

Unit 2: Anatomy and Physiology for Injury Prevention

PAPER 8 — Injury Prevention

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(Key muscle-joint functions • Connective-tissue health • Nervous reflexes • Circulation in healing • Vulnerable zones/Marmas)

1) Key muscle groups and joint functions in Kalari practice -

Kalari uses long, low **vadivu** (stances), rapid **kicks and spins**, ground-to-standing transitions, and **weapon arcs**. The body must share load across the **ankle-knee-hip-spine-shoulder** chain.

Lower quarter. The **ankle-foot** complex provides spring and balance: calf (gastrocnemius-soleus), tibialis posterior, peroneals, and foot intrinsics keep the arch responsive. The **knee** is a hinge that tolerates flex-extend but little rotation; the **quadriceps** control descent and landings, while **hamstrings** and **popliteus** protect against shear. The **hip** is the powerhouse: **gluteus maximus** produces drive, **gluteus medius/minimus** and deep rotators (piriformis, gemelli, obturator group) steer the femur so the knee tracks over the second-third toe. **Adductors** and **iliopsoas** contribute to high kicks but, under fatigue, become strain-prone if gluteals underperform.

Trunk and breath. The **diaphragm**, **transversus abdominis**, **obliques**, and **multifidus** create a pressure “canister” that shares spinal load. When stances or strikes are performed with breath-holding and a lax trunk, the lumbar spine takes shear instead of the hips taking hinge.

Upper quarter. Overhead arcs and thrusts demand **scapular rhythm**: serratus anterior and lower trapezius upwardly rotate and posteriorly tilt the scapula, clearing space for the rotator cuff (supraspinatus, infraspinatus, teres minor, subscapularis). Without that rhythm, impingement follows. At the **elbow** and **wrist**, extensors/flexors must withstand repetitive gripping; neutral wrist and forearm rotation save tendons in weapon work and in therapy (Uzhichil).

How this prevents injury. Move big loads at **hips and shoulders**, not small joints. Keep **knees tracking** with the foot, maintain **ankle dorsiflexion** for safe squat depth, and time **breath with effort** to stabilize the spine.

2) Ligaments, tendons, and connective tissue health -

Ligaments guide joint end-range; **tendons** transmit muscle force; **fascia** links everything and slides when well hydrated. These tissues adapt slowly. Collagen turnover and cross-linking strengthen with **progressive, rhythmic loading**, adequate **protein, vitamin C, and sleep**, and degrade with load spikes, dehydration, and chronic stress.

Healthy tendon behaves like a **spring**: short bouts of tension-release keep it elastic; long static postures and sudden “too much, too soon” create micro-tears and tendinopathy. Fascia needs **movement variability** and **temperature**: a brief warm-up raises its viscosity so it glides; cold rooms make it sticky and prone to strain. Ligaments hate **twist at end-range**—protect them by aligning joints and using muscular co-contraction rather than relying on passive stretch.

Practical implications: progress training volume **10-20% per week**, rotate drills (don’t hammer the same tissue day after day), drink water around sessions, and prioritize **sleep**—your cheapest collagen supplement.

3) Nervous system and reflexive response to strain -

The nervous system decides how hard a muscle fires and when it lets go. The **muscle spindle** triggers the **stretch reflex**—a sudden lengthening evokes protective contraction (common in hamstring “grabs” during high kicks). The **Golgi**

tendon organ monitors tension and can inhibit over-contraction; slow eccentrics and breath cue this safety circuit. The **gamma loop** sets baseline muscle tone, rising with anxiety and startle; fast, jerky cues elevate tone and risk.

Pain and threat perception modulate output before tissue failure. **Calm nasal breathing**, longer exhales, and consistent **pre-movement routines** reduce unnecessary co-contraction and allow cleaner technique. Nerve tissue also glides in its tunnels: gentle **neural glides** (e.g., ankle pumps with knee extension) keep sciatic and median nerve tracks mobile; forcing end-range stretches with numbness/tingling is counterproductive.

4) Circulatory system's role in healing and protection -

Blood delivers oxygen and nutrients; **venous and lymphatic** systems remove heat and waste. Muscles are well perfused and generally heal fast; **tendons, ligaments, and cartilage** are relatively **avascular**, so they heal slowly and respond best to **graded loading** that pumps fluid in-out. Warm-up increases local blood flow; rhythmic movements act as a **peripheral heart** for venous return. After training or therapy, **easy walking, diaphragmatic breathing, and gentle distal-to-proximal strokes** speed clearance and reduce next-day soreness. In cases of **varicose veins** or suspected clotting, avoid deep local compression; favour limb elevation, gentle returns, and medical review when indicated.

5) Identifying vulnerable anatomical zones (e.g., Marmas) -

Certain zones are both **functionally influential and structurally vulnerable**. In training, avoid direct impact; in therapy, use **breadth, oblique angles, and low force**.

- **Head/neck:** **Śaṅkha** (temple), **Sthāpanī** (glabella), **Krikatikā** (occipital notch), **Mātrikā/Dhamanī** (carotid corridors). Protect with guard positions; never compress carotids; use feather contact only near temples and glabella.
- **Chest/abdomen/pelvis:** **Hṛdaya** (precordium), **Nābhi** (umbilical hub), **Basti** (pelvic/vesical field). No strikes; in manual work, **no vertical pressure or stacked heat**.
- **Limb joints and neurovascular gates:** **Jānu** (knee ring), **Gulpha** (ankle mortise), **Kūrpara** (elbow), **Maṇibandha** (wrist), **Ūrvi** (medial thigh bed near femoral bundle), **Kukundara** (sciatic notch). Train alignment (knee over toes, neutral wrist), and when sore, use traction, ring-work, and distance-first mobilization rather than poking hot spots.

Knowing these areas lets you **shield** them in combat drills and **dose touch** wisely in recovery.

Summary Tables

A) Movement map — muscles that protect joints

Region	Primary protectors	What they do for you	If they underperform...
Foot/ankle	Calf complex, tibialis posterior, peroneals, foot intrinsics	Spring, arch control, balance	Plantar/Achilles overload, knee valgus
Knee	Quads (esp. VMO), hamstrings, gluteals	Control descent/landing; limit shear	Patellofemoral pain, hamstring strains
Hip	Glute max/med, deep rotators, adductors	Drive and steer femur	Groin pulls, ITB friction, knee drift
Spine	Diaphragm, TVA, obliques, multifidus	Pressure "canister," hinge protection	Lumbar shear, facet irritation
Shoulder	Serratus ant., lower traps, rotator cuff	Scapular rhythm, cuff clearance	Impingement, biceps tendinopathy

Region	Primary protectors	What they do for you	If they underperform...
Elbow/wrist	Forearm flexors/extensors, pronators/supinators	Grip without tendon overload	Tennis/golfer's elbow, CTS-like symptoms

B) Connective tissue care — what helps, what harms

Tissue	Help	Harm
Tendon	Rhythmic, progressive loading; eccentrics; sleep	Sudden spikes; long static holds; dehydration
Ligament	Alignment; avoid end-range twist; co-contraction	Forced ROM at end-range; repeated valgus/varus
Fascia	Warm-up, movement variety, hydration	Cold rooms; monotonous drills; chronic immobility

C) Nervous system quick guide

Reflex/feature	Risk if ignored	Prevention cue
Stretch reflex	Hamstring/adductor “grabs”	“Ease into end-range; exhale as you lengthen”
Startle/high tone	Rigid, jerky movement	“Soften jaw; long nasal exhale; smooth entries”
Neural glide	Paresthesia with end-range	“Move nerves, don’t pin them—gentle pumps, no numbness”

D) Circulation & recovery checklist

Goal	Do	Avoid
Warm tissues	8-12 min RAMP warm-up; light sweat	Static stretching cold
Clear metabolites	5-10 min easy locomotion + 4/6 breath	Stopping dead after hard sets
Protect veins	Distal→proximal returns; elevation if needed	Deep pressure over varicosities

E) Vulnerable zones (Marmas) — safety snapshot

Zone	Training rule	Therapy rule
Temples, glabella, carotids	Never take direct impact; guard up	Feather contact; no carotid compression
Precordium, umbilicus, pelvis	No strikes; shield in sparring	Broad, breath-timed touch; no heat + pressure
Knee, ankle, elbow, wrist	Align; avoid twisting landings	Traction/ring-work; avoid vertical pokes
Medial thigh, sciatic notch	Avoid pointed contact	Work around neurovascular beds

Key take-aways

1. Power comes from **hips and shoulders**, protection from **alignment and breath**.
2. Tendons/ligaments need **progressive load, sleep, hydration**, and time; fascia needs **warmth and variability**.
3. Calm the nervous system to move better: **long exhales, smooth entries, gentle eccentrics**.
4. Boost circulation before and after work; respect veins and lymph.
5. Know your **vulnerable zones**—shield them in training, and use **breadth + oblique angles** if you must work near them in recovery.