Show Notes w/ Dr. Anna Cohen- Rosenblum

Basic Sci

- Osseointegration
  - Tyypically describes the fusion of bone to titanium
  - Titanium implants- retained in bone through mechanical stabilization& chemically through direct contact w/ calcium atoms and titanium oxide surface (no protein interlayer) > pure osseointegration
  - Cobalt-chromium
    - Also used, but titanium has a modulus elasticity closer to bone, less thigh pain and stress shielding
  - Porous implant- allows extensive bone formation w/ vascularization + osteoblast activity within implant

Cementless fixation

- Osseointegration- attachment of lamellar bone to implants w/o intervening fibrous tissue
- Want to minimize micromotion
- Micromotion >150um leads to fibrous tissue formation
- 40-150 um- bone + fibrous tissue
- <20um - predominant bone formation

Factors that influence stability

- Geometry, roughness + stem coating, prep technique + bone quality

Surfaces/coating

- Ingrowth- bone grows inside a porous surface
  - Requires pore size between 50 & 400um, % of voids w/i coating should be between 30-40%
  - Surfaces
    - Sintered beads- microspheres of cobalt chromium ot titanium alloy- attached by high temp
    - Fiber mesh- metal pads attached by diffusion bonding
    - Porous metals- uniform 3D network, w/ high interconnectivity of voids + porosity (75-80%)
      - Compared w/ fiber metal coatings 30-50%
- Ongrowth- bone grows onto roughened surface
  - Created by grit blasting or plasma spraying
    - Grit blasting- bombards implant w/ small abrasive particles like aluminum oxide

            - Can be used as an adjunct below fiber mesh ro sintered beads
        - Plasma spraying- mixing metal powders w/ inert gas thats pressurized and ionized- forming a high energy flams
            - Molten material sprayed onto implant
            - Less porosity than ingrowth, but 90% implant fatigue strength retained
        - Hydroxyapatite- a calcium phosphate compound thats plasma sprayed directly on implant alone or over porous coating
- In general- surfaces should b circumfrential + continuous
    - Enhances metaphyseal osseointegration + proximal stress transfer and decrease bone loss from stress shielding
- Most common alloys used- cobalt-chromium-molybdenum + titanium aluminum vanadium alloys MC used for cementless femoral stem design

Cementless design + outcomes

- 7 main types
    - Type 1- short stem subclassified by increasing fixation
    - Type 2-5 conventional straight stems, classified by increasing fixation
    - Type 6- modular- classified as modular neck or body
    - Type 7- curved, anatomic design
- Type 1- short + ultra short stem
    - Designed as alternative to conventional stems to preserve proximal femooral bone stock
    - Cutoff generally <120mm
    - Indicated- primary THA
    - Stem advantages:
        - Bone preservation
        - Less thigh pain (less diaphyseal engagement)
        - Fixation in metaphyseal bone similar to physiological femur
        - May also require less OR time
    - Outcomes- unsatisfactory to comparable to traditional stems
    - Type 1A (femoral neck)
        - Femoral neck fixation only
        - Stability- through cancellous compresion
        - Femoral neck variability leads to variations (varus/valgus stems, geometrical shapes such as wedge type, cylindrical, threaded) +/- collar for load distribution
        - Clinical outcomes are variable
    - Type 1B- calcar loading stem
        - Necksparing stems
        - Achieve fixation in calcar + proximal femoral cortex (goal to not resp cancellous bone but impact metaphyseal bone to obtain cortical contact in load bearing region)
        - Femoral neck is preserved and adds some stability

- Various results (ex mayo zimmer stem)
- Lack of femoral canal reaming. Stem malalignment and intraop femur fractures occur
- Type 1C- calcal-loading stem w/ lateral flare
  - Lateral flare achieves fixation in lateral cortex and calcar + allows load distribution in proximal part of femur, resembling psysiological stresses
  - Ex- proxima stem by depuy
- Type 1D- shortened tapered stem
  - Similar to conventional, but has a shorter distal taper to avoid stress shielding
  - Often extends only to proxial aspect of diaphysis, designed for proximal stress transfer
  - Ex fitmore stem zimmer
- Type 2- single wedge (single taper) stem
  - Engage metaphyseal bone in medial/lateral plane only, flat and thin in anterior plane
  - Allows for rotational stability , initial stability obtained by wedge fixation in medial/lateral plane or 3 point fixation along stem
  - Primary the
  - Excellent long term outcomes. Good osseointegration along proximal coating
- Type 3- double wedge (dual taper), metaphyseal fillilng stem
  - Engage proximal femur in medial/lateral and anterior/posterior planes
  - Dome require diaphyseal engagement to enhance rotational stability
  - General indication for primary THA
  - Excellent long term outcomes
  - Stress shielding + thigh pain less than cylindrical fully coated stems
- Type 4- gradual taper, metadiaphyseal filling stem
  - Smooth gradual taper (rather than abrupt), in AP and medial/lateral plane
  - Fixation achieved at metadiaphseal region
  - Two subtypes: tapered round (4A) and tapered rectabgle (4b)
  - Type 4A- Tapered round stem
    - Conical design w/ rounded corners + taper in AP ML plane
    - Proximal ⅔ are coated
    - Proximal fins or ribs may be present for rotational stability
    - Minimal recent literature (mallory head stem biomet)
    - Good outcomes
  - Type 4B- tapered rectangle stem
    - Straight stem prosthesis w/ rectangular cross section - more rotational stability
    - 3 point of fixation in metadiaphyseal junction due to straight stem and curved femur
    - Zweymuller zimmer stem
- Type 5- diaphyseal engaging stem

        - Better in hips where proximal fixation is difficult to achieve
        - Indicated in primary THA hips w/ proximal bone deficiency or revision THA
        - 2 types: tapered spline or cone stems and cylindrical fully coated
        - Type 5A- Tapered spline-cone stem
            - Roughened surface w/ longitudinal splines or ribs
            - Stem wedges into femoral medullary canal providing axial + bending stability
            - Roughened surface- bone ongrowth
            - May be used again to bridge prox bone defects and revising bone deficient hips
            - Ex: wagner stem sulzer ortho
        - Type 5B- cylindrical fully coated stem
            - Rely on initial fixation along entire prosthesis- particular diaphyseal engagement
            - Useful in patients with proximal femur deficiency
            - Some have a collar that transmits forces to calcar
            - Others have uncoated distal stem with distal flutes to enhance stability
            - Concern for stress shielding and thigh pain given extensive coating
        - Type 6- modular stem
            - Theoretical- stem - fine tune anteversion , length, and offset
            - Disadvantagex - fretting corrosion at
            - Indications - revision or complex primary tha in patients with abnormal anatomy
            - Risk for fracture at modular junction
            - Cobalt chrome - more crevice corrosion and fretting of neck stem taper
            - Titanium is more likely to cold weld
        - Type 6A - stem with modular neck
            - Allows ability to adjust neck shaft angle for complex cases
        - Type 6B - stem with modular body
    - Useful in complex deformities like hip dysplasia
    - Allows separate preparation for metaphyseal proximal body or sleeve and diaphyseal stem
    - Good short to mid term outcomes. Useful in revision surgery
- Type 7 - Anatomic stem
    - Bow posteriorly in metaphysis and anteriorly in diaphysis
    - Fixation through metaphyseal fit and fill distal bow

Cemenfed v cementless

- Similar outcomes , also similar outcomes between short and conventiomal sfemz
- For otherz poor evidemce to supportmusemof most stems
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