REVIEW ARTICLE

ACETABULAR REVISION OF PAPROSKY III DEFECTS WITH A NEW CONCEPT SHELL: A PRELIMINARY STUDY ON 34 CONSECUTIVE CASES

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Abstract

The increasing duration of life with total hip arthroplasties and trend toward indication for surgery at younger ages, will increase the amount and complexity of revision surgery.

Cementless acetabular components have shown improved long term survival over cemented components. Sometimes peripheral acetabular circumference (RIM) and acetabular wall integrity aren't enough preserved to guarantee a new implant good stability.

Usually the treatment options for III A and III B Paprosky defects are: cage implant with cemented polyethylene liner, cementless implants with augmentation using, big revision shell implant with biological/metal augmentation or the stemmed cup implant.

The LIMA acetabular revision system born to make possible the combination between cage benefit with all the primary implant shell advantages. This solution gives the same stability of a cage and more options than a primary cup to restore the hip rotation centre without cement using.

We analyze a consecutive 34 THR executed between 2009-2013 with at least 5 years follow up.

INTRODUCTION

Revision total hip arthroplasty is a challenge wherever there are acetabular defects to be filled. Multiple classification systems have been devised to assess acetabular deficiency as Paprosky classification or the AAOOS classification, which are widely used. Differently from AAOOS Paprosky classification quantify the amount of supportive bone[3,4].

In Paprosky classification[5] Type IIIA defects are characterized by >3 cm of superior migration of the femoral component cephalad to the superior obturator line, moderate teardrop and ischial lysis, and an intact Kohler line. Less than 50% of host bone support is present.

Type IIIB defects are characterized by >3 cm of superior migration of the femoral component, severe to complete destruction of the teardrop, extensive ischium osteolysis and migration of the component medial to Kohler's line. In these defects, there is typically 40% of host bone available for contact with the surface of the acetabular component. The defect usually involves more than half the circumference of the rim. Patients with a type III B defect are at high risk for a pelvic discontinuity, which should be assessed at the time of surgery.

Treatment options for reconstructing an acetabulum with a type III A-B defect include cancellous allograft with a cage, structural allograft of the posterior column with a cage, trabecular metal with augments or a stemmed cup implant[2].

It's well known that deficiencies requiring more than 50% socket coverage with allograft had to be supported by metal ring or cage with cemented cup to unload the grafts during revascularization phase.

Actually we have an alternative solution to cage implant in Paprosky III A-B defects represented by LIMA delta TT revision system. This is an implant which combines the cages advantages with primary cup properties.

In this big bone defects usually is necessary to do a good impaction grafting finalized to transform the segmental defects into cavitary defects and to obtain full graft compaction in order to restore the bone stock.

Lima system guarantees graft protection from mechanical overload during its revascularization phase. It allows also to achieve primary stability of the cup and to restore the hip rotation center with a cup anatomically located in the acetabulum.

In our experience of acetabular bone defects we treated between 2009 and 2013 34 patients with an average age of 69 years. We performed 34 revision of acetabular implant due to a bone loosening classified with Paprosky classification: 19 patients with III-A defect, 15 patients with III-B defect.

All patients were treated with Delta revision TT shell (Limacorporate S.p.a. – Via Nazionale n. 52, 33038 Villanova di San Daniele del Friuli, Italia). No patient data were missed in our retrospective study.

SURGICAL TECHNIQUE

All THR were performed with direct lateral access according to Hardinge.
We have done a pre-operative adequate evaluation of acetabular wall with X-rays and CT scans.
After only intraoperative benchmarking we confirmed the bone defect kind and Grafton A-Flex and frozen allograft using.
After an appropriate acetabular socket exposure and cleaning, we removed soft tissues for a right view of the defect.
Following we filled the defect with allografts obtained by femoral head cut to slices with oscillating saws.
In extended defects case allografts are morcellizzed at surgeon will.
Then cartilage was cleaned out and allografts were reduced to chip of 7 mm diameter before washing in 0.9% saline. Its good practice performs 3 preventive control buffers from the liquid solution and 3 buffers by allografts without the saline solution.
In Paprosky IIIA and IIIB defects we are used to apply on the socket bottom demineralized bone matrix as Grafton a-FLEX on which the bone chips are placed.Wherever we can't use demineralized bon matrix (DBM) we put in the socket withdrawal from the iliac crest bone marrow centrifuged.
Grafton demineralized bone matrix has significative inductive and osteo-conductive properties which increase the grafts integration probability.
Weight bearing was accorded in all patients only after 3 months from surgery to obtain the grafts integration safeguard.
Between 2009 and 2013 we implanted 34 Delta Revision TT shell in 31 patients, including 5 men and 26 women with an average age of 69 years and average follow-up of 58 months.
In addition 31 of 34 patients treated were aseptic acetabular revisions while the remaining 3 were septic revisions.
The sample acetabular defects were classified with Paprosky classification in: 14 patients with III-A defect, 15 patients with III-B defect.
All patients were treated by the same surgeon and the same equip with the same cup.
The patients were separated retrospectively in two homogeneous groups:

- Group A of 19 patients Delta Revision TT, Grafton A-Flex or stim marrow and bone chips obtained from the femoral head of the bank (Paprosky defect representation 8 IIIA, 11 IIIB)
- Group B of 15 patients Delta Revision TT and the only chips of morcellised bone (Paprosky defect representation 10 IIIA, 5 IIIB);

After surgery all the patients performed the same rehabilitation protocol.

THE LIMA DELTA TT REVISION SHELL

Since the introduction of the Lima Delta Revision system to our department it has become the revision component of choice in Paprosky Type IIIA up to IIIB situations and in case of a lot of bone grafts using.

The Delta Revision TT shell has a complex shape: it consists of a central portion comparable to a trabecular titanium sump guard internal locking holes with screws.

The other eccentric component consists of a freeform ring attached to the lower pole of the shell central portion. On the upper pole of the shell there are 3 vertical plates welded with 2 holes each except the one in the middle which has 3 iliac fixation of the competition.

This hybrid system between cage and classic shell comes to have cup classic solutions such as for primary implants with speech of modularity by making it applicable even where there are no walls enough to ensure good stability of conventional plants.

The system allows for intraoperative customization.

The trabecular titanium shell is equipped with a hook to be placed in the obturator foramen; furthermore screw fixation is done by dome screws placed in the direction of the resulting hip force and fins to be fixed by screws to the iliac bone.

After proper implantation of the shell special augments can be used to obtain optimal inclination and anteversion angles. If bone voids are apparent they can be filled by specially designed hemispheric modules matching to the implanted diameter of the shell. After having chosen the most suitable inner augment the surgeon can chose between various liner options up to 36mm diameter Delta ceramic inlays or dual mobility liners for maximum stability.

All components having intimate bone contact are built of Trabecular Titanium (TT), a titanium structure built up by electron beam melting. The friction coefficient of this material is higher than tantalum and the elastic modulus is very close to natural bone

RESULTS

Patients were pre-operatively evaluated with the Harris Hip Score scale obtaining an average score of 21.52 pts. While postoperatively obtained a total average score of 78.82 pt (Group A: 79.63; Group B: 77,93).

The complications found were as follows: 2 cases of morcellized bone grafts resorption (only in group B) which led in a case to implant aseptic loosening resolved spontaneously with the stabilization of the same; 1 case of spacer decoupling due to its insufficient typing; 1 case of patient death in the postoperative period due to causes not related to the surgery.

We found that there were no statistically significant differences for the HHS calculated on the Group A and Group B (calculated by Student's t with mean difference; variance Group A: 21.35; variance Group B: 34,20; Student T: 0,17 freedom degrees: 32, T < the expected value for 32

freedom degrees).
Therefore, the functional outcome and symptomatic employing Grafton A-flex or marrow-stim together with bone grafts didn't give significant improvements in this regard.
In contrast, we found that using marrow-stim or Grafton A-Flex we got in all cases the bone grafts osteointegration.
Indeed we found grafts resorption only in the cases of the in group B.

DISCUSSION

The ultimate goal of revision acetabular reconstruction should be to obtain stable fixation and restore the hip center [6].
While the treatment methods for Paprosky IIIA and IIIB defects are different, healing of the discontinuity, hip center restoration and stable acetabular construct remain the treatment goals. Cementless acetabular components have shown improved long term survival over cemented components1
A custom triflange acetabular component is an option that has been proposed to achieve both of these goals [7]. The variability and shape of the pelvis and the variety, size, and shape of acetabular defects make treatment with conventional off the shelf implants difficult [7, 8,9].
The use of triflanged titanium cementless custom-made acetabular implants in the management of complex acetabular bone deficiencies has already been reported by Joshi et al 10 in 2002 with satisfactory functional and short-term results.
In 2007 DeBoer et al [11] reported good clinical results in 18 patients at a mean follow-up of 10 years after implantation of a custom-made porous-coated triflanged acetabular component for the treatment of pelvic discontinuity.
Colen et al12 obtained in series of six patients with severe acetabular bone loss and pelvic discontinuity fair clinical and good radiological results using a MCTARR with a follow-up of 10 to 58 months.
Custom triflange cups have high reported clinical success in short to midterm follow-up [13,14] but there are disadvantages including increased cost.
Custom triflange acetabular prostheses are indicated for the treatment of massive acetabuluar bone loss and pelvic discontinuity, situations where the amount of bone loss exceeds the limits of defect-matching techniques [15].
Until few years ago the implant was customized from data obtained from 3-dimensional CT reconstruction imaging, which details the degree and location of bone loss as well as the orientation of the pelvic dissociation. Accordingly, the time needed to design, manufacture, and sterilize these prostheses can take up to several months and must be taken into consideration during the pre-operative planning process.
Delta TT revision Cup differently from the custom made implants has the big advantage to be ready for implantation and it is intraoperatively customizable. This revision cup is also in

trabecular titanium which encourages biologic fixation to host bone. Lima Delta Revision TT represents a reproducible treatment solution for every Paprosky IIIA-B acetabular defects with a cost lower than custom made triflanged cups[16].

In our experience Delta Revision TT shell is a good alternative to the cages in the major acetabular defects where the integrity of the RIM isn't enough to obtain a fit with the shell.

There aren't evidences in literature about these systems differently to the cages.

In our experience there was 1 only implant mobilization in a patient treated without DBM A-Flex. There wasn't an case of implant rupture but only a decoupling of the spacer from the metal back shell due to bad positioning during spacer assembling.

This system has the advantage to guarantee a good stability thanks to the plates integrated into the cup, and it has the same advantages of modular systems of first use.

Besides the possibility of acetabular cup lateralization by means of spacers gives the system a remarkable versatility allowing the surgeon to restore the most anatomically possible with less difficulty the hip rotation center, the lateral and longitudinal offset. This implant when positioned it's simple to be revisioned for rupture or components wearing. Differently from cages with cemented polyethylene cup Delta revision TT shell has the considerable advantage of allowing the surgeon to choose the most suitable tribological coupling for the case in question.

This system introduces the most modern solutions to a tribological revision system for the acetabular defects that didn't allow before metal or ceramic head coupling with the polyethylene cup.

Furthermore, while the system of cages is very operator-dependent as regards the lateralization or the management of the acetabular roof coverage, the delta revision TT takes advantage of a modular system easy to use independent of the positioning of the shell that allows in case of need a greater coverage of the acetabular roof. This is possible thanks to the polyaxial spacers designed to fit together in the shell.

In our opinion, Delta revision TT system doesn't escape from revision plants complications as mobilization, infection, wear or disassembly of components but introduces in total hip revision surgery of the mayor acetabular defects the modular design and the prosthetic implants most modern concepts commonly used in primary THA. It also greatly simplifies the most complex revisions without this being at the expense of the system stability.

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CASES

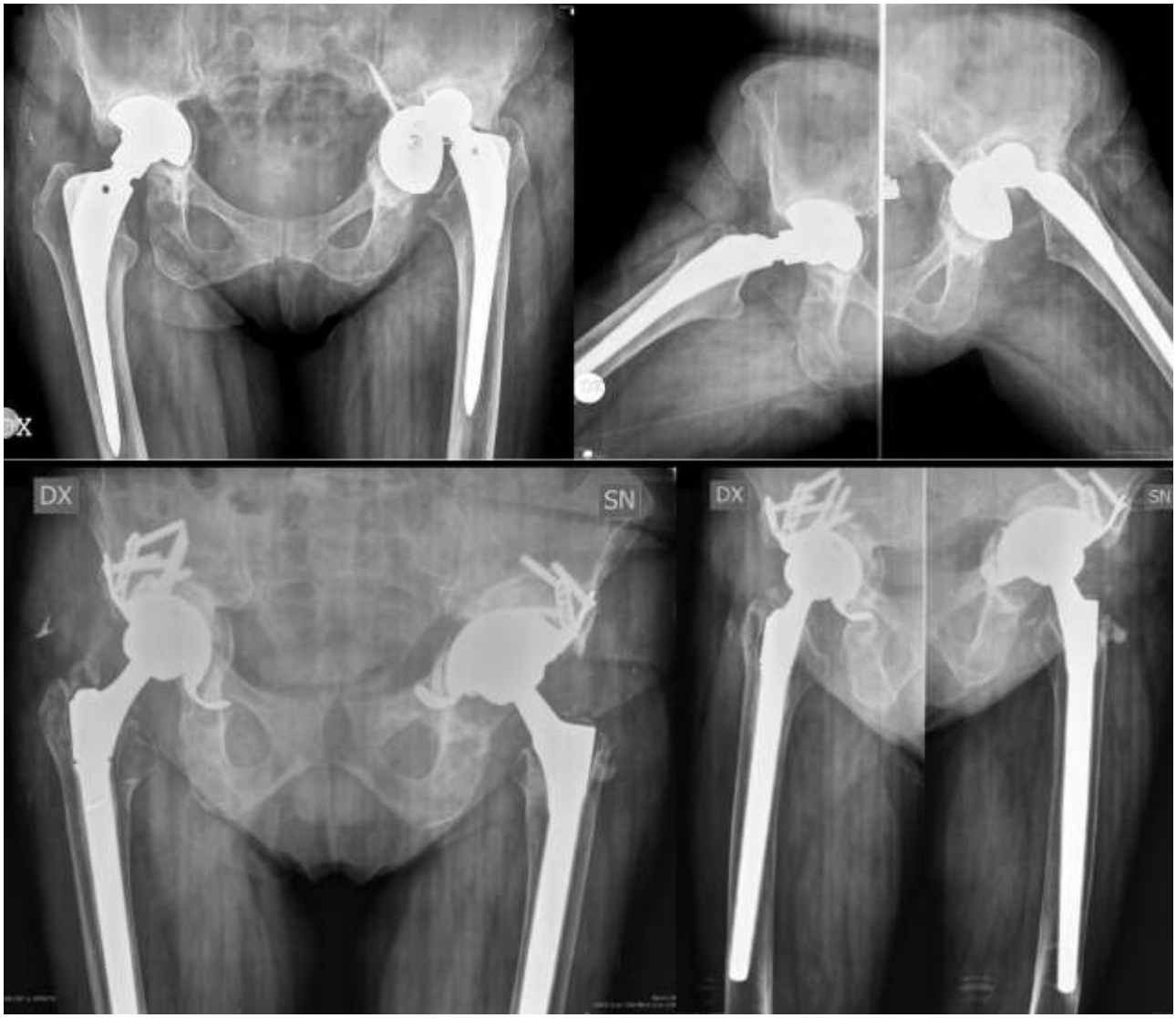

Fig 1. 68 years old woman patients with a bilateral aseptic acetabular implant mobilization (IIIA on the right side and IIIB on the left side). On the right side was performed a total hip revision with delta revision TT , bone chips and Grafton a flex (demineralizad bone matrix). On the left side was performed a revision with delta tt revision shell and only bone chips. While the integration of implant was obtained in the right side, in the left side we look bone chips resorption.

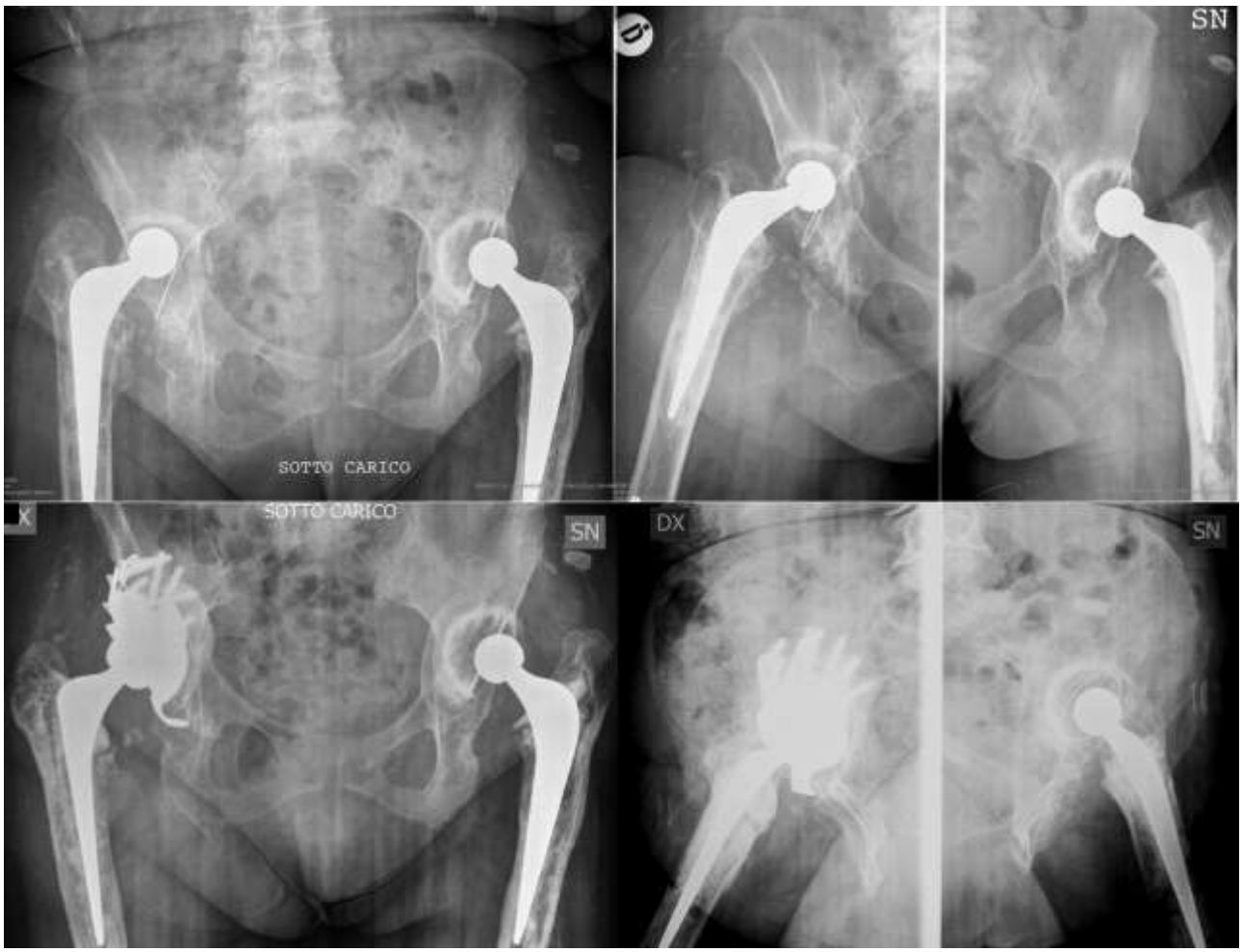

Fig 2. 76 years old woman patient with an aseptic acetabular mobilization and Paprosky IIIA bone defect treated with an acetabular revision with delta revision tt shell and bone chips. After 2 yars good integration of the implant.

Fig 3. Female 56 years old with a IIIB defect treated with Lima delta TT revision shell and metal augment and allograft good integrated after 1 year from surgery;

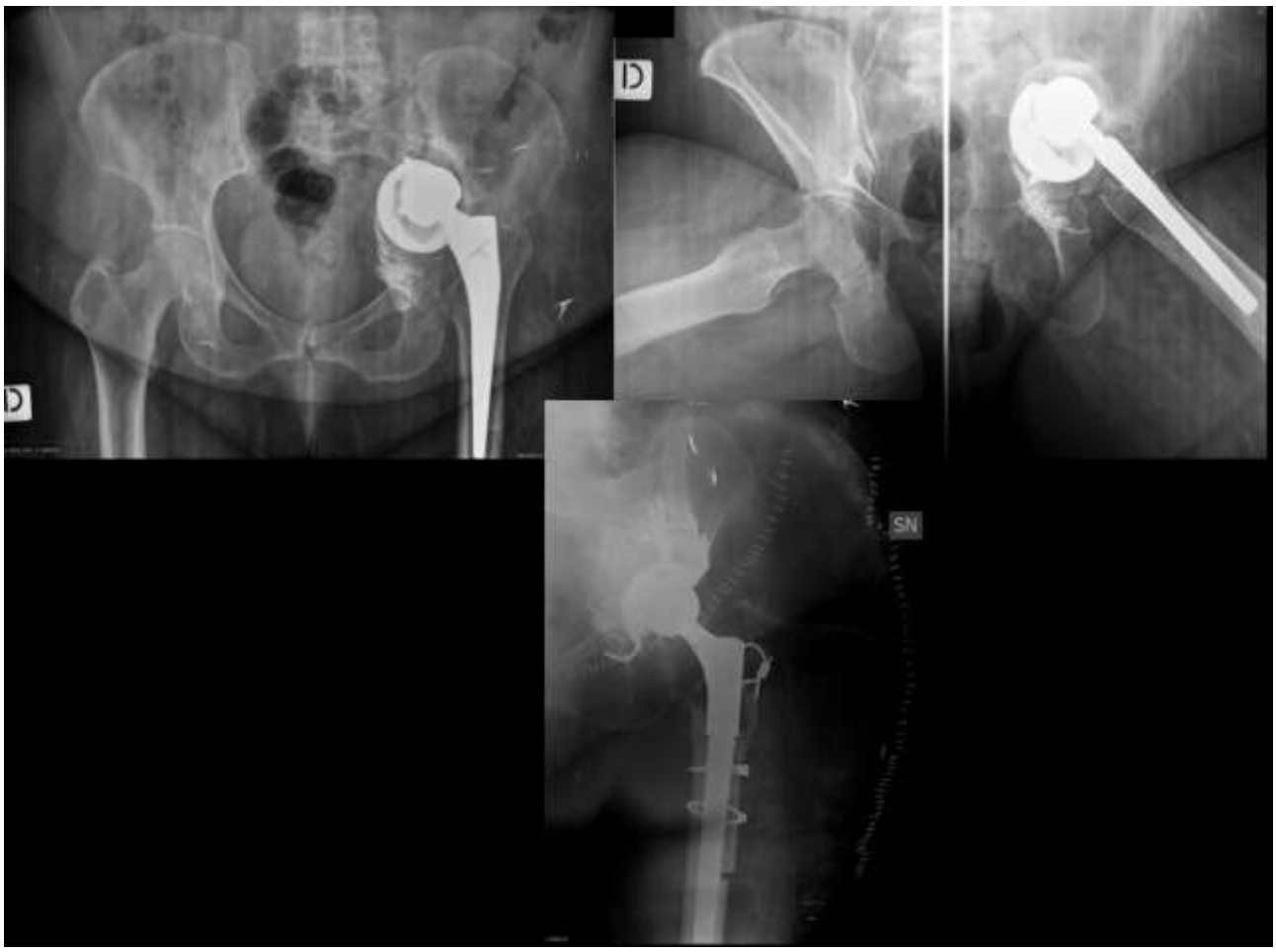

Fig 4. Male 50 years old with a IIIB defect treated with Lima delta TT revision shell and allograft;

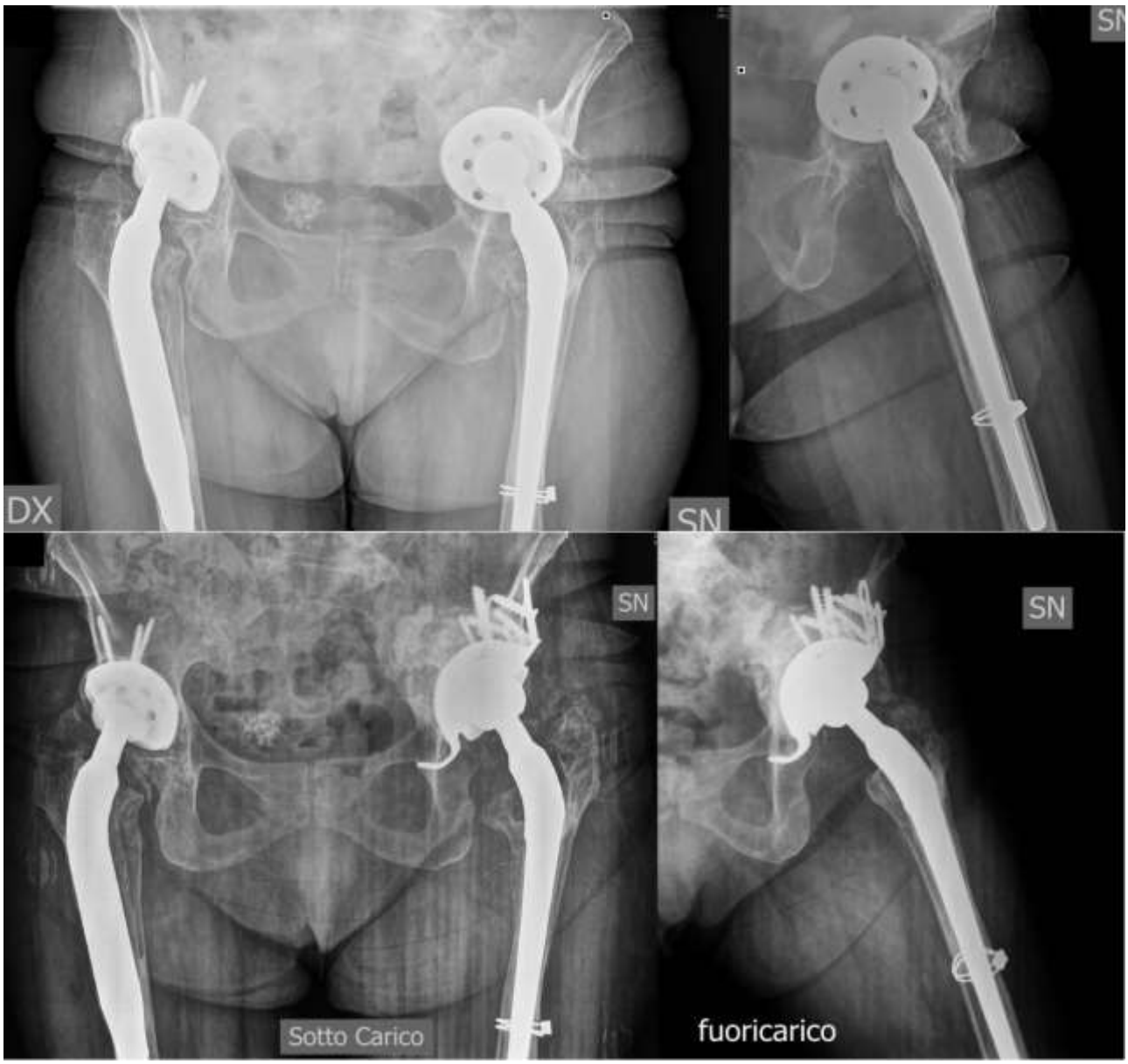

Fig 5. Male 78 years old with a IIIB defect treated with Lima delta TT revision shell and grafton A flex and allograft;

Fig 6. Female 29 years old with a IIIB defect treated with Lima delta TT revision shell and grafton A flex and allograft;