

## Collaborative Engineering

### Product Concepts – TKP System



- Geometry, Motion – Knee
- Overall Mechanisms
- Component Concepts
- Assembly Concepts

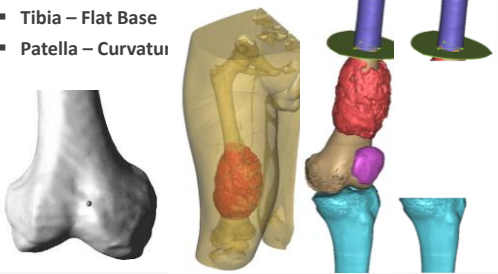
OrthoCAD Lab, I.I.T. Bombay

## Basic Concept Development

- Basic Concepts
  - 2 Degrees of Freedom
  - Load bearing
  - Assembly/ Disassembly
- Constraints
  - Size
  - Shape (Anatomy)
  - Weight
- Material
  - Bio-compatible
  - Strength

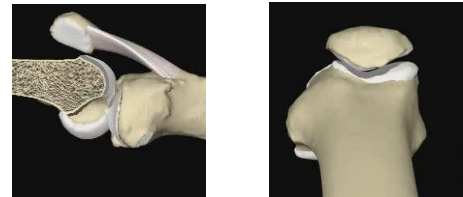
## Geometry

- Shape – Size
  - Femur – Condyle
  - Tibia – Flat Base
  - Patella – Curvature



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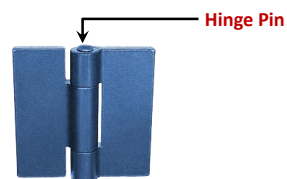
## Motion

- Two Degrees of Freedom
  - Flexion ( $0^\circ - 120^\circ$ )
  - Rotation ( $\pm 5^\circ$ )



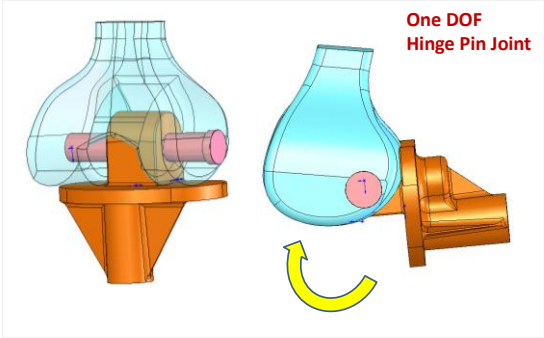
## Concepts for Motion

- Two Degrees of Freedom
  - Flexion
  - Rotation

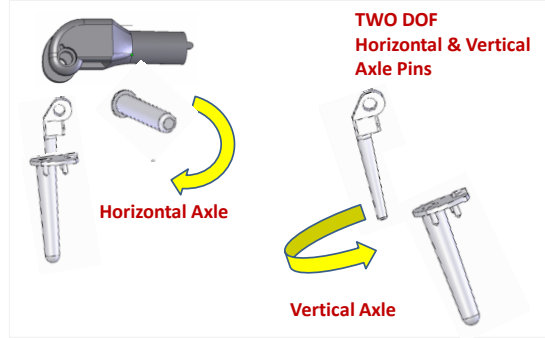


Door Hinge

**Concept I – Hinge Mechanism**



**Concept II – Two Hinge Mechanism**

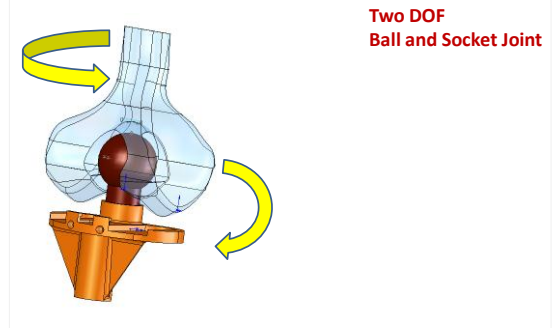


**Concept for Motion**

- Two Degrees of Freedom
  - Flexion
  - Rotation



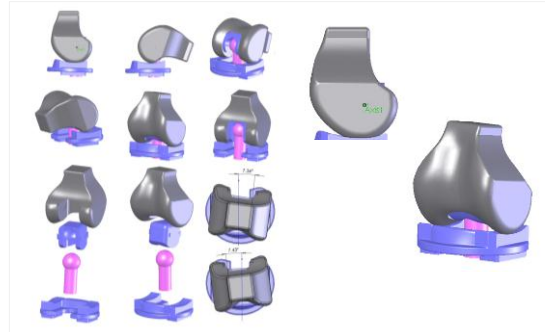
**Concept II – Ball & Socket Mechanisms**



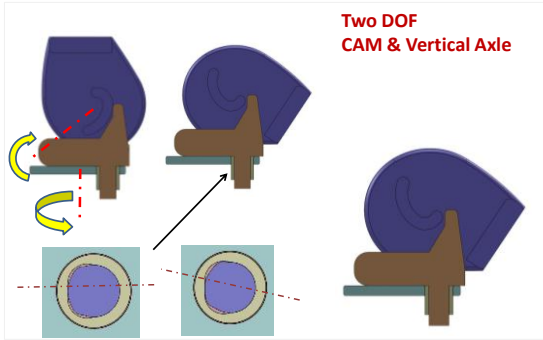
**Concept II – Ball & Socket – Ball Pin**



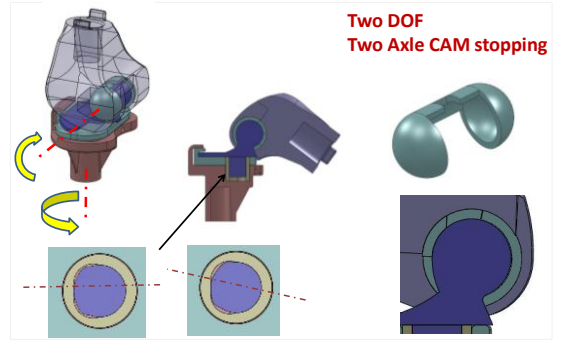
**Concept II – Ball & Socket Improved**



### Concept III – CAM & Axle Mechanisms



### Concept IV – Ball-Axle-CAM Mechanisms



### Component Level Concept – Braking

Controlled Braking

Joining Modular Components



Contoured Component –  
Avoid Impact Stopping

Small Screws

Tapered Joint

### Concepts for Assembly

Directional Assembly



Two Directional – Pins

One Directional – Circlips

### SUMMARY

- IMPROVEMENT – VALUE ADDITION (at each level)
- Un-constrained Thinking – Forget existing solutions
- Inspired Thinking – Borrow fundamentals
- Refresh & Restart
- DISCARD YOUR OWN IDEAS – DEVILS ADVOCATE!