

Introduction to Orthopaedic Devices

Introduction to Orthopaedic Devices – Study Notes

1. What Are Orthopaedic Devices?

- **Definition:** Medical instruments, implants, or prostheses used to treat, support, or replace components of the musculoskeletal system (bones, joints, ligaments, tendons, muscles, and related soft tissues).
 - **Purpose:**
 - Restore function and mobility
 - Relieve pain
 - Correct deformities
 - Facilitate healing after trauma or disease
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2. Major Categories

Category	Typical Examples	Primary Indications
External Fixation	External frames, pins, clamps	Fracture stabilization, limb lengthening
Internal Fixation	Plates, screws, intramedullary nails, rods	Definitive fracture fixation
Joint Arthroplasty	Hip, knee, shoulder, elbow prostheses	End-stage arthritis, severe joint damage
Spinal Implants	Pedicle screws, cages, rods, dynamic stabilizers	Degenerative disease, trauma, deformity correction
Soft-Tissue Devices	Tendon grafts, ligament reconstructions, meniscal implants	Ligament tears, tendon ruptures
Bone Substitutes & Fillers	Calcium phosphate cements, hydroxyapatite blocks, BMP-laden scaffolds	Bone void filling, augmentation, fusion
Assistive Orthoses	Braces, splints, orthotic footwear	Support, immobilization, functional assistance

3. Design & Engineering Fundamentals

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Aspect	Key Points
Biomechanics	Replicate natural load transmission; avoid stress shielding; ensure fatigue resistance
Materials	- Metals: Ti-6Al-4V, stainless steel, cobalt-chrome (high strength, corrosion resistance) - Polymers: UHMWPE, PEEK, PMMA (low wear, radiolucent) - Ceramics: Alumina, zirconia (hard, wear-resistant) - Composites & Bioactive ceramics (enhance osseointegration)
Surface Engineering	Porous coatings, plasma spraying, hydroxyapatite, nano-texturing to promote bone ingrowth
Manufacturing	CNC machining, additive manufacturing (3D printing), forging, injection molding; emphasis on tolerances and repeatability
Sterilization	Gamma irradiation, ethylene oxide, steam; material selection must tolerate chosen method
Regulatory Compliance	FDA 510(k) or PMA, EU MDR classification, ISO 13485 quality management, ASTM/ISO testing standards (mechanical, biocompatibility)
Longevity & Wear	Fatigue testing, wear simulation (e.g., hip simulator), retrieval analysis for real-world performance

4. Clinical Workflow Overview

1. **Assessment** – Imaging (X-ray, CT, MRI) + functional evaluation.
2. **Device Selection** – Based on anatomy, pathology, patient age/activity level, and surgeon preference.
3. **Pre-operative Planning** – Digital templating, computer-assisted navigation, patient-specific instrumentation (PSI).

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