CHAPTER: C - Ultrasound Therapy:

1. A 35-year-old athlete with acute ankle sprain visits your clinic. What is the single most accurate one-sentence definition of therapeutic ultrasound you would document before treatment?
2. The patient inquires, "How does ultrasound actually work inside my body?" Explain the bio-physics of ultrasound in ≤ 20 words (focus on wave type and tissue interaction).
3. Before applying ultrasound, you screen for safety. List any FOUR absolute contraindications for ultrasound therapy (0.25 mark each).
4. The same patient has a recent fracture near the ankle. Is this an indication or contraindication for ultrasound? Justify in one sentence based on bio-physics.
5. Indications check: Name THREE common musculoskeletal conditions where ultrasound is indicated for its thermal effects.
6. Bio-physics deep dive: Ultrasound waves exhibit three key properties in tissues—name them (Reflection, Transmission, Absorption) and state which one primarily causes therapeutic heating.
7. In the property of absorption, which tissue type absorbs ultrasound the most, and why? (bio-physical reason)
8. Reflection property scenario: At the bone-soft tissue interface, what percentage of ultrasound is typically reflected, and how does this affect treatment?
9. Transmission property: Lower frequency ultrasound transmits deeper. State the typical therapeutic frequency range (in MHz) and corresponding depth (in cm).
10. Ultrasonic field structure: Describe the two zones of the ultrasonic field and which one is used for safe therapeutic application.
11. A patient with irregular skin surface needs ultrasound. Why is a coupling medium essential bio-physically? (one reason)
12. Coupling media options: Name THREE common coupling agents and one clinical situation where water immersion is preferred over gel.
13. Bio-physics integration: In continuous mode ultrasound, heat is generated via _____ (fill: cavitation / viscous friction), whereas pulsed mode minimizes this for non-thermal effects.
14. Safety in ultrasonic field: If air bubbles are present in the coupling medium, what property (reflection/absorption) increases, leading to potential burns?
15. Final clinical case: For chronic tendinitis, outline rationale covering definition, one bio-physical mechanism, one indication, one contraindication to rule out, one property effect, field zone used, and coupling choice.

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ANSWER KEY:

1. Therapeutic ultrasound is the application of high-frequency sound waves (above 20 kHz) to body tissues for heating, micromassage, and promoting healing.
2. Longitudinal mechanical waves cause particle vibration, leading to thermal and non-thermal effects in tissues.
3. Any four: Malignant tumors, Pregnancy (over abdomen), Acute infections, Vascular insufficiency, Metal implants/pacemakers, Eyes/epiphysis, Haemorrhagic areas.
4. Contraindication; ultrasound absorption at fracture site can delay bone healing or cause periosteal pain.
5. Any three: Tendinitis, Bursitis, Muscle spasms, Scar tissue, Chronic arthritis.
6. Reflection, Transmission, Absorption; Absorption causes therapeutic heating by converting acoustic energy to heat.
7. Protein-rich tissues (e.g., tendons, ligaments); high collagen content increases viscous friction and energy attenuation.
8. About 35–40% reflected; causes standing waves and hot spots, requiring careful head movement.
9. 0.5–3 MHz; 1 MHz penetrates up to 5 cm, 3 MHz up to 1–2 cm.
10. Near field (Fresnel: uneven intensity) and Far field (Fraunhofer: uniform); Far field used for therapy to avoid hot spots.
11. Prevents reflection of waves at air-skin interface, ensuring transmission into tissues.
12. Any three: Ultrasound gel, Water, Oil/lotion; Water immersion preferred for irregular surfaces like hands/feet.
13. Viscous friction (or molecular collision).
14. Reflection increases; air interfaces reflect nearly 100% of waves, causing superficial overheating.
15. Definition: High-frequency sound for tissue healing; Bio-physics: Particle vibration/heat; Indication: Chronic tendinitis pain relief; Contraindication: Rule out malignancy; Property: Absorption for heating; Field: Far field; Coupling: Gel for even contact.