Product Information

smith&nephew
SL-PLUS°
Cementless Femoral Hip System

Supporting healthcare professionals
SL-PLUS - the GOLD STANDARD\textsuperscript{1,2}

It all started with the philosophy to develop a universal hip system that can be used for young and older patients alike to relieve hip pain and restore hip motion\textsuperscript{3-7}.

In 1992 the first SL-PLUS stem was implanted. This cementless straight stem with its rectangular, double-tapered form, according to Professor Karl Zweymuller, proved itself to be a reliable system\textsuperscript{3,5,6,8-10} over a hundred thousand times worldwide\textsuperscript{11}, providing predictable and reproducible results\textsuperscript{10,12}.

The SL-PLUS stem offers a successful biological anchoring concept\textsuperscript{3,7,9,13} fitting in a variety of bone morphologies\textsuperscript{3,14,15} allowing success even also in the hands of less experienced surgeons\textsuperscript{10}.

Dual taper principle

With the precisely defined taper angle, multiple cortical contacts are achieved along the entire length of the stem. This allows the load to be transferred over a broad area in the metaphyseal and diaphyseal regions in both projection planes leading to favorable load distribution\textsuperscript{16}.

Rectangular taper

The rectangular cross section of the SL-PLUS stem requires minimum excavation of the medullary canal\textsuperscript{13,16}. The cortical support at the edges leads to excellent primary and rotational stability\textsuperscript{7,13,14} and leaves enough room for the bone to be supplied with nutrients from the medullary cavity\textsuperscript{13,16}. 
Design Rationale

Freedom of movement
The proximally tapered neck is designed to provide an optimum balance between the greatest possible range of motion (ROM) and high strength.

Well adapted product range
With its anatomically adapted size distribution it matches nearly every patient and helps restore the biomechanical center, offering a standard stem with a Centrum Collum Diaphyseal (CCD) angle of 131° and a lateral option with 123°.

High primary stability
The dual-tapered straight stem with its rectangular cross section leads to excellent primary and rotational stability in the cortical bone. This leads to favorable load distribution by transmitting it in both projection planes to prevent subsidence of the implant.

The point of reference
The shoulder serves as the reference point for the preoperative planning, medullary canal preparation and stem implantation. Furthermore, it contains a 8mm extraction thread along the axis of the stem.

Trochanteric wing
The characteristic proximal-lateral trochanteric wing, with its enlarged surface, supports the initial anchorage and, together with the rectangular base profile of the SL-PLUS stem, provides high level of rotational stability.

Improved secondary stability
The INTEGRATION-PLUS™ multi layer Titanium/Hydroxyapatite (Ti/HA) coating in the proximal area leads to accelerated and increased bone on-/in-growth with the aim of avoiding radiolucent lines by enhancement of load transmission in the metaphyseal region.

Pyramid-shaped tip
The taper at the prosthesis tip is rounded and changes smoothly into a pyramid-shaped tip. This shall allow a physiological transfer of forces to the implant tip, which may result in reduced tension peaks in the distal diaphyseal area.
Anatomically matched stem sizes

The SL-PLUS system offers a total of 52 stem options: 14 sizes for the Standard and 12 sizes for the Lateral option, each available as non-coated and Ti/HA coated version. The specific size increments were developed by a computer-assisted series of measurements, so that the system can provide an optimal fit and facilitate the intraoperative choice of the correct size. This distinct design of anatomical adapted size increments is an important advantage of this system.

<table>
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* Special size (optional)
**Two offset options**

The restoration of the anatomically correct offset is of prime importance and so the SL-PLUS stem is available in two offset options:

- **Standard stem**: 131° CCD angle
- **Lateral stem**: 123° CCD angle

The offset increases proportionally while the height of the rotation center remains equal for the lateralized stems, but gives an additional offset of +6 to +9mm with a ball head M/+4.

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**Pyramid shaped tip**

The taper at the prosthesis tip is rounded and changes smoothly into a pyramid-shaped design. This may lead into reduced tension peaks in the distal diaphyseal area.
INTEGRATION-PLUS™:
Excellent primary and secondary stability
7,14,16

The base material of the SL-PLUS INTEGRATION-PLUS stem is a forged and corundum blasted Ti-6Al-7Nb alloy with a surface roughness of Ra 4-8 µm. The proximal part is additionally Vacuum Plasma Sprayed (VPS) with a 0.3 mm open-pore titanium plasma layer and a 0.05 mm hydroxyapatite (HA) layer.

Abnormal of the VPS Ti/HA coating

The open-pore titanium layer more than doubles the surface and its roughness and therefore increases bone on-/in-growth.19,22

HA coating facilitates bone cell attachment and bone deposition (surface coverage), supporting osseointegration.18,19,22,23

The bond strength of the HA coating is improved thanks to a mechanical interlock with the roughened Ti surface. This prevents coating delamination.19,23

In the event of local HA resorption, the underlying roughened Titanium-Plasma-Spray layer encourages osseointegration.19

With HA coating, gaps between the implant and bone can be bridged by approx. 1mm.18,19,22,24,25,30

Advantage of the VPS Ti/HA coating

 Plasma spraying is a well-established coating process that is widely available and well accepted.23,26-28

Implant fatigue resistance superior to sintered porous surfaces.19

Implant fatigue resistance superior to sintered porous surfaces.

Increased purity and adhesive strength compared to other processes (e.g. APS Atmospheric Plasma Spray).26

What are the advantages of Vacuum Plasma Spraying?

The histology from an explanted SL-PLUS MIA Ti/HA stem confirms that HA can facilitate implant osseointegration in the early postoperative period:

Electron microscope scans:

Implant cross-section showing the Ti/HA coating

Innovative Ti/HA coating of a stem surface; mean roughness Ra approx. 20–30 µm. (Stereomicrograph, x 20, SL-PLUS with INTEGRATION-PLUS)

*Image courtesy of OA Priv.-Doz. Dr. Monika Huber, SMZ Otto Wagner Hospital, Pathological-Bacteriological Institute, Vienna

Histology after 4 months*
Clinical results

A systematic review of literature\(^1\) found:

- Low overall total revision rate of 3.2% at 9.2 years follow up, which fell to 2.5% when calculating revision specific to the stem
- Mean postoperative HHS of 89.1 (1,327 hips from 11 studies)

A supplementary review of registry data showed:

- Data on SL-PLUS were available in the annual reports of three separate national joint registries (Australian Orthopaedic Association National Joint Replacement Registry 2016, National Joint Registry for England, Wales, Northern Ireland, and Isle of Man 2016, Registro dell’Implantologia Protesica Ortopedica 2015) with a total of 11,527 devices. Final revision rates/survival times were at or better than the separate registries’ class averages in the majority of cases (three out of five categories)

In conclusion, the SL-PLUS is a safe and effective non-cemented stem (confirmed by both published clinical data and national joint registry data).

Case follow-ups
(Courtesy of Primarius Univ.-Prof. Dr. med. Peter Ritschl, Vienna)

Case 1

- Preop: Male Patient, born 1951, massive coxarthrosis right hip
- 7 months post-op: SL-PLUS stem w. BICON-PLUS cup.
- 22 years post-op: minimal radiolucent zones at the stem shoulder, otherwise complete osseointegration of the implant without atrophy at the cortical bone.

Case 2

- Preop: Male patient, born 1956, massive coxarthrosis left hip
- 2 months post-op: SL-PLUS stem in varus position, minimal leg lengthening and BICON-PLUS cup.
- 12 years post-op: stem in unchanged varus position and well osseointegrated. The patient is doing fine with full function in the operated left hip