

## Collaborative Engineering

### Project Identification Example: TKP



- Medical Devices
- Orthopedic Implants
- Tumour Knee Prosthesis
- Domain Immersion

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## Medical Devices – Market

- Global market: US\$ 220 billion.
- Innovation-driven (R&D spending > 10% of sales)
- Indian market: US\$ 3.2 billion (Rs. 15,000 crore)
- 60-70% imported from the West
- Dominated by MNCs (ex. Depuy, Roche, Philips)
- Indian industry: inadequate R&D, trained personnel
- DCGI regulation for device manufacturers

[Source: NIPER Report, 2009]

## Medical Devices – Classification

- **Equipment** – To diagnose, monitor, aid surgery/therapy
- **Implant** – Inserted or embedded in body
- **Prosthesis** – Replaces body organ/part to restore function
- **Orthosis** – Supports/improves existing body organ/ part function

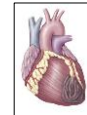


Prosthesis



Orthosis

## Medical Devices – Speciality



Renal



Dental



Cardio



Orthopaedic

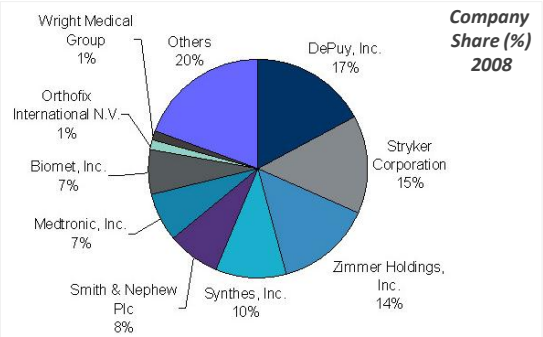
many more...

## Orthopaedic Devices – Market

- Ageing population – Major driver
- Standard of Living – Healthcare opportunities
- Minimal Invasive Surgery – Faster Recovery



## Orthopaedic Devices – Manufacturers



## Orthopaedic Equipment

Diagnostic

Disposables

Surgical



Bone Densitometer



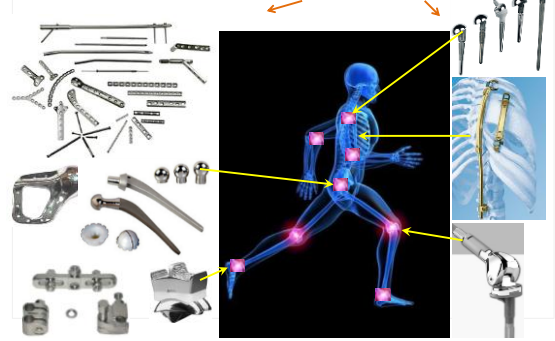
Bone Cement Gun



Bone Cutting Jigs

## Orthopaedic Implants

Types of orthopaedic implants: bone plates | prostheses

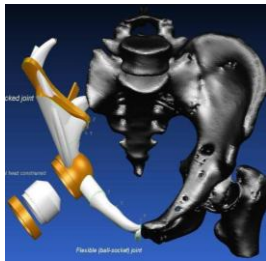


## Orthopaedic Implants – Classification

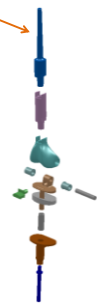
standard | custom | modular



Fixed Sizes



Patient Specific

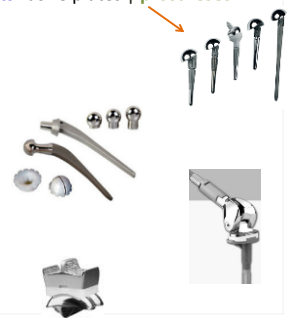


Family of Parts

## Prostheses

Types of orthopaedic implants: bone plates | prostheses

- Joints - Shoulder, Elbow, Hip, Knee, Ankle etc
- Trauma/ Sarcoma/ Joint Disease
- Arthritic joints – major share



## Orthosis

- Crutches
- Braces
- Accessories – Wheelchair

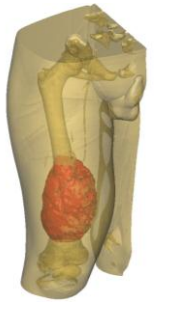


## Skeletal Reconstruction – Indications

- Malignant tumours
  - e.g., Sarcomas (osteo, chondro, Ewing, fibrous), giant cell
- Non-inflammatory degenerative joint disease (NIDJD)
  - e.g., avascular necrosis, osteoarthritis
- Inflammatory joint disease (IJD)
  - e.g., rheumatoid arthritis
- Revision cases – failed previous prosthesis
- Severe trauma

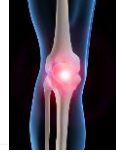
### Osteosarcoma – Focus Area

- 6<sup>th</sup> worst occurring cancer
- Most common malignant tumour
- Occurs in long bones
- Affects the growth plates
- Observed skeletally immature (young)
- 60% cases in between 10yrs-20yrs
- 80 % in joints site of highest growth rat
- 70 % cases occur in knee



### Symptoms

- Persistent pain
- Swelling or a firm lump on a bone
- Difficulty in movement (A limp if the tumor affects the leg)
- Pain while standing/ load bearing
- Bone fracture - occurs spontaneously or after a minor bump



### Diagnosis

- X-ray of the affected area
- Blood tests
- Bone scans
- Biopsy
- CT scan of body (check spreading)
- CT scan of the affected area
- MRI of the affected area

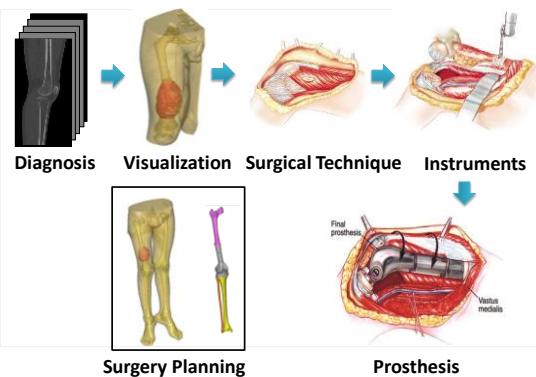


### Treatment

- Chemotherapy
- Radiotherapy
- Surgery
  - Amputation
  - Allograft (Other person)
  - Autograft (Same person)
  - Rotation-plasty (Twisted)
  - Prosthetic Reconstruction



### Surgical Treatment – Improvement



### Current Status and Problem

- **Imported Joints** – Excellent Quality
- But – Prohibitively expensive (Rs 5-15 lacs)  
Not exactly designed for the Indian anatomy
- **Indian Joints** – Affordable (Rs 1 lacs)
- But – Structural breakages  
Functional limitations



