Unit 1: Fundamentals of Injury Mechanisms

PAPER 8 — Injury Prevention

Unit 1: Fundamentals of Injury Mechanisms

(Causes of MSK injuries • Movement biomechanics • Risk factors in martial & therapeutic contexts • Acute vs. chronic • Warm-up & cooldown)

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1) Understanding common causes of musculoskeletal injuries

Most injuries happen when **tissue demand exceeds tissue capacity**. Capacity is built by genetics, nutrition, sleep, prior training, and recovery; demand spikes with harder/longer/faster work or poor technique. In practice, five patterns account for most problems:

- **Load spikes**: abrupt jumps in training volume or intensity (new stance drills, extra weapon practice, longer treatments without conditioning) outpace tendon/ligament adaptation.
- **Technique faults**: valgus knees in deep lunges, spinal hinging instead of hip hinging, punching with a rotated wrist, or therapists pressing vertically from the thumb instead of stacking joints.
- **Under-recovery**: poor sleep, low iron/protein, dehydration, or stress reduce collagen turnover and motor control.
- **Environment & equipment**: hard/slippery floors, cold rooms (stiff tissues), worn footwear, cluttered spaces.
- **Medical/constitutional factors**: hypermobility, prior injury, metabolic conditions—these don’t doom you, but they raise the bar for preparation and monitoring.

Think of injury risk as a **stack**: when several modest risks coincide (cold room + heavy session + new drill + little sleep), the same movement that was fine yesterday can injure today.

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2) Biomechanics of movement and postural stress

Levers and lines of force explain why some positions hurt more than others. The farther a load is from a joint, the higher the torque. Deep stances increase knee and hip moments; overhead motions elevate shoulder demand; spinal load rises when the trunk leans while the core is lax.

Key ideas for safe mechanics:

- **Neutral zones, then excursion**: establish rib-cage–pelvis alignment before reaching into extremes.
- **Hip hinge > spinal hinge**: fold at hips with a long spine for lifting, striking from the ground, or leaning during bodywork.
- **Knee tracking**: knees align over 2nd–3rd toe; avoid collapsing inward under fatigue.
- **Scapular mechanics**: upward rotation + posterior tilt create space for overhead strikes and staff work.
- **Ankle dorsiflexion**: limited dorsiflexion pushes stress to the knee and low back; mobilize ankles to save knees.
- **Breath & pressure**: diaphragmatic breathing and gentle abdominal brace create intra-abdominal pressure that shares spinal load (“can inside the torso”).
- **Eccentric control**: most strains occur when decelerating (landing, catching, lowering). Train slow, controlled eccentrics.

Postural stress is **time × load**. Ten minutes of sub-optimal posture is tolerable; hours become tendinopathy. Micro-breaks reset the clock.

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3) Risk factors in traditional martial and therapeutic practices

Kalaripayattu practice

- **Low, long stances (vadivu)**: knee valgus, ankle collapse, and hip adduction under fatigue → patellofemoral and adductor strains.
- **High kicks & spins**: hamstring/adductor strains, lumbar rotation stress if core/hip timing is late.
- **Weapons forms**: shoulder impingement if scapulae don't upwardly rotate; wrist tendons if grip is too rigid.
- **Barefoot on hard floors**: plantar fascia and Achilles overload without progressive conditioning.

Kalari Uzhichil (therapeutic) practice

- **Therapist overuse**: thumbs/wrists pressed vertically, long reaches across the table, static trunk flexion → CMC arthritis, lateral epicondylitis, low-back fatigue.
- **Heat hazards**: steaming or bolus too hot; stacked heat over chest/abdomen; slippery floors from oils.
- **Marma zones**: excessive depth/pressure over heart, umbilicus, pelvic and carotid areas.
- **Clinic factors**: poor table height, cold room (stiff clients, strained therapist), inadequate towel management (slip risk).

Mitigation is simple: **progressive loading**, **mechanics coaching**, **ergonomics** (stacked joints, neutral wrists, table at mid-thigh to wrist-crease height), and **temperature control**.

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4) Difference between acute and chronic injuries

Acute injuries are sudden (sprain, strain, contusion). They feature sharp pain, swelling, warmth, and functional loss. Early care: protect, relative rest, compression, elevation, gentle pain-free motion, and medical review for severe loss of function or deformity.

Chronic/overuse injuries develop slowly (tendinopathy, bursitis, stress reaction). Pain is dull/aching, worse with repeated load, better with warm-up, and may flare after activity. Management blends **load reduction**, **technique correction**, **graded strength (especially eccentrics)**, mobility where limited, and **sleep/nutrition** improvements.

Healing timelines vary: muscle (2–4 weeks), tendon (6–12+), ligament (8–12+), bone stress (6–8+). Pain can calm before tissue is strong—**progress gradually even when pain is gone**.

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5) Role of warm-up and cooldown in prevention

A smart warm-up raises temperature, switches on the right muscles, rehearses ranges, and "primes" the nervous system.

Warm-up (10–15 min; RAMP model):

- **Raise**: light skipping/shadow moves to elevate temperature and heart rate.
- **Activate**: core, glutes, mid-back (dead bug, glute bridge, scap push-ups).
- **Mobilize**: dynamic ankle, hip, thoracic flows; knee tracking drills.
- **Potentiate**: 2–3 short, crisp technique reps at session intensity (not fatigue).

Cooldown (5–10 min):

- Gentle locomotion to clear metabolites; **nasal breathing** (4-in/6-out) to shift to parasympathetic; **positional mobility** (calf, hip flexor, pec door stretch); skin temperature back to baseline before leaving.

Therapists also warm up: 3–5 minutes of **wrist/elbow circles, scap sets, hip hinge drills, and two slow diaphragmatic breaths** before first client; micro-breaks between clients.

Summary Tables

A) Common injury causes & how to mitigate

Cause	Examples	Mitigation
Load spikes	Doubling stance reps, extra weapon class, longer treatment day	10–20% weekly progression; deload weeks
Technique faults	Knee valgus, spinal hinge, rigid wrist	Coaching, mirrors/video, cue “knees track 2nd toe,” “hinge at hips,” neutral wrist
Under-recovery	<6–7 h sleep, low protein/iron, dehydration, stress	Sleep routine, 1.6–2.2 g/kg protein (athletes), fluids/electrolytes, stress hygiene
Environment	Hard/cold floors, clutter, poor lighting	Mats or floor prep, room at comfortable warmth, clear pathway
Prior injury	Old ankle sprain, shoulder impingement	Targeted strength/balance, ankle/shoulder prep in warm-up

B) Movement faults → quick corrections

Fault	Why it loads tissue	Fix (one cue)
Knees collapse inward in lunge	Increases patellofemoral stress	“Press knee out to 2nd–3rd toe”
Rounded low back when lifting	Shear on discs/ligaments	“Chest long, hinge from hips”
Overhead arm without scap motion	Rotator cuff pinch	“Reach then rotate—elbow to ceiling, shoulder blade up”
Short ankle dorsiflexion	Compensatory knee/hip load	“Knee to wall” ankle drills pre-session
Breath holding	Loses trunk pressure & control	“Exhale through effort, keep ribs soft”

C) Risk in martial & therapeutic practice

Context	Specific risk	Prevention
Low stances	Knee valgus, adductor strain	Ankle/hip mobility; glute activation; limit depth under fatigue
High kicks/spins	Hamstring/lumbar strain	Eccentric hamstring work; core timing; gradual height
Weapons forms	Shoulder impingement; wrist tendinopathy	Scap upward rotation drills; neutral wrist grip
Therapist thumbs/wrists	CMC pain, lateral elbow pain	Stack joints, use forearm/palm, adjust table height
Heat modalities	Burns, syncope	Temp checks, rotate boluses, no heat on high-risk marmas
Slippery floors	Falls	Towel discipline, footwear policy, spill SOP

D) Acute vs. chronic snapshot

Feature	Acute	Chronic/Overuse
Onset	Sudden	Gradual
Pain	Sharp → ache	Dull, morning stiffness, warms up
Signs	Swelling, redness, loss of function	Thickened tendon, crepitus
First steps	Protect, relative rest, compression, elevation, medical check if severe	Reduce/modify load, technique fix, eccentric strength, sleep/nutrition
Refer now if…	Deformity, “giving way,” night pain, neuro signs, fever	Persistent worsening >2–3 weeks despite load modification

E) Warm-up & cooldown checklists

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Phase	Do	Duration
Warm-up — Raise	Light cardio/shadow moves	2–3 min
Activate	Core/glute/scap sets	3–4 min
Mobilize	Ankles/hips/T-spine dynamic flows	3–5 min
Potentiate	2–3 crisp reps of key skills	1–3 min
Cooldown	Walk/breathe 4-in/6-out, gentle stretches	5–10 min

Key take-aways

1. Injuries are **capacity–demand mismatches**; adjust one or both.
2. Good mechanics = **hinge at hips, align knees, breathe and brace, control eccentrics**.
3. In Kalari and Kalari Uzhichil, reduce risk with **progression, ergonomics, temperature control, and marma safety**.
4. Distinguish **acute vs. chronic**—each needs a different first step.
5. A short, structured **warm-up and cooldown** is the cheapest insurance you can buy.