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# The Innovative Sivash Artificial Total Hip Joint

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The contributions of Sir John Charnley to the field of joint arthroplasty have been widely recognized. However, far less is known about the contributions to hip arthroplasty made by Konstantin Mitrophanovich Sivash, head of one of the Units of the Central Institute of Traumatology and Orthopaedics of Moscow. This article highlights some of the innovations of the Sivash prosthesis and provides a comparison to the well known Charnley design.

Working behind the iron curtain, Russian orthopaedic surgeon Professor Konstantin Mitrophanovich Sivash in 1956 introduced an uncemented, constrained total hip prosthesis with a metal-on-metal bearing surface (Figures 1 and 2). In 1963, Sivash presented his hip replacement method at the Conference on Bone and Joint Tuberculosis in Moscow[1]. With one implant system, Sivash may have unknowingly provided an early prototype addressing the problems of joint instability as well as aseptic loosening associated with wear debris from polyethylene and poly-methyl-methacrylate[2, 3, 4].

Widely recognized are the efforts of Professor "Sir" John Charnley from Wrightington Hospital, Lancashire, UK, who in 1962 introduced the well known 22.25 mm diameter head articulating within a 40 or 43 mm cemented polyethylene cup. One goal of Charnley's "low friction arthroplasty" approach was to protect the bone-cement interface from forces arising from articulation of the artificial joint[5, 6]. In comparison, the Sivash prosthesis did not use cement and relied upon primary stability obtained by a press-fit cup and a fenestrated metal stem for short-term and subsequent bone attachment for long-term mechanical fixation.

Another goal of the Charnley design was a reduction in the dislocation rate. Etienne, Cupic, and Charnley stated this was attributable to the correct alignment of the implants, the conservation of the joint capsule, an accurate reattachment of the trochanter, and the use of an abduction pillow post-operatively for seven days. In later iterations, the dislocation rate was further reduced because of the low position of the socket and the use of a peculiar "Long Posterior Wall" cup[7]. In comparison, the Sivash implant included a constrained cup which was of great benefit to patients at risk for dislocation. The Sivash prosthesis was manufactured with a constraining ring mechanism (Figure 3) that permanently retained the head within the cup. This innovation allowed movement and prevented dislocation but meant that the Sivash prosthesis was implanted as single device consisting of femoral stem and acetabular cup.

The surgical technique was explained by Sivash in his manual entitled "Alloplasty of the hip joint. A laboratory and clinical study" dated 1967[8] (Figure 4). The prosthesis was implanted by a direct lateral approach that exposed the major trochanter. A small flake of bone with the insertion of the gluteal muscles was removed by a trochanteric osteotomy. Next, the femur was cut at the level of the lesser trochanter and the femoral head and neck were removed. The intertrochanteric area was prepared with the help of grooved chisels, and the femoral canal was shaped by special cone cutters which precisely match the size of the femoral component, whereas the acetabulum was prepared to achieve a 2-3 mm press-fit. After reaming the acetabulum, the femoral component was inserted, followed by the cup that was inserted with the blades perpendicular to the acetabular opening. The socket was seated by impact which pressed the blades into


**Figure 1**. The original hip prosthesis from Professor Sivash. The three parallel rows of fenestrated titanium "petals" on its outer surface for a direct acetabular bony anchorage are noticeable along with the trochanteric dowel and the proximal sleeve for enhanced collar calcar contact. The stem is introduced in the reamed femoral channel and stabilized because of the femoral bone elasticity. Fenestrations of the stem in the distal part are intended to permit bone ingrowth that guarantees for definitive stabilization. Translation: ISKUSSTVIeNNYJ = Artificial, TAZOBIeDRIeNNYJ = Acetabular, SUSTAV = Joint, SISTIeMY = Systems, K.M. SIVAŠA = K. M. Sivash. (Original figure is courtesy of Prof. Konstantin Mikhailovich Sherepo - Republican Research Center for Radiation Medicine and Human Ecology of Gomel, Belarus).

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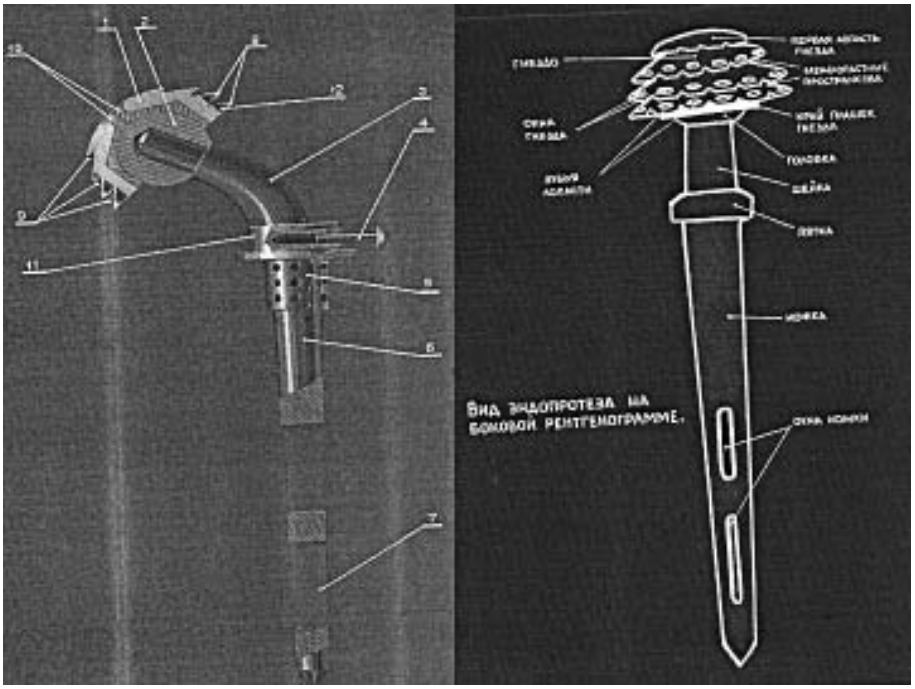


**Figure 2**. Schematic rendering of the hip prosthesis. Translation: VID = View, ENDOPROTIeZA = Endoprosthesis, NA = On, BOKOVOJ = Lateral, RIeNTHIeNOGRAMMIe = To the Roentgenogram. (Original figure is courtesy of Prof. Konstantin Mikhailovich Sherepo - Republican Research Center for Radiation Medicine and Human Ecology of Gomel, Belarus).

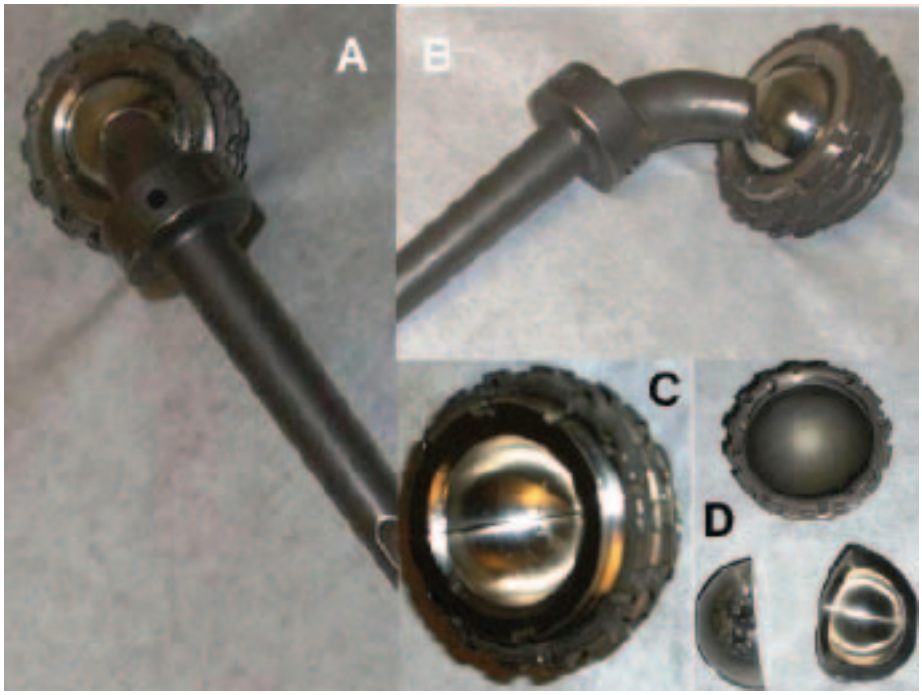


**Figure 3**. An assembled (A-B) and a disassembled (C-D) Sivash constrained acetabular component. It is visible the peculiar liner retainer mechanism made of two hemispherical devices to lock the femoral ball (Photos are courtesy of Dr Jerrold Gorski, Orthopedic Surgery, Mineola, New York, U.S.A.).

the acetabular bone for primary fixation. The gluteal muscles were reattached with a 5 mm diameter metal dowel that passed through the greater trochanter and into the femoral component. The dowel was hammered into place.

In 1971, the United States Surgical Corporation bought the license for production of the Sivash total hip prosthesis for distribution in the United States and Canada. In 1974, two company engineers, Douglas Noiles and Fred DeCarlo, improved the design by incorporating a 3° Morse taper, adding a distal coronal slot to avoid the potential risk of splitting the femur and eight distal flutes to prevent failure by rotation of the stem in the femoral canal[9]. In 1975, these modifications yielded a new design that was named SRN (Sivash Russin Noiles) Total Hip Prosthesis manufactured by United States


**Figure 4**. Cover of the original manual written by Konstantin Mitrophanovic Sivash entitled "Alloplasty of the hip joint. A laboratory and clinical study.", Moscow 1967. (Original figure is courtesy of Dr. Alexander Chelnokov—Ural Scientific Institute of Traumatology and Orthopaedics of Ekaterinburg, Russia).

Surgical Corporation (Stamford, Connecticut, USA). The SRN was available in two versions. The first version was produced with a metal liner that was assembled at the factory and surgically implanted like the original design as one unit. The second version was produced with a polyethylene lined cup that was prone to dislocation and was later modified with a reinforcing ring in 1974.

The use of any constrained device may be associated with decreased range of motion, potential impingement, and enhanced interfacial stresses that may result in increased risks of wear, osteolysis, and loosening[10]. Furthermore, constrained failures due to dissociations or to disengagement of factory-preassembled component interfaces have been reported[11]. Compared to the Charnley design, some of the innovations embodied in the Sivash design included a constrained joint, cementless fixation, and metal on metal bearing surfaces. The Sivash monoblock prosthesis was the precursor of the S-ROM (Sivash Range of Motion) total hip prosthesis that was introduced in 1984[12,13,14,15]. After nearly 50 years since its introduction, production of the Sivash total hip prosthesis stopped in 2007.

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