Applied Biomechanics for Gymnastics Coaches

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Center of mass and balance

Concept

Center of mass is the weighted average position of body mass. In gymnastics it moves as body segments change position. Balance depends on the relationship between the line of gravity, the base of support, and the athlete’s control of angular motion.

Coaching application: compare a straight-body support with a tucked support. Observe changes in center of mass without assuming a single fixed anatomical point.

Teaching checks

Use low-risk supported shapes. Ask the gymnast to hold alignment, then make a small controlled change in shoulder or hip angle.

Error: teaching balance by looking only at the feet. Correction: evaluate the whole body and support contact.

Force, impulse, and landings

Concept

Impulse equals the integral of force over time and changes momentum. For comparable momentum change, extending the time of deceleration can reduce average impact force. Peak forces also depend on technique and surface.

Coaching checks

Progress landing from low heights to higher demands only when control is repeatable. Watch knee and hip alignment, trunk control, and ability to stabilize without extra steps.

Avoid prescribing a single universal landing angle. Technique must reflect task and individual athlete.

Torque and angular motion

Concept

Torque depends on force and perpendicular moment arm. Angular momentum is related to rotational inertia and angular velocity. Tucking changes rotational inertia, not angular momentum magically.

Application

Use body-shape drills before introducing rotational skills. Compare tuck, pike, and straight shapes under safe, non-flight conditions.

Do not infer the correct technical shape of a specific gymnastics skill from a generic mechanics diagram.

Swing mechanics and shoulder action

Concept

Swings involve exchanges between gravitational potential and kinetic energy, and require precise timing of body-shape and shoulder actions.

Application

Progress from supported hang, active shoulder positions and small controlled swings, then apparatus-specific coaching progressions.

Do not use generic swing advice as a substitute for qualified spotting or apparatus requirements.

Motor learning and feedback

Concept

Early learners benefit from clear task goals, appropriate repetitions, and feedback that directs attention to an observable feature.

Application

Give one primary cue at a time, vary practice only after basic safety and control are established, and record progress against observable criteria.

Monitoring and injury prevention

Concept

Technique quality, readiness, fatigue and training exposure all affect risk. No single screening test guarantees injury prevention.

Application

Stop when pain, dizziness or technique breakdown occurs. Check mats, apparatus height, spacing, coach qualifications, and emergency procedures before training.

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