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Case report

Early complication of a subtrochanteric periprosthetic fracture following hip resurfacing. Is varus healing aceptable? A case report and literature review.

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Abstract. *Background:* The increase in the incidence of osteoarthritis of the hip (coxarthrosis) in young patients with high functionality requirements and the development of new materials in the last twenty years have resulted in an increase in the number of surgeries involving hip resurfacing procedures. There has also been an increase in associated periprosthetic fractures, which currently occur in 1%-2% of cases. According to the medical literature, fractures of this type can be treated conservatively, using reduction and synthesis or through prosthetic revision. *Case report:* Patient aged 69 years who had undergone resurfacing of the right hip ten years previously, who came to our attention as a result of direct contusion trauma with x-ray evidence of a periprosthetic fracture in the subtrochanteric region. We treated the fracture by preserving the prosthesis and performing osteosynthesis using a plate and screws. After two months the synthesis was complicated by breakage of a proximal screw and varus collapse of the fracture. We treated this complication conservatively by adjusting the weight-bearing regime and administering physical and drug therapy. Six months after the fracture, despite the residual varus displacement and the less than stellar x-ray result, the clinical outcome was satisfactory. *Discussion and conclusions*: Treatment of periprosthetic fractures following hip resurfacing is often technically complex. The major difficulties arise from the presence of prosthetic components and the limited bone stock available. Fractures often affect the neck of the femur and the trochanteric region, and in rare cases there is involvement of the subtrochanteric region. Our review confirms this trend and raises the question as to which method of synthesis is ideal for a fracture pattern so rarely described in the literature. (www.actabiomedica.it)

Key words: Hip resurfacing, Periprosthetic fractures, Subtrochanteric fractures.

Background

In the early 2000s, the development of new metal-on-metal prosthetic implants lead to a resurgence in hip resurfacing procedures, which had been abandoned in the past because of high failure rates due to wear of the prosthetic components. The benefits of bone sparing, improved biomechanical restoration and greater stability have led to an increase in the use of these implants in young patients suffering from osteoarthritis of the hip with high functionality requirements.

This has meant a consequent increase in periprosthetic fractures located in the femoral neck and the trochanteric region. Indeed, the incidence of periprosthetic fractures in the first year following femoral resurfacing is 1%-2%, and it thus represents one of the major complications of this type of surgery (1). The most frequent causes predisposing to the onset of periprosthetic fractures are notching of the femoral

neck, avascular necrosis and stress shielding of the femoral head.

Periprosthetic fractures following femoral hip resurfacing are difficult to treat using orthopaedic surgery because of the limited bone stock available for synthesis and the need to keep the prosthetic implant in place. There is considerable debate about the methods used to treat fractures of this type and the literature describes various techniques ranging from conservative treatment to synthesis and prosthetic replacement.

In our case report, we describe the plate-based treatment of a subtrochanteric fracture occurring following hip resurfacing and a subsequent complication treated conservatively.

The review of the literature on periprosthetic fractures following hip resurfacing involved an analysis of 27 articles published between 2003 and 2020, on a total of 137 cases. Each article was critically assessed by two independent reviewers to determine whether it should be included. The search for articles was carried out using a combination of the following key words: "Hip resurfacing" and "Fractures", "Hip resurfacing" and "Periprosthetic fractures", and "Hip resurfacing" and "Complications".

We reviewed the fracture pattern occurring, the surgical technique applied to treat it and the clinical outcome for the patient.

Case Report

Male patient aged 69 years, with hip resurfacing prostheses implanted on the left side twelve years previously (*BHR*, *Smith & Nephew*) and the right side ten years previously (*Conserve Plus*, *Wright*) (Figure 1 A, B), who came to our attention as a result of high-energy trauma with x-ray evidence of a subtrochanteric fracture of the right femur (AO 31-A3.2), with no x-ray signs of mobilisation of the prosthesis (Figure 2 A, B). The following day we performed synthesis using a 4.5/5.0 locking compression plate (LCP) with trochanteric fixation (Figure 3 A, B). After surgery, the limb was kept in non-weight-bearing position for six weeks and, following a satisfactory clinical and x-ray check-up, a

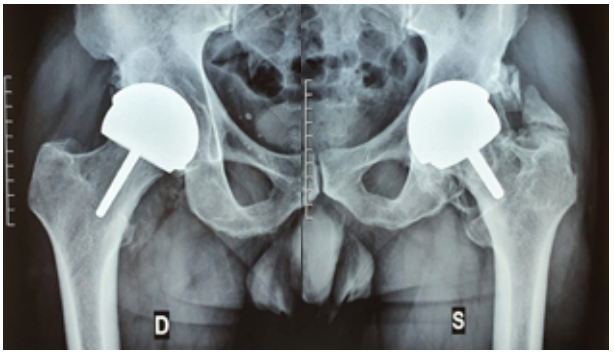

Figure 1. A,B. Bilateral hip resurfacing prosthesis

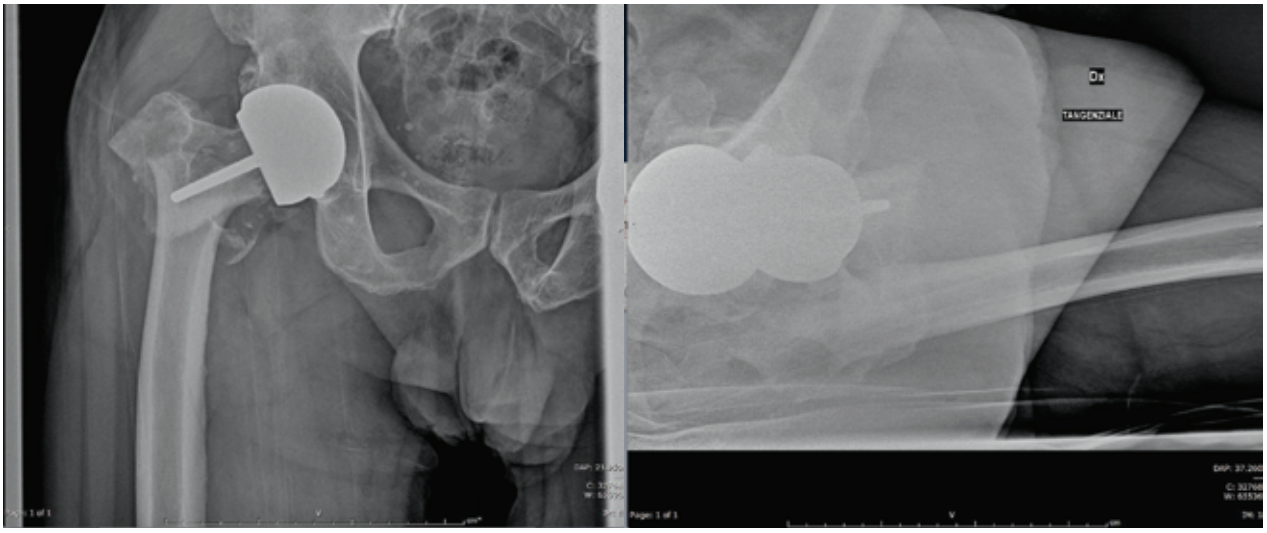

Figure 2. A, B. Right subtrochanteric periprosthetic fracture. The femoral components do not show signs of mobilization.

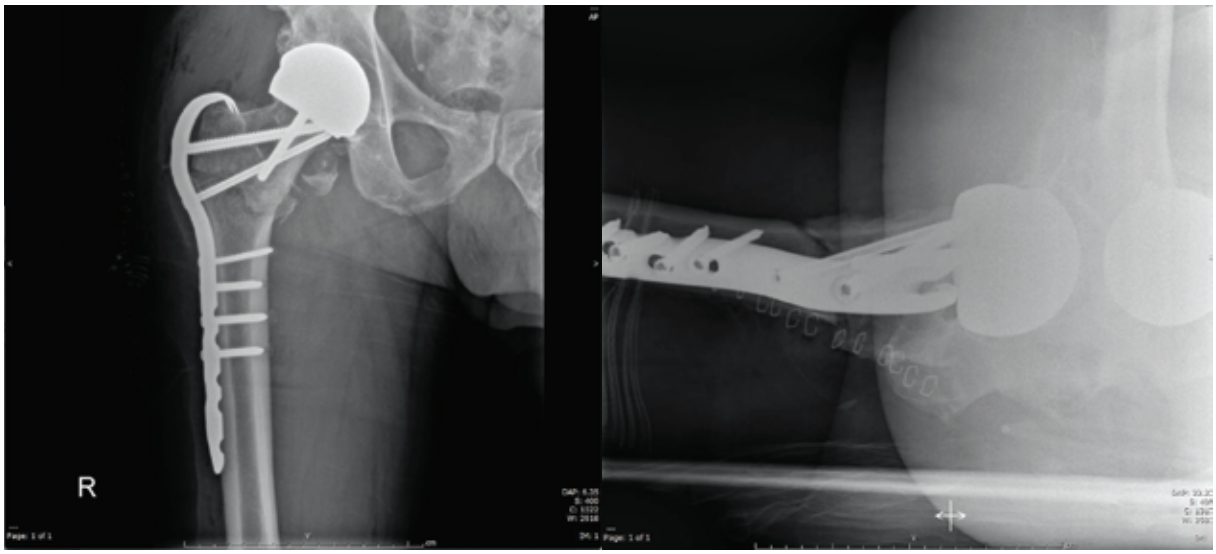

Figure 3 A, B. Synthesis using LCP for proximal femur with trochanteric fixation

protected weight-bearing regime was introduced along with a cycle of physiotherapy. One month later, as a result of a functional overload, we saw the patient again for a sudden feeling of collapse associated with localised pain in the trochanteric region. The x-rays taken in A&E showed a breakage of one of the proximal screws on the plate and varus collapse of the fracture (Figure 4). Given the characteristics of the fracture and the presence at the site of synthesis materials and the prosthetic implant, we assessed the possibility of further synthesis or revision of the implant. However, we decided to opt for conservative treatment, adjusting the weight-bearing regime and adding a cycle of biophysical stimulation and treatment with clodronate. Six months after the fracture, the clinical outcome is satisfactory despite a lack of consolidation of the varus fracture and even though the x-ray and CT scan images do not show a complete recovery (Figure 5 A, B).

Results and Discussion

The increase in recent years in the number of patients undergoing prosthetic replacement surgery using hip resurfacing has meant that the incidence of periprosthetic fractures resulting from this treatment represents an increasingly topical issue.

Figure 4. Breakage of a screw and varus collapse of the fracture

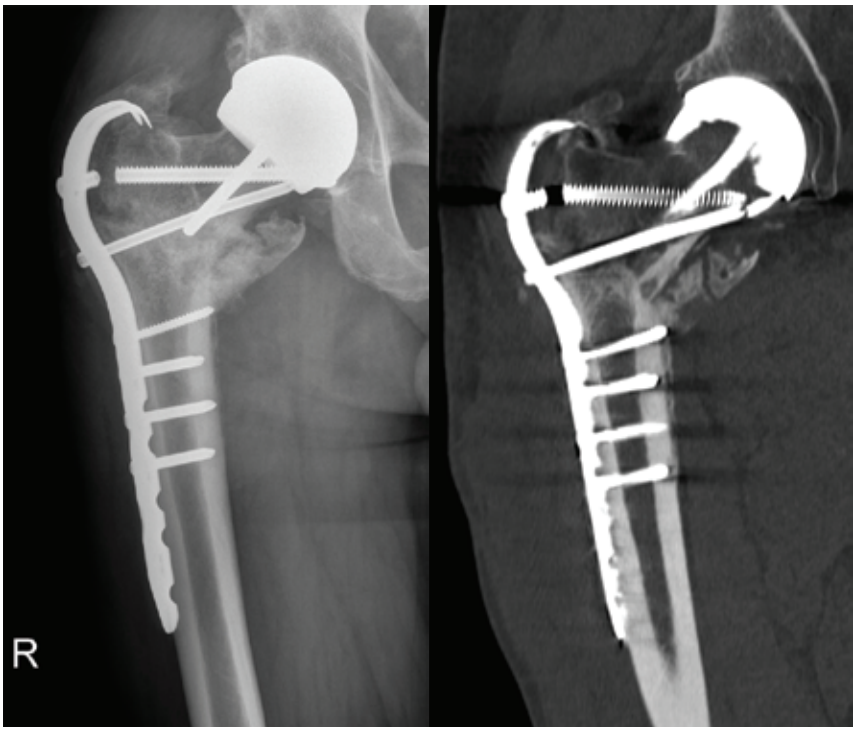

Figure 5. A, B. Initial healing of the fracture shown by x-ray and CT scan imaging at six-month check-up.

The presence of sufficient bone stock, the type of fracture (correlated with the risk of avascular necrosis of the femoral head) and the residual stability of the prosthetic implant are elements that guide the choice of treatment for periprosthetic fractures. Given these factors, surgeons have thus far treated the bulk of cases of this complication using osteosynthesis (2). The mechanical characteristics of resurfacing prostheses also make it possible to use synthesis methods that cannot be used in the treatment of periprosthetic fractures on traditional prostheses.

Periprosthetic fractures on hip resurfacing prostheses usually concern the region of the femoral neck or the greater trochanter, although in rare cases the subtrochanteric region can be affected.

Even after many years, risk factors for a subsequent periprosthetic fracture often include poor positioning of the implant and inexperience of the surgeon (3, 4).

Our review analysed 27 articles published between 2003 and 2020, and a total of 137 cases of fractures following resurfacing prosthetic implant (Table 1).

The results of the review described below are summarised in Table 2.

The majority of the periprosthetic fractures concerned the femoral neck region (118 patients, 86.1%), although a small number concerned the trochanteric region (16 patients, 11.7%) and only three cases involved fractures of the subtrochanteric region (2.2%).

In terms of treatment of the periprosthetic fracture, the options proposed by the literature range from prosthetic revision to conservative treatment.

In our review, 62.8% of patients (86 cases of 137) underwent prosthetic revision surgery. Osteosynthesis was performed in 21 cases: these procedures involved a plate in 11 patients (8%), an intramedullary nail in six cases (4.4%), and cannulated screws in four patients (2.9%). Conservative treatment was administered in ten patients (7.3% of the total). In the five patients in the article by Amstutz *et al* (5) and the 15 patients in the article by Steffen *et al* (28), the type of treatment is not described (14.6% of the total of 137 cases).

With regard to the specific case of subtrochanteric periprosthetic fractures, only three cases are described in the literature, all of which were treated using open-reduction internal fixation (ORIF). In one

Table 1. Articles published between 2003 and 2020 on periprosthetic fractures following hip resurfacing.

Revised articles			Periprosthetic fractures	
Authors	**Year**	**Cases**	**Fractures**	**Treatment**
Amstutz et al[5]	2004	5	Femoral neck	Not described
Aning et al[6]	2005	1	Subtrochanteric	Intramedullary nail
Banerjee et al[7]	2015	1	Pertrochanteric	Intramedullary nail
Baxter et al[8]	2010	1	Pertrochanteric	Plate
Brennan et al[9]	2013	1	Femoral neck	Intramedullary nail
Carpentier et al[10]	2012	1	Pertrochanteric	Plate
Cossey et al[11]	2005	7	Femoral neck	Non-operative
Cumming et al[12]	2003	1	Femoral neck	Non-operative
Fabbri et al[13]	2018	1	Femoral neck	Cannulated screws
Koulisher et al[14]	2019	1	Pertrochanteric	Plate
Kutty et al[15]	2009	1	Femoral neck	Cannulated screws
Lein et al[16]	2010	1	Pertrochanteric	Cannulated screws
MacDonald et al[17]	2014	1	Pertrochanteric	Plate
MacDonald et al[18]	2017	1	Pertrochanteric	Plate
Matharu et al[19]	2013	34	Femoral neck	Total hip arthroplasty
Merredy et al[20]	2009	1	Femoral neck	Cannulated screws
Morgan et al[21]	2008	2	Pertrochanteric	Non-operative
Orpen et al[22]	2009	2	Pertrochanteric	Plate
Peskun et al[23]	2012	2	Subtrochanteric	Intramedullary nail
Sharma et al[24]	2005	2	Femoral neck	Revision
Shimmin et al[25]	2005	50	Femoral neck	Total hip arthroplasty
Silk et al[26]	2011	1	Pertrochanteric	Plate
Soin et al[27]	2020	1	Pertrochanteric	Intramedullary nail
Steffen et al[28]	2009	15	Femoral neck	Not described
Weinrauch et al[29]	2008	1	Pertrochanteric	Plate
Weusten et al[30]	2012	1	Pertrochanteric	Plate
Whittingam-Jones et al[31]	2010	1	Subtrochanteric	Plate

Table 2. Periprosthetic fracture and associated treatment.

Periprosthetic fracture following hip resurfacing - review of 137 cases			
Fractures		**Treatment**	
Femoral neck	118 - 86.1%	Total Hip Arthroplasty (THA)	86 - 62.8%
Pertrochanteric	16 - 11.7%	Intramedullary nail	6 - 4.4%
Subtrochanteric	3 - 2.2%	Cannulated screws	4 - 2.9%
		Plate	11 - 8%
		Non-operative	10 - 7.3%
		Not described	20 - 14.6%

case, the decision was made to perform synthesis using a dynamic compression plate (DCP) and screws (31), while the other two opted for the use of an intramedullary nail (6, 23). In both treatments, stabilisation and synthesis resulted in the healing of the fracture.

The small number of cases described, although treated using different synthesis methods, does not provide any resolution to the discussion of the ideal synthesis method in subtrochanteric fractures in patients treated with hip resurfacing.

An analysis of the results presented to date in the literature reveals that if the characteristics of the fracture favour treatment using synthesis (stable implant, fracture with limited risk of avascular necrosis of the femoral head, adequate bone stock, well positioned primary implant), the objective of treatment should be to seek a balance between strict compliance with the principles of osteosynthesis of trauma to the proximal femur and respect for the biomechanics of the prosthetic implant previously positioned.

In the patient in our clinical case, the varus collapse of the fracture did not influence the functional outcome and that finding is also supported by the literature (17).

However, as stated in the article by Macdonald (18), the varus collapse of the fracture can alter the biomechanics of the resurfacing implant, changing the associated load forces and causing premature surface wear. Close follow-up is therefore necessary even after the bone component has healed.

Conclusion

Periprosthetic fractures following hip resurfacing currently represent a challenge for orthopaedic surgeons. The factors that complicate the choice of ideal treatment are a justified desire to keep in place a prosthetic implant that is still effective, the stability of that implant and the limited bone stock available for synthesis using traditional methods. The minimal number of cases described in the literature relating to subtrochanteric fractures means that the debate as to which method of synthesis is ideal in this specific case cannot yet be resolved. Irrespective of the treatment administered, varus collapse does not seem to influence the functional outcome in the short term.

Conflict of Interest: Each author declares that he or she has no commercial associations (e.g. consultancies, stock ownership, equity interest, patent/licensing arrangement etc.) that might pose a conflict of interest in connection with the submitted article

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