Short-and medium-term results after THA with a cementless anatomic stem SP-CL (W. LINK, GERMANY)

Petar Angelov, Andrey Iotov
Department Orthopedics and Traumatology: University Hospital Sofiamed, Sofia, Bulgaria
dr.p.angelov@mail.bg

Abstract— Since the 80s-90s of the XX century, in connection with the development of technologies, the progress of tribology, innovations in the design of prostheses and the accumulation of more clinical experience, TH arthroplasty has been "rejuvenated" and began to be more widely and successfully applied in middle-aged and young patients. The main indications at the beginning - dysplasia of the hip joint, A.V.N. and juvenile rheumatoid arthritis - subsequently expanded to the whole spectrum of hip pathology in younger people. Straight cementless stems show excellent long-term results, but periprosthetic fractures and gluteal insufficiency are still a problem. In contrast, the flattened proximal-lateral profile of the anatomic cementless SP-CL® stem can protect the greater trochanter and can avoid gluteal insufficiency after THA. Another advantage of this stem design is the rotational stability and natural weight distribution due to the anatomical concept. In this context, we report here our experience with the use of the SP-CL® anatomical cementless stem.

Keywords— Cementless total hip arthroplasty, anatomical cementless stem

1 Introduction

Anatomical cementless stems were first introduced in the 1990s. Their geometry comes as close as possible to the anatomy of the femoral canal. They have a wide metaphyseal section and a distal curve following the curvature of the femur[7,21]. Stems are different for left and right sides. Fixation is primarily achieved with a diaphyseal press-fit contact. The first generation of anatomical stems did not show very good results. In 5-9%, stem loosening is observed only 5 to 8 years after their implantation. A large percentage also report hip pain[3,10,11]. The second generation leads to very good clinical results thanks to the change in their design and coating. Anatomic stems are designed based on previous experience and computer-assisted technique based on CT-examination.

The new SP-CL® Cementless Anatomic Stem offers several new features that could improve outcomes after total hip arthroplasty:

1) grooves in the proximal part of the implant to ensure early rotational stability



Figure 1. Osseointegration of stem 11 months post op.

2) anatomical S-shape and integral anteversion, compensating all axial and rotational forces;

3) CaP- porous coating in the proximal 2/3 of the stem to ensure good osseointegration and secondary stability;

4) polished, rounded tip of the implant, allowing sliding in the medullary femoral canal, which does not cause an increase in tension and can reduce the incidence of hip pain.

The SP-CL® system is primarily aimed for young and active patients. It was created for this specific contingent in mind. The ergonomic instrumentation allows the use of minimally invasive techniques. The reduced proximal-lateral profile of the rasps and stem protects the greater trochanter from iatrogenic fractures and reduces the likelihood of gluteal insufficiency[23]. The rasps are compressive and bone preserving. There is a choice of implants with 126˚ and 135˚ neck-shaft angle, as well as lateralized versions, which promotes good biomechanics.

2. Material and methods

For the period from February 2020 to July 2022, 52 THA were performed at the SOFIAMED HOSPITAL, using an anatomical cementless SP-CL® stem (W. LINK, GERMANY). The main indications for surgery are: primary coxarthrosis; hip dysplasia; Chandler's disease; post-traumatic coxarthrosis; femoral neck fracture and complications of Perthes disease.

For diagnosis of the pathology, we use a standard pelvis X-ray examination in AP view. If necessary, laterography, CT or MRI is also used. Preoperative planning is an important step in preparation before performing THA. Modern digital preoperative planning makes it possible to calibrate the X-ray image with great accuracy. In our practice, we use two-dimensional planning (2D) specialized medical software from the company Medicad (Germany). For this purpose, a radiographic examination with a standardized DICOM-format protocol is required. Operative interventions are performed with limited antero-lateral approach - modified Hardinge or mini-invasive Röttinger approach. The approach utilizes the interval between tensor facia latea and the abductors thereby reducing complications and achieving a faster recovery after surgery (13).



Figure 2. Röttinger approach

The patient is placed in lateral position. After reaching the hip joint are performed femoral osteotomy, extirpation of the femoral head and processing of the acetabulum. For the femur processing, it is necessary to ensure a good overview to the medullary canal. It is important to have a good visualization to avoid complications. The processing of the femur begins with “Zamba”. The femoral canal is opened with a “Charnley” instrument. Expansion is performed using anatomically shaped rasp impactor. Their terraced surface provides good compression of the cancellous bone, and the rounded tip prevents false route. The rasps are left and right. Their numbering starts from №4 to №16. The SP-CL anatomical stem has a different neck-shaft angle, 126˚ and 135˚ respectively, and a lateralized version is also available.

The instrumentation is ergonomic and allows work with mini-invasive and direct anterior approaches. Determining the exact size of the implant is achieved by changing the sound, testing for rotational stability, and following the preoperative planning. Its determination is most accurate with digital templating to avoid shortening, lengthening of the limb, or change in biomechanics. Impaction of the definitive implant is carried out until it stops “sinking”, and it is important that it stops at the level of the last rasp. Then the definitive head is placed, and in all cases of the group we use a Biolox 36 mm ceramic head.



Figure 3. SP-CL cementless stem: A) AP view; B) lateral view

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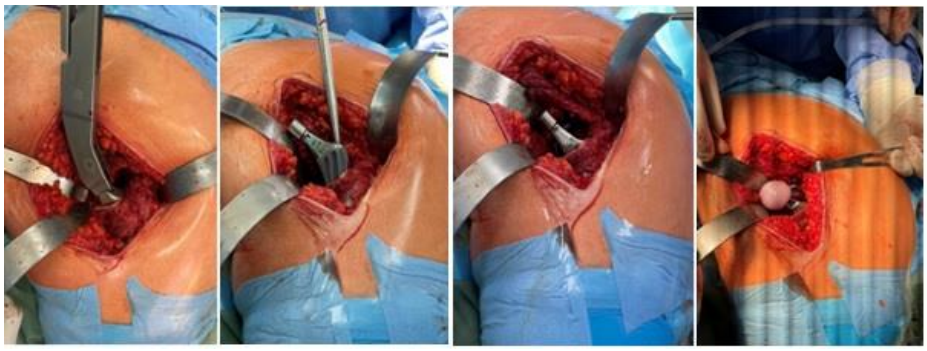


Figure 4. A) implantation of the impacting rasp; B) C) implantation of the definitive stem D) placement of ceramic head

This is followed by joint reposition and tests for instability and length of the limb. Control X-ray of the pelvis in antero-posterior view is performed. 2, 6, and 12 months postoperatively. The postoperative rehabilitation protocol begins on the 1st postoperative day with full weight-bearing and protection with crutch-type aids for 3-4 weeks. Antibiotic prophylaxis is administered for 24 hours period. Routine thromboprophylaxis is performed with LMWH for the duration of the hospital stay and 30 days with factor "X-a" inhibitor. The radiographic method of assessing the stability of implants occupies an important place in the follow-up of results after cementless hip arthroplasty. We use the most widely used "Engh Grading Scale" (EGS). This scale helps us determine bone fixation and implant stability. At postoperative follow-up, the position of the implant was measured in the metaphyseal and diaphyseal zones relative to the Grüen zones. For clinical evaluation, we use the Harris Hip Score (HHS) system. It is a physical examination with 8 questions to which the patient answers. The sum gives a maximum of 100 points with full function of the joint and 0 points with no function.

PATIENTS

The study included 52 total arthroplasty patients with SP-CL anatomic stem with CaP coating, cementless capsule with TiCaP coating and UHMWPE inlay for the period from February 2020 to July 2022. In four of the patients the procedure was performed bilaterally. Indications for the operative intervention were: primary coxarthrosis; DDH; avascular necrosis; post-traumatic coxarthrosis and complications of Perthes disease. 33 men and 18 women with a mean age of 54 years (range 32 to 76). Contraindications for the operative procedure are revision endoprosthesis and pelvic fractures. In the cohort, 25 patients were diagnosed with coxarthrosis, 19 patients with avascular necrosis of the femoral head, 4 with posttraumatic coxarthrosis, 1 patient with DDH, 1 with femoral neck fracture, and 2 with complications of Perthes disease. Intraoperatively, 2 patients had a periprosthetic fracture during stem implantation. 1 patient required cerclage and 1 patient was treated conservatively with weight-bearing restrictions for a period of 2 months.

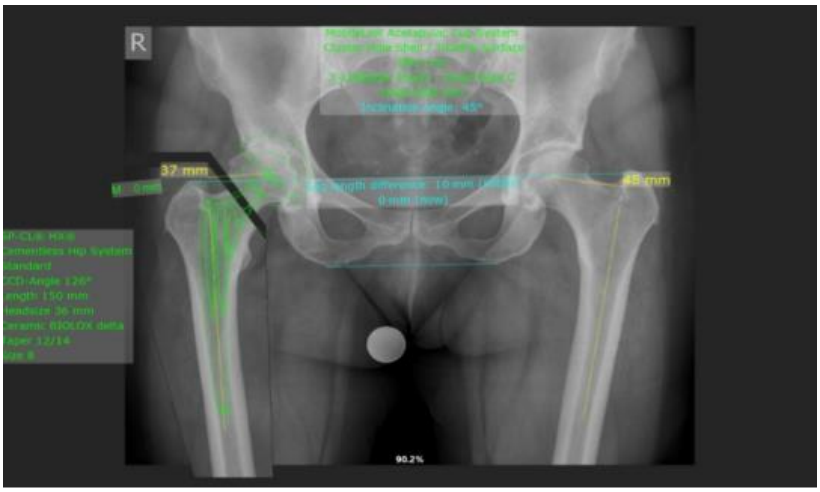


Figure 5. Preoperative planning in a 59-year-old woman with osteoarthritis



Figure 6. Post-operative X-ray

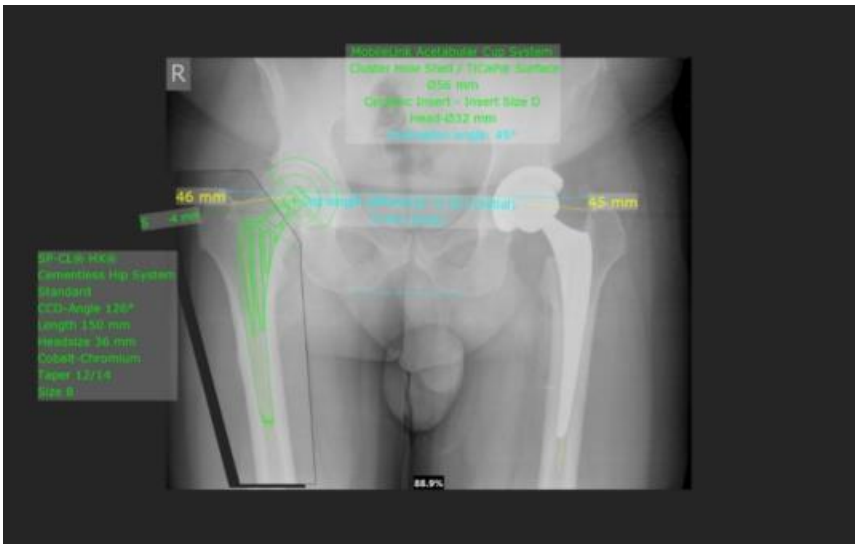


Figure 7. Preoperative planning in 32-year-old man with AVN



Figure 8. Postoperative X-ray

3. Results

At an average follow-up for 16 months (34 m.-2 m.) all stems are integrated and stable, no stem subsidence is observed. At short- and medium-term follow-up, no pedestal formation was observed. No superficial or deep infections. There are no dislocations.

Brooker grade II ectopic ossification was observed in one patient. One patient described pain in the hip area that did not restrict movement.



Figure 9. 37 years old man with femoral neck fracture. X-ray 1 year p.o. Brooker grade II-III myositis ossificans



Figure 10. 52 years old woman performed in one stage - extraction of osteosynthesis material and total arthroplasty. Intraoperative fracture treated with 1 cerclage.

The mean HHS score varied significantly from 64 points (42–86) preoperatively to 88 (76–100) postoperatively. In 92% of patients, HHS is good (80-89) and very good (90-100). According to the Engh Grading scale, 100% of the stems were classified as stable and osseointegrated. During follow-up examinations at the 2nd month, a decrease in bone density was observed in zones 1, 2, 6 and 7 according to Grüen. One year postoperatively, bone density recovered in zones 1, 2, and 6, with a slight decrease in bone density noted in zone 7. Long-term follow-up results are pending.

4. Discussion

In terms of geometry cementless stems are devided into three groups: cylindrical (AML), conical (taper slip) and anatomical. Clinical studies of cylindrical stems presents very good survival including young patients. Engh et al. in series of 223 cases follow-up for an average of 14- years, reported on aseptic loosening at 3,4% [6]. McAuley et al. reported for 96,1% 15-year survival in 293 patients younger than 50-years old[14]. Moyer et al. follows 115 patients with arthroplasties at middle age 39 years. Mean duration of follow-up 8,6 years and found 99,1% retention of fixation of AML stem[16]. AML problems stem from their massiveness and rigid contact with the bone. This leads to proximal stress absorbsion, osteolysis and hip pain without real relaxation[6,7]. Engh et al. founds significant pain along the course of the thigh in 3,9% of followed 1545 patients with AML stems with no correlation between this complication and the implant size[5]. The second generation AML stem aims to reduce the coating area and add a polished tip (haspal). Henessy at al. reported complaints of hip paint in less than 2% in 100 arthroplasties when using the second generation AML stem[9].

Conical stems represent new biomechanical conception. The clinical results of the use of conical stem are encouraging (2,18). Müller et al. observed a 98,8% seventeen-year survival rate in Spotorno stems (type 1). 25% reported mild to severe hip pain[17]. In series by Lee et al. of 85 type 2 stem procedures 100% of implants survived at 10-year follow-up[12].

The design of the anatomical stems reflects the modern views in the field of biomechanics in hip arthroplasty. The geometry of the implants comes as close as possible to the endosseous anatomy of the proximal femur. Stability is achieved by tight metaphyseal press-fit contact proximally and even distal distribution of stress along the course of the curve (4,8). Early models of anatomical stems were not very successful. They loosened in 5-9% of the operated after 5-8 years, and hip pain accompanied 28-36% of the patients[15,22].

Design changes in the stem led to a significant improvement in clinical outcomes. When using anatomical stems of the second generation Kim at al. Reported 0% revisions, relaxations and hip pain in 601 arhtroplasties followed for a period of 5-12 years[11]. Sariali et al. report their experience with a second-generation SPS cimentless anatomical stem. With 176 arthroplsty performed, they reported a 97,2% ten-year implant survival rate[19]. Tootsi et al. reported 11 intraoperative fractures after performing 222 THA with an SP-CL stem[22]. Baker et al. reported 100% stem survival in 69 hip arthroplasties

performed and followed for a period of 15 years[1]. Similar results were reported by Schramm et al. using a CLS stem in 89 patients followed for a period of 10 years[20].

The stem SP-CL® (W. LINK- Germany) has a metaphyseal attachment and according to the Mount group classification belongs to group 6 with an anatomical shape and conical design ensuring optimal fit and fill in the metaphyseal area. The implant is made of titanium alloy - Tilastan-S® providing elasticity close to that of the bone, which helps to reduce the tension in the intramedullary canal. The ribbed structure serves to stabilize the implant in the impacted bone, providing high primary stability. The smoothed proximal lateral profile protects the greater trochanter and reduces the risk of gluteal insufficiency. Ca-P porous coating has good osteoconductive properties and promotes bone growth.

5. Conclusion

It can be concluded that after the innovations in the design, the anatomical stems increase their biomechanical qualities, which finds the corresponding clinical reflection. Thanks to their geometry, they are more suitable when using mini-invasive techniques. Complaints of hip pain and periprosthetic intraoperative fractures are less common[22].

The SP-CL® system is primarily aimed at young and active patients wich doesn't have deviations of bone anatomie caused by congenital disorders, osteotomies or fracture of the femur. Short- and medium-term follow-up shows verry good and excellent results. Long- term follow-up is needed to confirm the good results.

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Authors

Petar Yordanov Angelov, M.D., is a member of the Bulgarian Orthopedic and Traumatology Association (BOTA), member of the EFORT, member of the BMA. He works as an orthopedic surgeon at Department Orthopedics and Traumatology: University Hospital Sofiamed, Sofia, Bulgaria, Tel: +359899897797, e-mail: dr.p.angelov@mail.bg

Prof. Dr. Andrey Marinovich Iotov, MD, DSc is member of the Bulgarian Orthopedic and Traumatology Association (BOTA), member of the EFORT, member of the ESTES. He works as a head of Department Orthopedics and Traumatology: University Hospital Sofiamed, Sofia, Bulgaria, e-mail: iotov_a@mail.bg