The Exeter Stem – How it works

- **Geometry:**
  - *Absence of collar* – reduces bone resorption from cut surface of neck and changes a shape-closed system (forces transmitted to cement-bone interface) into a **force-closed system** (forces transmitted to prosthesis-cement interface)
  - *Double taper* in AP and ML directions, narrowing distally
  - *Polished finish* (surface roughness 0.8 to 1.3 Ra) allows subsidence. Also permits fretting wear in response to normal in vivo torsional stress (posteromedial and anterolateral) instead of abrasive wear which might destabilise cement-prosthesis interface by allowing fluid passage, pressure chances and debris
  - *Hollow centraliser* – allows controlled subsidence (taper-slip) without end-loading at tip, that might otherwise predispose to failure

- Subsidence is allowed by the visco-elastic nature of bone cement. In particular due to physiological intermittent loading (where a person cannot walk constantly for several years), there are periods where the prosthesis is relatively unloaded to allow stress relaxation.
  - Subsidence of 1.32 mm in Simplex at 10 years
  - Subsidence of 1.5 mm/year over 1st 28 months and then 0.3 mm/year over next 31 months, when using Boneloc cement (more visco-elastic than PMMA)

- Provided there is no end-bearing, then subsidence of the **taper-slip stem**, then there are 3 important phenomena:
  - Force that produces subsidence at prosthesis-cement interface is dissipated and not available to challenge the cement-bone interface. Thus movement at one interface protects the other.
  - Stem subsides so at a given level there is a larger cross-sectional area accommodated by the cement, generating hoop tensile stresses in the cement mantle and radial compressive stresses. Because the stem does not back out during rest period, hoop tensile stress relaxation prevents fatigue fracture, yet radial compressive stress is maintained to minimise stress shielding and resorption within the proximal femur.
  - Evidence of increased torsional stability.

- Intra-operative technical advantages of collarless design:
  - Level and direction of femoral cut not important
  - No fixed depth for insertion, allows restoration of leg length and off-set
  - Maintained access to proximal end of stem-cement interface to allow pressurisation to be maintained during insertion and curing periods.
  - Easier to extract (due to geometry and surface finish)