact area, greater load distribution and stability; narrower shell: fits tighter footwear; medial extension increases medial column support; lateral extension increases lateral column engagement
Gait Influence	Full-width shell provides more consistent contact throughout stance; narrow shell may allow medial/lateral foot overhang, reducing effective control
Loading Changes	Wider shell reduces peak plantar pressures by distributing load; medial extension adds medial longitudinal arch loading; lateral extension adds lateral column support
Primary Indications	Wide shell: maximum control indications (PTTD, severe flat foot); narrow shell: narrow footwear (dress shoes, cycling shoes); medial extension: hypermobile flat foot, tibialis posterior dysfunction
Contraindications / Cautions	Shell must fit footwear without displacement or rocking; excessive width causes footwear fit failure; lateral extension may cause 5th metatarsal base pressure

26. Frame Filler (Medial Longitudinal Arch Fill)

Aspect	Detail
Location	The void/space beneath the medial longitudinal arch between the heel and forefoot sections of the orthotic
Biomechanical Effect	Fills the medial arch void, increasing the contact area under the plantar medial arch; provides continuous load distribution from heel to forefoot; increases arch support by engaging the plantar arch surface
Gait Influence	Reduces arch collapse in midstance; provides proprioceptive input through arch contact; may improve STJ control through increased contact area
Loading Changes	Distributes medial arch loading along the entire arch rather than concentrating at heel and forefoot only; reduces midfoot soft tissue stress
Primary Indications	Hypermobile flat foot, PTTD stage I, pes planus with medial arch pain, patients who feel orthotics are not touching their arch
Contraindications / Cautions	Pes cavus (rigid arch — frame fill will create dorsal pressure on plantar arch); navicular bursitis with arch tenderness; must use appropriate material (EVA, Poron, or Plastazote) — rigidity of fill must match required arch control

27. Frame Undercut (Medial Longitudinal Arch Undercut)

Aspect	Detail
Location	Undersurface of the medial arch section — material is ground/removed from beneath the medial longitudinal arch area of the shell
Biomechanical Effect	Creates clearance between the orthotic and the plantar arch surface; allows the arch to drop slightly without contacting the orthotic; reduces direct compressive pressure on the plantar arch
Gait Influence	Reduces arch pressure during midstance; accommodates patients who are sensitive to direct arch contact
Loading Changes	Reduces medial arch plantar pressure; may slightly reduce arch support effect — trade-off between comfort and control
Primary Indications	Plantar arch tenderness/bursitis, navicular tuberosity sensitivity, patients who cannot tolerate direct arch contact, plantar fascia sensitivity in the arch region, medial plantar nerve entrapment
Contraindications / Cautions	Not appropriate when maximum arch support is the primary goal (PTTD, severe pronation); do not combine with frame filler

28. Heel Aperture

Aspect	Detail
Location	A void/cut-out in the heel section of the orthotic shell, typically beneath the central plantar heel (calcaneal tubercle) or a specific painful focal point
Biomechanical Effect	Transfers load away from the targeted heel area by creating a void; pressure redistributes to the heel perimeter and surrounding plantar surface; similar in principle to horseshoe pad but incorporated into the shell itself
Gait Influence	Reduces focal heel pain at initial contact; allows more comfortable heel strike
Loading Changes	Eliminates direct shell contact at the cut-out site; surrounding shell edges redistribute pressure to adjacent heel tissue — edge must be bevelled/chamfered to avoid pressure concentration
Primary Indications	Heel fat pad central focal pain, inferior calcaneal spur with point tenderness, plantar fasciitis with severe calcaneal tubercle focal pain, heel ulcer offloading (bespoke/diabetic), Haglund's-related plantar pain
Contraindications / Cautions	Shell edges must be smoothed/bevelled to prevent edge irritation; shell integrity must be maintained — too large an aperture weakens the heel section; not for diffuse heel pain (horseshoe or cushioning more appropriate)

29. Heel Undercut

Aspect	Detail
Location	The posterior edge of the heel section — ground/skived away on the posterior plantar surface of the shell
Biomechanical Effect	Allows the heel to rock into the orthotic at heel strike by bevelling the posterior edge; reduces abrupt heel contact; smoother heel strike transition; reduces impact forces at initial contact
Gait Influence	Smoother transition from heel strike to foot flat; reduces heel strike impact transient; improves heel contact comfort especially with rigid shells
Loading Changes	Reduces peak pressure at posterior heel edge; distributes heel strike load more gradually
Primary Indications	Patients complaining of heel edge discomfort with rigid orthoses, insertional heel pain, older patients with rigid gait pattern, heel pain where rigid shell posterior edge is causing a pressure point, transition from accommodative to functional orthosis
Contraindications / Cautions	Excessive undercut reduces posterior heel control; do not apply to polypropylene where structural integrity is critical; must be symmetrical bilaterally

6 Top Cover Variations

18. Full-Length Top Cover vs Sulcus Length vs 3/4 Length

Length	Where It Ends	Clinical Use
Full Length (to end of toes)	Distal tip of toes	Maximum cushioning; protects toe surfaces; preferred for neuropathy, forefoot pathology, toe deformities
Sulcus Length (to just behind met heads)	Proximal to metatarsal heads / sulcus	Most common choice; balances forefoot feel with orthotic function; suitable for most presentations
3/4 Length (to met heads)	At the metatarsal heads	Maximises shoe space; less forefoot influence; preferred for dress shoes or tight footwear

CLINICAL CONSIDERATION — TOP COVER MATERIAL

Top cover material choice (Poron, Plastazote, EVA, leather) is as important as length — material properties determine cushioning, shear reduction, and durability. Refer to the Materials Reference (M2) for full material guidance.

This reference covers 29 modifications across 6 sections. Modifications should always be selected based on clinical assessment findings, biomechanical rationale, and patient-specific factors. Combinations of modifications are common — ensure the combined mechanical effect is considered as a whole.