

MODULUS

FUNCTION RE-INVENTED

CLINICAL CASES



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Foreword

Abnormal anatomy and previous surgery make primary hip arthroplasty for osteoarthritis secondary to severe developmental dysplasia of the hip (DDH), osteotomies and/ or trauma technically difficult. Appropriate implant selection and meticulous surgical technique are the key factors to ensure optimal longevity of the implant in these often relatively young patients.

Crowe et al.¹ described a method of classification of dysplastic hips according to the grade of subluxation. Crowe type-III (75%-100% subluxation) and type-IV (complete dislocation) hips have the greatest degree of anatomical abnormality and consequent technical difficulty during hip arthroplasty procedure.

In a study of the three-dimensional shape of the dysplastic femur by Noble et al², the femurs of the DDH patients were shown to have shorter necks and smaller straighter canals than the control normal femurs. It was observed that the shape of the canal became more abnormal with the increase of the subluxation. Furthermore, a proximal femoral deformity arises from a rotation within the diaphysis between the lesser trochanter and the isthmus. Depending on the degree of hip subluxation, an increase in anteversion between 5° and 16° was noted. Moreover, the canals in dysplastic femurs are often greater in the antero-posterior than in the medial-lateral dimension and this situation can also be observed in post-traumatic cases.

Conical femoral fixation and the possibility to recover length, offset and thus stability with a modular neck is mandatory for these important, difficult cases.

The Modulus hip prosthesis is the unique system that provides both strong conical femoral fixation and the modularity needed to the surgeon to adapt to an anomalous anatomical condition and create “physiological” hip biomechanics.

The Modulus stem showed good mid-term results in terms of survivorship as well as clinical and radiographic outcome in a prospective evaluation performed on 222 consecutive patients (239 hips) that underwent primary THA between October 2001 and December 2006, mainly due to coxarthrosis associated with anatomical deformity (varus, valgus or dismorphic neck) and developmental dysplasia of the hip (DDH).

At an average follow-up of 5.4 years (2-8 years), the average Harris Hip Score improved from 35 points preoperatively to 97 at the final follow-up. The average Oxford Hip score fell from 57.5 points preoperatively to 14.3 postoperatively. In 100% of cases, it was possible to show a stable bone growth at the stem-endosteum interface. According to Kaplan-Meier analysis, the survival rate at 5 years was 98.28% with a 95% confidence interval³.

The intraoperative possibility to achieve the strongest fixation independently from the biomechanical restoration makes the Modulus stem the first choice in the treatment of the challenging cases, ensuring a good functional recovery and implant stability.

The following nine interesting clinical cases illustrate some examples of difficult preoperative situations that can be solved thanks to this modular system.

1 THE MODULUS STEM IN A BILATERAL CASE OF A SEVERE DDH



RIGHT - PREOPERATIVE



LEFT - PREOPERATIVE

PREOPERATIVE

A 55-year-old female (165 cm height, 65 kg weight, 24 BMI) showed a severe DDH, compromising her active lifestyle with clinically important limping and positive Trendelenburg sign. The excessive anteversion, combined with the leg length discrepancy caused severe pain and important difficulties in walking. The patient developed an extreme symptomatic osteoarthritis on the left side, with only 45° flexion and 15° abduction. The surgical reconstruction had to restore the correct centre of rotation and the offset, correcting the leg length discrepancy.

TREATMENT

Primary total hip arthroplasty through an antero-lateral approach was performed bilaterally with a cementless 16-mm Modulus stem with a 135° short neck. Both hip joints underwent surgery within 3 months in order to provide the patient enough time for recovery of muscle stability. The centres of rotation were restored by implanting the cups in the anatomical position and choosing the correct anteversion of the modular neck.

Courtesy of F. Benazzo, MD, IRCCS Policlinico San Matteo, University of Pavia, Italy.

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**MODULUS STEM
+ 135° SHORT NECK**

POSTOPERATIVE

Postoperative X-rays showed a correct bilateral implant alignment and a good stability. The previous significant length discrepancy of both legs was completely corrected.

8-YEAR FOLLOW-UP

X-rays showed a bilateral implant with a good stability, no radiolucent lines nor stress shielding. The patient showed a satisfactory clinical functionality (HHS >95 points), a good walking performance with no limping and no pain. She was very satisfied with her improved quality of life.



RIGHT - 8 YEARS



LEFT - 8 YEARS

2 THE MODULUS STEM IN A CASE OF A PREVIOUS SCHANZ OSTEOTOMY



PREOPERATIVE

PREOPERATIVE

A 65-year-old female (162 cm height, 64 kg weight, 25 BMI) underwent a previous Schanz osteotomy and presented secondary osteoarthritis with all related clinical problems. Flexion was very painful up to 60° degrees and 20° abduction, climbing stairs or getting up from a deep chair was very difficult.

The surgical problems involved the restoration of the correct offset and centre of rotation. The cup positioning and the entry point of the medullary canal made the procedure very challenging.

TREATMENT

Initially, a greater trochanter osteotomy was performed through lateral approach. The modular cementless 19-mm Modulus stem was implanted and connected with a 135° long neck. The osteotomy was then fixed by a plate with cerclages. The result was stable with a good intraoperative ROM and stability.

Courtesy of F. Benazzo, MD, IRCCS Policlinico San Matteo, University of Pavia, Italy.



2 YEARS

POSTOPERATIVE

Postoperative X-rays showed a correct implant alignment, good stability and a restored centre of rotation.

2-YEAR FOLLOW-UP

The stem was stable and osteointegrated with neither signs of radiolucent lines nor loosening. The patient had a good functional recovery (HHS score > 90 points) with no limping and complete pain relief. The patient was satisfied with the clinical outcome and glad to have the possibility to improve the quality of daily life.

3 THE MODULUS STEM IN A BILATERAL CASE OF SEVERE DDH WITH PREVIOUS OSTEOTOMY



RIGHT - PREOPERATIVE



LEFT - PREOPERATIVE

PREOPERATIVE

A 60-year-old female (167 cm height, 71 kg weight, 25 BMI) presented a severe DDH with a previous osteotomy performed on her right hip. Daily life became very difficult with continuous pain, limping and significant decrease in functionality. Flexion was very painful up to 30°, 10° abduction and 10° internal/external rotation. The surgical involved the restoration of the offset and centre of rotation, the correction of the osteotomy deformation on the right side and the reconstruction of the two femurs with different flare indexes.

TREATMENT

Both hip joints underwent surgery within 1 year. THA was performed through a lateral approach with a 22-mm Modulus stem with 125° long neck on the left side (stove pipe femoral canal) and a 15-mm Modulus stem with 125° long neck on the right osteotomised femur.

Courtesy of F. Benazzo, MD, IRCCS Policlinico San Matteo, University of Pavia, Italy.

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POSTOPERATIVE

Postoperative X-rays showed a correct implant alignment, good stability and a restored centre of rotation.

4 AND 5-YEAR FOLLOW-UP

The X-rays showed a stable bone in-growth along the stem with neither signs of radiolucent lines nor stress shielding. The patient regained a very satisfactory functional recovery with a HHS score exceeding 95 points, no residual pain, a good ROM and walking performance. Her quality of life was significantly improved.



RIGHT - 5 YEARS



LEFT - 4 YEARS

4 THE MODULUS STEM IN A CASE OF CROWE TYPE-III DDH



PREOPERATIVE

PREOPERATIVE

A 47-year-old female (151 cm height, 46 kg weight, 20 BMI) showed a left severe osteoarthritis in a Crowe type-III DDH. The excessive anteversion, combined with the shortening of the leg caused severe pain and important difficulties in walking, climbing stairs and rising from a deep chair. This extreme symptomatic osteoarthritis on the left side was associated with a mobility reduced to only 20° flexion and 5° abduction.

TREATMENT

Primary total hip arthroplasty through an antero-lateral approach was performed with a cementless 15-mm Modulus stem coupled with a 125° long neck, medium 28-mm femoral head. The centre of rotation was completely restored, implanting the cup in the anatomical position and choosing a 40° anteversion for the modular neck.

POSTOPERATIVE

Postoperatively, x-rays showed a correct implant alignment and a good stability. The previous significant leg length discrepancy was completely corrected.

12-MONTH FOLLOW-UP

X-rays showed an implant with good stability and no radiolucent lines around the stem. Furthermore, no signs of stress shielding have been observed. The patient had a good functional recovery with flexion up to 120° and no residual pain. She was very satisfied to regain an adequate mobility and the ability to walk again without crutches.

Courtesy of Yukio Yoshida, MD, East Medical Center Higashi Municipal Hospital, City of Nagoya, Japan.

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POSTOPERATIVE



6 MONTHS



12 MONTHS

5 THE MODULUS STEM IN A CASE OF CROWE TYPE-IV DDH



PREOPERATIVE

PREOPERATIVE

A 60-year-old female (143 cm height, 45 kg weight, 22 BMI) showed a Crowe type-IV DDH that started to be symptomatic 5 years before. She suffered from severe walking pain, pain at rest, serious limitation of activities and poor ROM.

TREATMENT

Primary THA was performed through a postero-lateral approach. Bone quality was good, a preoperative 3.5-cm leg length discrepancy was confirmed. The femur was reconstructed with a 17-mm Modulus stem with a 135° short neck coupled with a 28 mm short femoral head and the acetabular side with a 46-mm cup, fixed by 3 screws. Intraoperatively, no complications occurred, the leg length discrepancy was corrected without any soft tissue involvement by means of a 3.5-cm subtrochanteric osteotomy with a V-cut, according to the preoperative plan.

POSTOPERATIVE

X-rays showed a correct implant alignment and good stability. Correct leg length was confirmed and the conical stem was in the recommended position in order to achieve the adequate healing of the osteotomy.

2 AND 9-MONTH FOLLOW-UP

X-rays showed implant with good stability, no malalignment and no radiolucent lines. After only 3 weeks from surgery, the patient had a very good recovery of the hip function with a full weight-bearing.

For this reason, the contralateral side was operated after 3 weeks from the first implant. The flexion was up to 90° with an 30° abduction and the walking performance was very good with no limping. At the last follow-up, no stem subsidence was observed, and the the osteotomy was completely healed.

Courtesy of Takuya Nakamura, MD, Toyama Prefectural Central Hospital, Japan.

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POSTOPERATIVE



2 MONTHS



9 MONTHS

6 THE MODULUS STEM IN A CASE OF GARDEN TYPE-III NECK FRACTURE



PREOPERATIVE

PREOPERATIVE

An 80-year-old male (163 cm height, 49 kg weight, 18 BMI) had a Garden type III femoral neck fracture on his right hip caused by a stair fall. The bone quality was good and a stove pipe femoral canal was confirmed. Considering his age, immediate surgery was planned in order to avoid the losing of mobility.

TREATMENT

Primary hip arthroplasty was performed through a postero-lateral approach. Bone quality was good as preoperatively shown by the x-ray. The acetabular side showed good cartilage, therefore a bipolar cup was implanted to reduce and facilitate the postoperative course. The 25-mm Modulus stem with a 135° short neck was implanted, fixed to a bipolar 50-mm cup with a 28-mm short head. The reposition of the implant confirmed a good joint congruency and an adequate intraoperative ROM.

POSTOPERATIVE

X-rays showed a correct implant alignment and good stability. The good centralisation of the implant justified immediate surgery.

2 AND 4-MONTH FOLLOW-UP

X-rays showed the implantation of a stem with a very good stability, initial bone fixation and no signs of subsidence. The patient was able to start walking without crutches soon after surgery, facilitating the postoperative recovery. The relatively good muscular status of the patient helped to get a good ROM, allowing the patient to regain his normal daily activity.

Courtesy of Takeshi Ooki, MD, Hankai Hospital, Japan.

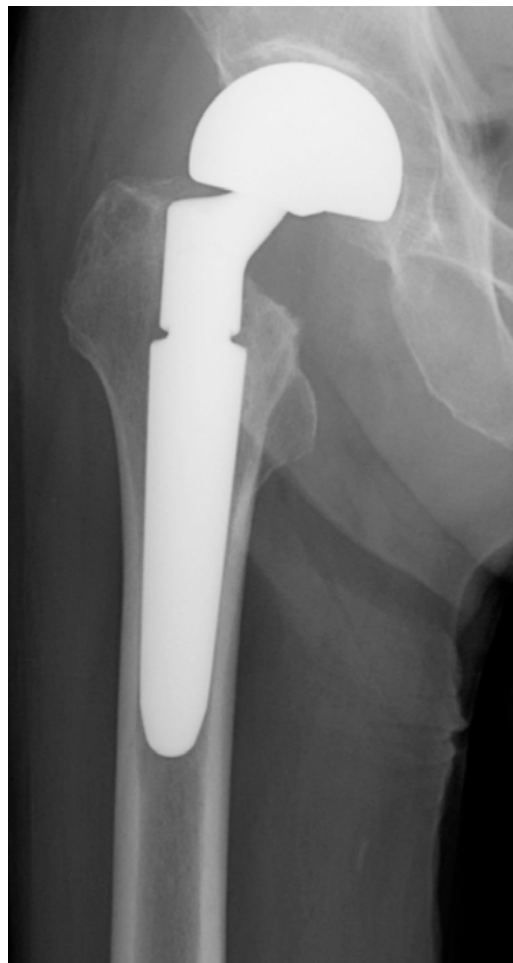
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POSTOPERATIVE



2 MONTHS



4 MONTHS

7 THE MODULUS STEM IN A CASE OF A PREVIOUS VALGUS OSTEOTOMY



PREOPERATIVE

PREOPERATIVE

A 50-year-old female (152 cm height, 49 kg weight, 21 BMI) showed a right DDH, previously operated on with a corrective valgus osteotomy. Secondary osteoarthritis associated with increasing pain and continuous decrease of ROM limited her active lifestyle.

TREATMENT

Primary total hip arthroplasty was performed through an antero-lateral approach on the right side, with a cementless 19-mm Modulus stem coupled with a 125° long modular neck and a 28-mm short head. The 2.5-cm leg length discrepancy of her right leg was reconstructed by the implant of the modular hip arthroplasty system. The cup was implanted in the anatomical position, providing the patient a correct centre of rotation of the arthroplastic hip.

POSTOPERATIVE

Postoperatively, x-rays showed a correct implant alignment and a good stability. The previous significant leg length discrepancy was completely corrected.

6-MONTH FOLLOW-UP

X-rays showed a good stability of the stem with no subsidence, no radiolucent lines and no stress shielding. Clinically, the patient showed a fast functional recovery, a good painless ROM with a flexion exceeding 90° and 30° abduction.

2-YEAR FOLLOW-UP

The patient was very satisfied with the clinical outcome and was able to acquire her normal daily activity improving her quality of life.

Radiologically, the implant was completely osteointegrated with no signs of instability.

Courtesy of Yuichi Doiguchi, MD, Nagasaki Rosai Hospital, Japan.

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POSTOPERATIVE



6 MONTHS



2 YEARS

8 THE MODULUS STEM IN A CASE OF CROWE TYPE-IV DDH



PREOPERATIVE

PREOPERATIVE

A 58-year-old female (156 cm height, 51 kg weight, 21 BMI) showed a left Crowe type-IV DDH. The patient complained of severe pain, functional limitation and difficulty to climbing the stairs along with progressive reduction of flexion and abduction of her left hip.

TREATMENT

Primary total hip arthroplasty was performed through an antero-lateral approach with a cementless Modulus stem coupled with a modular 125° long neck. The preoperative leg length discrepancy was corrected without any risk of ischiatic nerve distraction.

Courtesy of Yuichi Doiguchi, MD, Nagasaki Rosai Hospital, Japan.

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POSTOPERATIVE



2 YEARS

POSTOPERATIVE

Immediate postoperative X-rays showed a correct implant alignment. The cup was positioned in the anatomical position, ensuring a complete restoration of the offset thanks to the modular neck chosen.

2-YEAR FOLLOW-UP

Clinically, the patient achieved a good functional outcome with an adequate ROM with 100° flexion and a good walking performance. Completely satisfied after the surgery, she went back to normal daily work without restrictions. Radiologically, there were no signs of radiolucent lines and a slight asymptomatic stress shielding.

9 THE MODULUS STEM IN A CASE OF CROWE TYPE-IV DDH AFTER PREVIOUS OSTEOTOMY



PREOPERATIVE

PREOPERATIVE

A 78-year-old female (154 cm height, 48 kg weight, 20 BMI) showed left osteoarthritis secondary to Crowe type-IV DDH with an important antetorsion, a stove pipe femoral canal shape and proximalisation of the destructed femoral head. Severe pain, limping and poor functionality were the main symptoms leading to prosthetic surgery. The patient underwent a previous corrective osteotomy.

TREATMENT

Primary total hip arthroplasty was performed through an antero-lateral approach with a cementless 22-mm Modulus stem coupled with a 125° long neck and a 28-mm short head. The centre of rotation was restored; the femur was distalised with the implantation of the acetabular cup in the anatomical position; and the leg length discrepancy was corrected.

Courtesy of Takuya Nakamura, MD, Toyama Prefectural Central Hospital, Japan.

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POSTOPERATIVE



12 MONTHS

POSTOPERATIVE

The postoperative X-rays showed a correct implanted prosthesis with a good alignment and stability.

12-MONTH FOLLOW-UP

The patient was satisfied with the pain relief and functional recovery. She gained 85° flexion and 35° abduction. X-rays highlighted a stable stem with no subsidence and a complete osteointegration, even in the stem-neck junction. The presence of a slight bone hypertrophy was detected in Gruen zone 5.

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Limacorporate spa
Via Nazionale, 52
33038 Villanova di San Daniele
Udine - Italy
Tel.: +39 0432 945511
Fax: +39 0432 945512
E-mail: info@limacorporate.com
www.lima.it

Lima Implantés slu
Lluça 28, 2º
08028 Barcelona - Spain
Tel.: +34 93 228 9240
Fax: +34 93 426 1603
E-mail: lima@limaimplantés.com
www.limaimplantés.com

Lima France sas
Les Espaces de la Sainte Baume
Parc d'Activité de Gemenos - Bât.A5
30 Avenue du Château de Jouques
13420 Gemenos - France
Tel.: +33 (0) 4 42 01 63 12
Fax: +33 (0) 4 42 04 17 25
E-mail: info@limafrance.com
www.limafrance.com

Lima O.I. doo
Maksimirska, 103
10000 Zagreb - Croatia
Tel.: +385 (0) 1 2361 740
Fax: +385 (0) 1 2361 745
E-mail: lima-oi@lima-oi.hr
www.lima-oi.hr

Lima Switzerland sa
Birckenstrasse, 49
CH-6343 Rotkreuz - Zug
Switzerland
Tel.: +41 (0) 41 747 0660
Fax: +41 (0) 41 747 0669
E-mail: info@lima-switzerland.ch
www.lima-switzerland.ch

Lima Japan kk
Koshin Building 8F.
4-5-1 Nishi-shinjyuku, Shinjyuku,
Tokyo 160-0023 - Japan
Tel.: +81 3 5350 0755
Fax: +81 3 5350 0766
www.lima-japan.com

Lima CZ sro
Do Zahrádek I., 157/5
155 21 Praha 5 – Zličín
Czech Republic
Tel.: +420 222 720 011
Fax: +420 222 723 568
E-mail: info@limacz.cz
www.limacz.cz

Lima Deutschland GmbH
Kapstadtring 10
22297 Hamburg - Germany
Tel.: +49 (0)40 63 78 46 40
Fax: +49 (0)40 63 78 46 49
E-mail: info@lima-deutschland.com
www.lima-deutschland.com

Lima Austria GmbH
Ignaz-Köck-Strasse 10 / Top 3.2
1210 Wien - Austria
Tel.: +43 (1) 2712 469
Fax: +43 (1) 2712 469 100
E-mail: info@lima-austria.at
www.lima-austria.at

Lima SK s.r.o.
Zvolenská cesta 14
97405 Banská Bystrica - Slovakia
Tel.: +421 484 161 133
Fax: +421 484 161 138
E-mail: info@lima-sk.sk
www.lima-sk.sk

Lima Netherlands B.V.
Ginnekenweg 157
4818 JD Breda
The Netherlands
Tel.: +31(76) 514 6393
Fax: +31(76) 521 8889
info@lima-nederland.nl
www.lima-nederland.nl

Lima Implantés Portugal Lda
Rua Olavo D'Eça Leal N°6 Loja-1
1600-306 Lisboa - Portugal
Tel : +35 121 727 233 7
www.limaportugal.com

Lima Orthopaedics Australia Pty Ltd
Unit 1, 40 Ricketts Rd
Mt Waverley 3149
Victoria Australia
Tel.: +61 (03) 9550 0200
Fax: +61 (03) 9543 4003
www.limaortho.com.au

Lima Orthopaedics New Zealand Ltd
Zone 23
Unit 102 / 23 Edwin St
Mt Eden
Auckland 1024
New Zealand
Tel.: +64 (09) 511 5522
Fax: +64 (09) 522 3380
www.limaortho.co.nz

Lima UK
United Kingdom

Hit Medica spa
Strada Borrana 38
47899 Serravalle - Republic of San Marino
Tel.: +378 0549 961911
Fax: +378 0549 961912
E-mail: info.trauma@limacorporate.com

