Author query:
- Kindly verify the citations and legends of all the figures.
- Kindly provide legible Figure 5.
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- Please provide the references and conclusion of the chapter if any
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CHAPTER 52

S-Rom in Primary and Revision THA: Technical Details and Surgical Tips

Michael Neil

HISTORICAL PERSPECTIVE

Total hip arthroplasty (THA) began unsuccessfully in the 1890s, but prostheses made of plastic, metal and ceramics have improved steadily since the 1950s.

Cementless THA commenced in volume in the mid-1980s with the following:

- 1984: POROUS coated anatomic (PCA) prosthesis: scintered CrCo
- 1986: OMNIFIT Prosthesis (Geesink): Hydroxyapatite (HA) on macrotextured Titanium
- 1987: S-ROM (Cameron): Modular porous coated (Titanium) sleeve
- 1988: ZWEYMULLER: Alloclassic: Grit blasted Ti
- 1988: MALLORY-HEAD: Tapered plasma-sprayed Ti.

All the above stems, except for the PCA have enjoyed long term clinical success. Modularity however has distinct advantages in THA which outweigh the potential disadvantages of fretting and metallic debris, which has not been seen in 20 years experience with the S-ROM stem.

ADVANTAGES OF MODULARITY IN CEMENTLESS THA

The S-ROM design is based on the concept of "Fit and Fill" of the femur, to achieve immediate torsional stability and long term bony ingrowth of the implant. This allows immediate full weight bearing (in primary situations) as well as physiologic bony remodelling.

Advantages of modularity include:

- Correct offset
- Correct vertical drop
- Set version
- Set version independent of anatomical bow (revision)
- Address proximal to distal mismatch
- Immediate rotational stability
- Long-term fixation and survivorship
- Functionality/ROM.

WHY CHOOSE THE S-ROM MODULAR STEM?

The S-ROM stem is indicated for all types of primary and revision hip surgery including:

- Simple primary surgery
- Complex primary surgery including Developmental dysplasia of the hip (DDH), angular deformity , abnormal femoral anatomy post-trauma or osteotomy
- Tumour resection surgery
- Revision hip replacement including significant bone loss.

There are many modular stems available for clinical use currently, and include Biomet MH, Biomet Modular Reach, Stryker Restoration DPM, Stryker Restoration T3, Waldermer Link M3, Sulzer PFMR, Wright Medical Profemur, Lima, Exactech AcuMatch, Hayes UniSyn, Zimmer ZMR and Depuy S-ROM.

Table 1 shows the summary of some of these stems, and whether they achieve the goals of modularity. The S-ROM is the only stem which achieves all goals.

TECHNICAL DETAILS OF THE S-ROM STEM

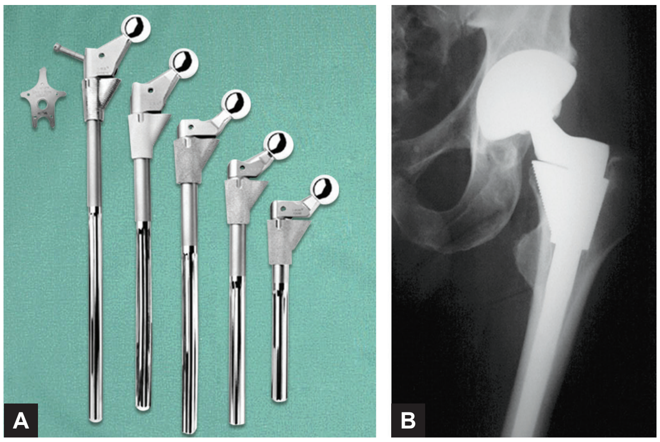
Full modularity of the S-ROM stem allows for over 8,000 combinations of sizes, through proximal modular sleeves, various lengths of stems, as well as various offsets and calcar lengths. This allows surgery to be performed on all types of primary and revision situations irrespective of femoral anatomy or bone loss.

Design Features (Figs. 1A and B)

- Vary proximally to distally by 5 mm and are referred to as such e.g. 18 × 13 stem
- Distal sizes start at 9 mm and go up to 21 mm (other sizes can be custom ordered)
- Neck lengths range from 30 mm, 36 mm and 42 mm

Table 1: Summary of modular stems and their results for total hip arthroplasty.

Parameters	*BIOMET*	*SHO DPM*	*Link*	*Sulzer*	*Lima*	*Exact/Hayes*	*ZMR*	*S-ROM*
Offset	No	Limited	No	No	No	Yes ?	Yes	Yes
Prox/dist mismatch	Limited	Yes	No	Limited	No	Yes	Limited	Yes
Rotational stability	Yes	Yes	Distal	Yes	Distal	Yes	Distal	Yes
Set version (primary)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Yes
Correct vertical drop	Limited	Limited	Limited	Limited	Limited	Yes ?	Yes	Yes
Version indep of bow	Yes	No	Yes	No	No	Yes	Yes	2003
Functionality/ROM	Restricted	Restricted	Restricted	Restricted	Restricted	Restricted	Yes	Yes
Survivorship	Yes	No	Yes	No	No	No	No	Yes



Figs. 1A and B: (A) Proximal modular loading; (B) Distal fixation.

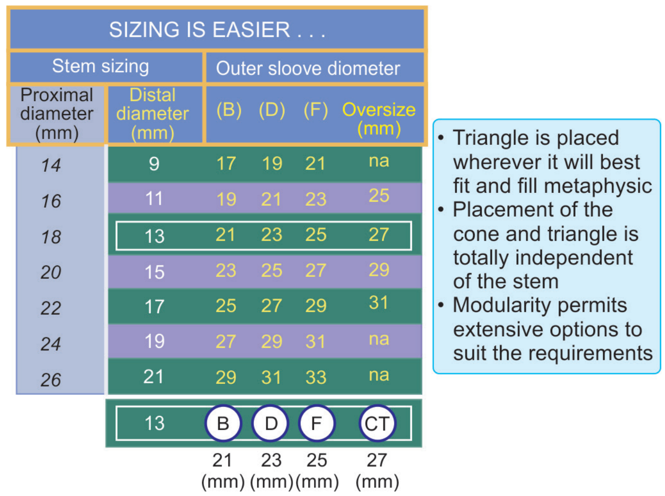


Fig. 3: Important features of S-ROM sleeve.

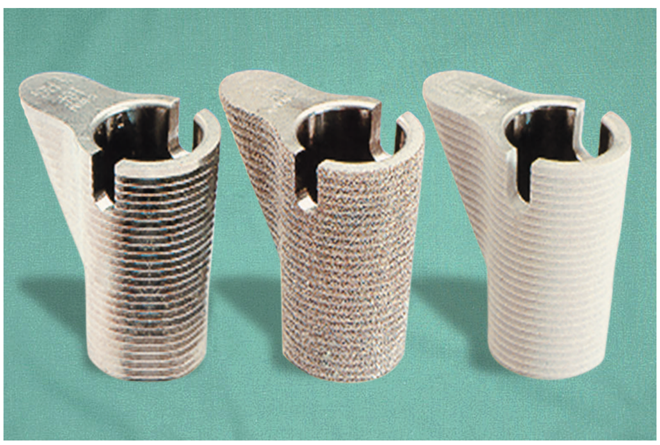


Fig. 2: Different types of sleeve.

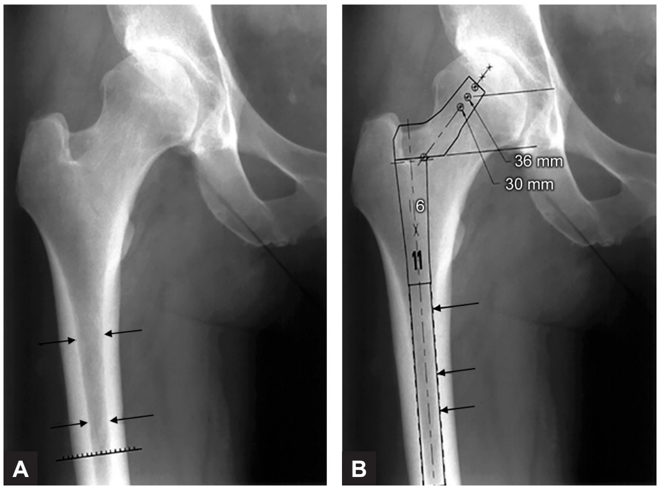
- Offsets range from 0, +4, +6, +8, +12 mm
- Distal flutes and clothes peg design to increase torsional stability and decrease end stem pain
- Aim to achieve proximal modular loading with sleeve, and distal stability.

Sleeve Features (Figs. 2 and 3)

- Manufactured from wrought Ti
- Porous, nonporous and HA coated
- Stepped triplanar wedge design
- Design transmits compressive load to bone and avoids hoop stresses
- 10 cones for each stem
- 2–3 triangles sizes for each cone
- B, D, F standard sizes, F oversize for larger canal.

Steps in Insertion of Stem

1. Preoperative templating to achieve maximum distal fit and proximal fill of canal, as well as estimate of offset, leg length and vertical drop (Figs. 4A and B).
2. Standard surgical approach (posterior approach preferred by author as the stem requires “lateralization” to avoid varus placement, and this can traumatise abductors in anterior approaches).
3. Locate and drill piriformis fossa with canal opening awl.



Figs. 4A and B: Templating preoperatively is first step in implantation of S-ROM stem.

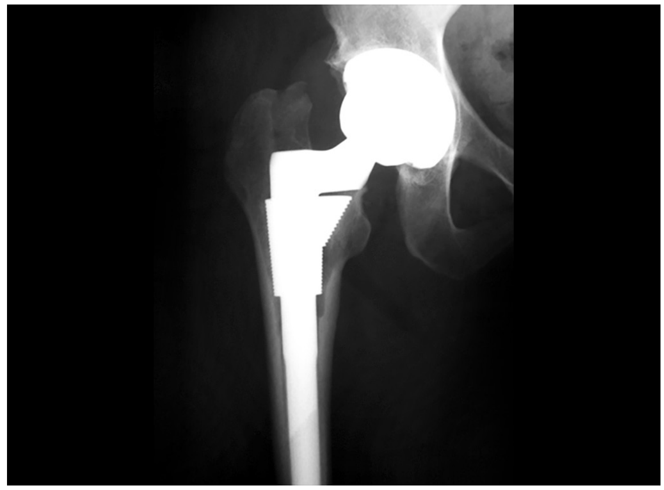


Fig. 6: Sleeve subsidence due to undetected fracture.

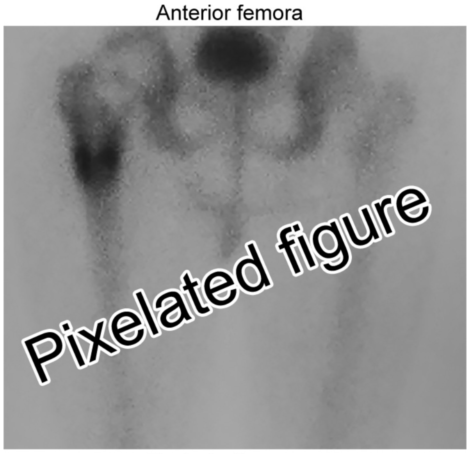


Fig. 5: Stress around S-ROM stem seen on bone scan, due to oversizing sleeve.

4. Distal intramedullary flexible reaming (to assess canal diameter) to 0.5 mm less than final stem size, e.g. if appears 13 mm stem will be tight, then flexible ream to 12.5 mm only.
5. Distal straight reaming line to line with planned stem size. Use T-handle on final reamer to assess fit by rotating femur with reamer. If femur rotates and not the reamer, then size is correct. If reamer rotates before femur, then need to upsize stem.
6. Proximal conical milling: Ream only to guides on the instrument, and stop upsizing as soon as cortical surface is reached. Over-reaming can lead to late proximal stress fractures at the junction of sleeve and stem distally due to stress riser effect (Fig. 5).
7. Neck resection based on preoperative template relative to lesser trochanter.
8. Proximal calcar milling: Be careful not to hit reamer and to apply valgus force to avoid varus. Check for any vertical fissure fractures, often seen posteriorly. If present, perform prophylactic cerclage cable *prior* to impaction of sleeve. Cabling necessary in about 20% cases and avoids complication of early subsidence (rare and always due to technical error) (Fig. 6).
9. Trial reduction to assess stability, leg length offset and ROM.
10. Impaction of sleeve to level of neck resection.
11. Impaction of stem through sleeve maintaining planned version with antirotation punch as a guide. (In revision surgery, if using stem longer than standard, it is necessary to preassemble the sleeve to the stem prior to implantation of the stem because of the curve of the longer stems).
12. Impaction of head to femoral trunion and reduction.

ADDENDUM JULY 2017

The S-ROM modular prosthesis (Fig. 7) is used by the author now only for complex primary surgery requiring femoral shortening, derotation or lengthening as in Congenital dislocation of the hip (CDH) as shown Figures 8 to 11.

THE "PARAGON" CEMENTLESS THR SYSTEM

For "routine" primary total hip replacement (THR) with normal anatomy we now use the "paragon" cementless stem as shown Figure 12.

For straight-forward primary THR as it is easier to insert with shorter operating time and quicker recovery. The "Paragon" is a double taper wedge design with compression grooves on the tension side of the implant (Figs. 13A and B).

Fig. 7: The modular S-ROM femoral hip prosthesis. Over 10 years more than 38,000 implantations have been done worldwide for primary and revision surgery.

Fig. 8: Preoperative X-ray pelvis in a M65 with longstanding Crowe 4 CDH treated by Girdlestone arthroplasty. (CDH: Cogenital dislocation of the hip)

The design lends itself to minimally invasive posterior approaches orminimally invasive (AMIS) either on or off table.

The implant has just appeared on the AOANJRR for 2017 and is already number 10 cementless stem in use in Australia, with first implantations from 2015.

The stem is a monobloc biplanar wedge design, which mimics some features of the "Corail" but with some distinct advantages, namely very box shaped proximal body for torsional stability, increased offset options for mechanical advantage, bullet nosed polished tip to avoid endosteal impingement, and patented tension grooves on lateral shoulder to load bone and avoid stress shielding in greater trochanter (Fig. 14).

TECHNIQUE FOR COMPLEX REVISION THR

Authors now preferred technique for complex revision THR. Having used the S-ROM THR stem for over 25 years

Fig. 9: Postoperative X-ray pelvis following complex THR using S-ROM stem with 6 cm femoral shortening.

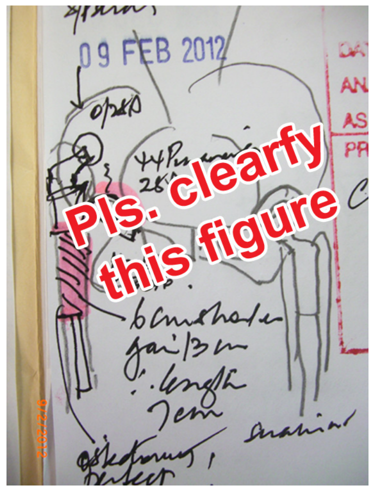


Fig. 10: Operative plan drawing of second side surgery.

for complex revision THR, we have now moved to the concept of distal fixation modular stems with host bone fixation and no structural allografts.

The reason is that proximal reconstruction of the deficient femur with a modular proximal fixation stem is extremely technically demanding, prolonged surgery requiring extensive inventory, and a bone bank that can provide cadaveric whole bone segments. This is not widely available and extremely expensive, not to mention the late failure and infection risk of about 50% at 10 years.

Distal fixation with modern modular revision stems has been a "game changer" for these cases. The femur is reconstructed from the bottom up, and rarely requires significant bone graft.

We have used the "Arcos" system with great success in these difficult cases (Figs. 15A and B).

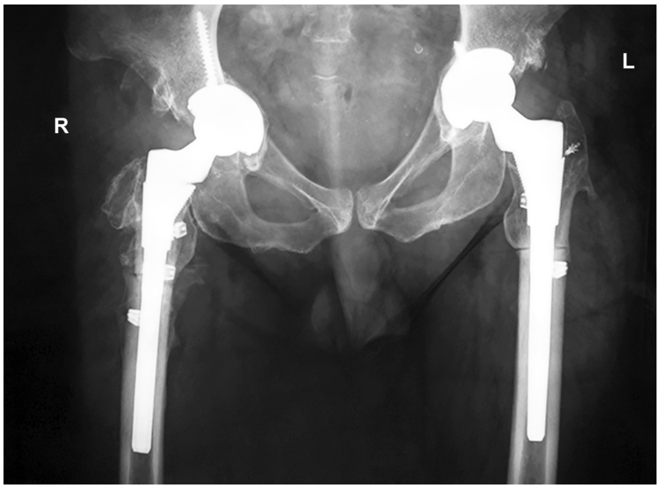
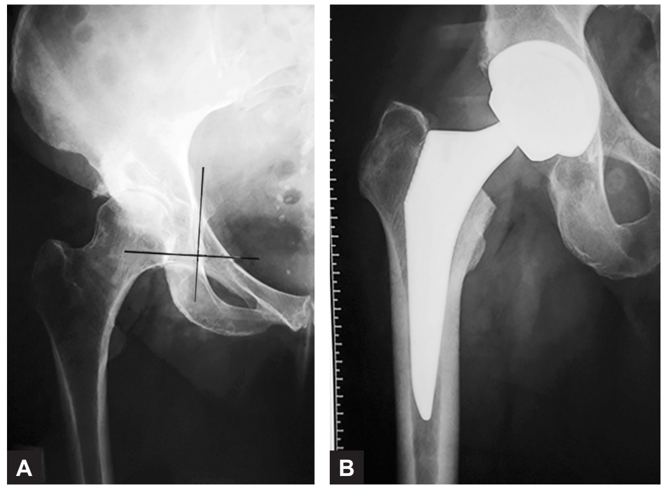


Fig. 11: Postoperative X-ray following second side surgery.



Figs. 13A and B: Use of "Paragon" cementless THR system. (THR: total hip replacement)

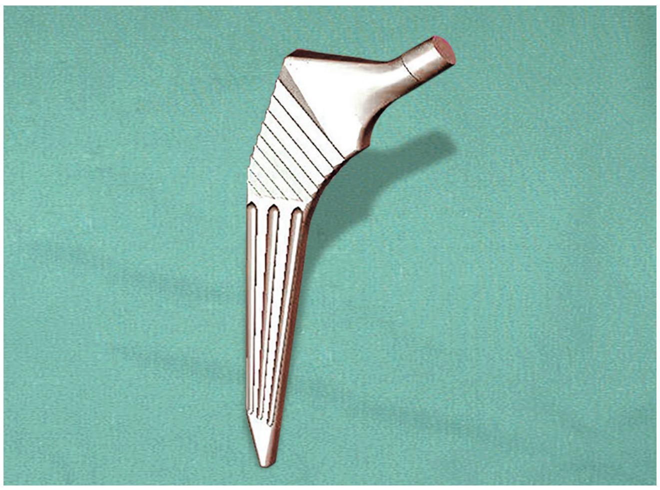


Fig. 12: "Paragon" cementless stem.

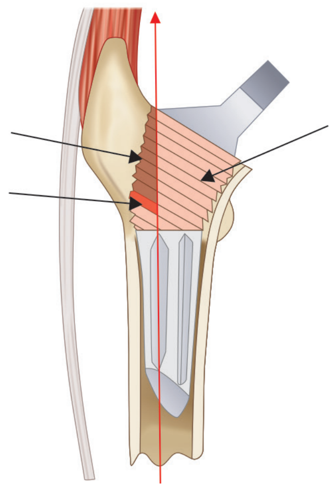
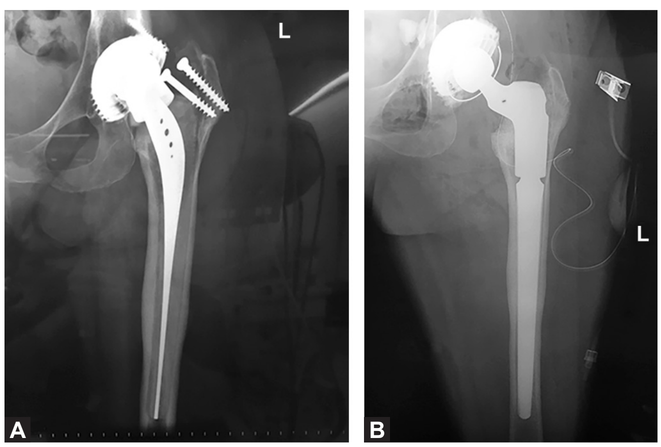
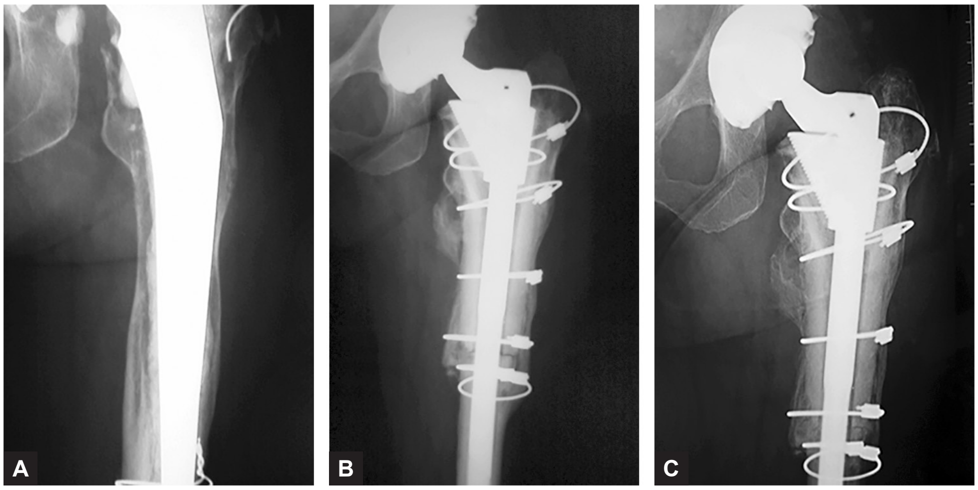


Fig. 14: Design of "Paragon" cementless stem.



Figs. 15A and B: Straight forward type 2 femur with loose isoelastic "Bombelli" stem revised easily with Arcos modular distal fixation stem with no ETO required. (ETO: .....)



Figs. 16 A to C: Complex revision THR for loose cemented stem with poor bone using S-ROM stem with proximal femoral allograft. Construct failing at 7 years 3 month and failed 10 years. (THR: total hip replacement)

The distal fixation stems are Wagner type splines with excellent in growth and stability for early weight-bearing and movement. The femur is reconstructed from distal to proximal to recreate leg length, offset and version using modularity with multiple combination options. Similar stems available include the "Restoration" system (Stryker). There is a general move away from proximal fixation stems in complex femoral revision surgery as the techniques of reconstruction using proximal femoral allografts or impaction grafting are expensive, time consuming and technically demanding, not to mention the definite failure rate at 10 years from graft resorption, loosening and late infection as shown in Figures 16A to C.