Case Report

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INCIDENTALOMA FOUND IN A METAL-ON-METAL REVISION TOTAL HIP ARTHROPLASTY: A CASE REPORT.

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SUMMARY

Metal-on-metal coupling in total hip replacements has traditionally been a valid alternative to other total hip bearings for young adults and very active elderly patients. Unfortunately, clinical experience has revealed that the difference in strength between the titanium alloy stem and the cobalt alloy-bearing surface leads to a conflict between the acetabular component and the head, which inturn leads to abnormal wear and osteolysis. The major problems are osteolysis, metal ion intoxication, potential genome toxicity, neoplasms, allergies and implant failure. The authors present an incidental finding of a pseudotumour of the external rotators of the hip in a total hip replacement (THR) revision in a 68 year old female patient.

Introduction

Total hip replacement is a universally recognized treatment for end stage osteoarthritis. Wear-related debris, primarily caused by contact between the surfaces of prosthetic components, represents the most important cause of periprosthetic osteolysis and implant failure [1,2]. Metal-on-metal bearings in total hip replacements has traditionally been a valid alternative to other total hip bearings for young adults and very active elderly patients[3,4]. Unfortunately, clinical experience has revealed that the difference in strength between the titanium alloy stem and the cobalt alloy-bearing surface leads to a conflict between the acetabular component and the head, which inturn leads to abnormal wear and osteolysis [5].

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Case Report

The patient came to U.O.C. Orthopedics and Traumatology "Gaetano Rummo" of Benevento, Italy, complaining of severe pain in her left hip, which had been previously operated on for a metal-on-metal THR in 2007.

The patient had a metal-on-polyethylene THR on her right side.

Clinical examination showed severe multidirectional limitation of movements of her left hip. Patient reported VAS=9 and Oxford Hip Score of 18/48. On the standard X-rays of the pelvis (**Figure 1**), a small area of osteolysis was found under the radiological U (Shenton's line). Routine blood tests (ESR, CRP, Procalcitonine, Blood Cell Count, Creatinine, Ion levels in blood, serum and red blood cells) were prescribed, in order to evaluate if there was periprosthetic infection and/or metal ion intoxication.

The patient came back after 5 days with blood tests that showed metal ion intoxication with normal level of creatinine, thus excluding the risk of periprosthetic infection.

The patient was recommended to undergo a total hip surgery revision. A posterolateral approach was used to expose the implants. After incision of the fascia, a hard, elastic mass, approximately the size of a tennis ball (**Figure 2 and Figure 3**), was found near the insertion of the exter-

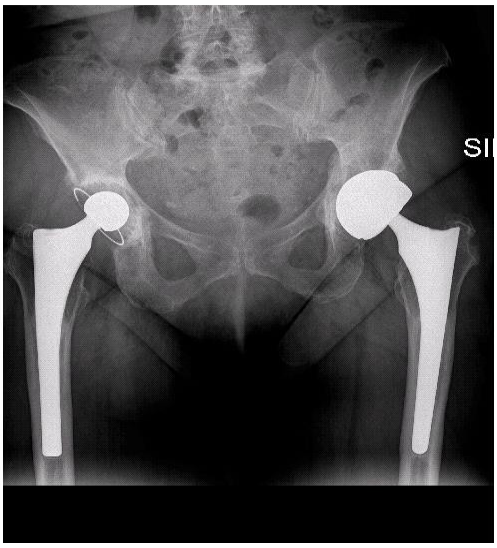

Figure 1. Pre-operative X-rays.

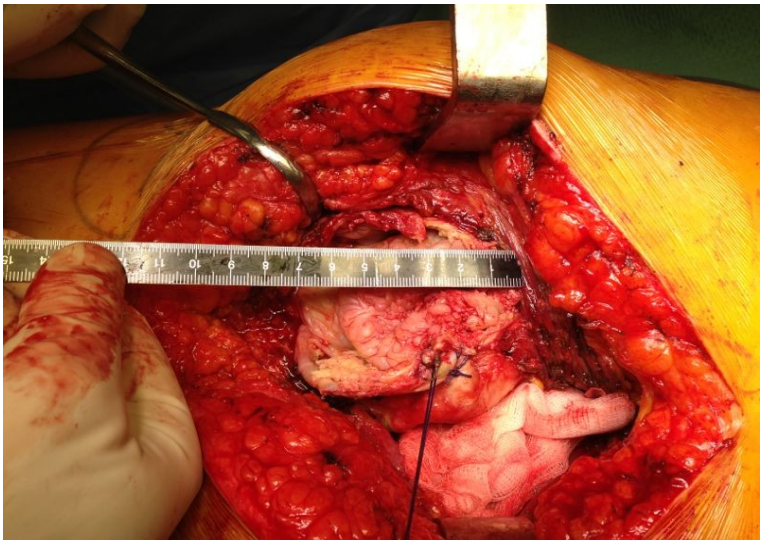

Figure 2. Intraoperative measurement of the hard-elastic neoplasm of the external rotators

nal rotators. This finding wasn't visible during the clinical examination due to thick adipose tissue coverage. The excision of the hard, elastic mass was very difficult as the mass extended from the greater to lesser trochanter and was adherent to the distal tendon of the ilio-psoas muscle. The specimen was sent for histopathological examination. After the excision of the mass, dislocation and removal of femoral head was performed, followed by extraction of the acetabular shell. After the removal of the acetabular shell, caseous necrotic tissue was found. This tissue was yellow in colour and fibrotic, probably a result of inflammatory response. Fortunately, the bone stock of the acetabulum was preserved. Most probably, the presence of the hard, elastic mass and of the fibrotic caseous necrosis were due to Chrome and Cobalt ions, which are capable of inducing both the secretion of Tumour Necrosis Factor (TNF) and the molecular cascade of caspase, cytokines, apoptosis and chronic inflammation, which can lead to the development of malignant neoplasms[6].

The acetabular component, with a polyethylene insert, was implanted after reaming. The stem was stable. A Morse-type ceramic femoral head was mounted (**Figure 4**). The patient underwent routine physio-

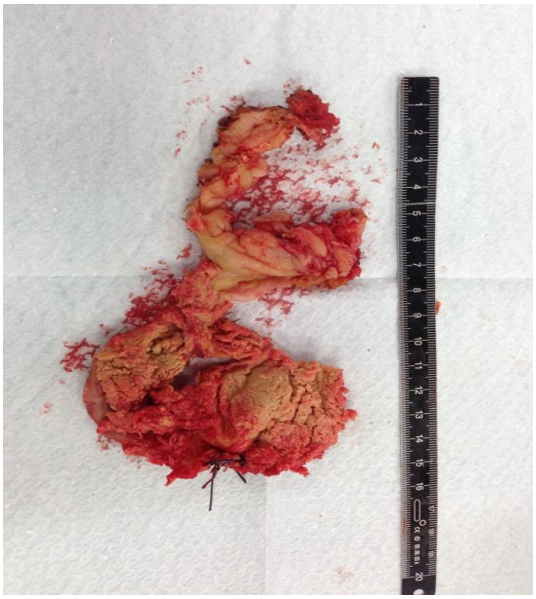

Figure 3. Hard-elastic neoplasm after removal

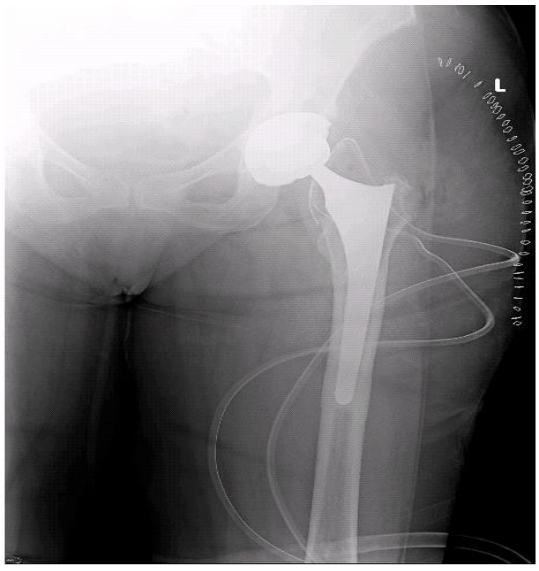

Figure 4. Post-operative X-rays.

kinesiotherapy.
The post-operative period was regular and no complications emerged. The patient performed proper post-operative rehabilitation. Five days after surgery the patient reported VAS=4 and Oxford Hip Score of 40/48. When she was discharged (7 days after surgery) her blood tests showed a definite decrease of systemic intoxication markers.
One month after surgery the patient reported VAS=2, normal blood tests and Oxford Hip Score of 46/48.
Histology report: metaplastic neoformation with fibrotic changes of the muscular tissue in presence of indirect signs of dysplasia.

Discussion
Charnley demonstrated that aseptic loosening caused by wear of the components provokes early failure of the implant, and introduced the low-friction arthroplasty principle as a solution to this problem. Low-friction arthroplasties showed good initial outcomes, but various couplings, such as metal-on-polyethylene and ceramic -on-polyethylene, continued generating wear-related debris, thus leading to osteolysis. As a result, alternative bearings, based on both new and old notions, were developed [7]. Factors like materials, macro/micro-geometry and components' lubrication influence the wear of metal-on-metal bearing much more than that of metal-on-polyethylene.
Due to their strength, Chrome and Cobalt alloys are utilized instead of other metals. Chrome is resistant to corrosion. The manufacturing process produces mixtures of Chrome, Cobalt and Molybdenum, containing high levels of Carbon. These carbides are highly adhesive to the underlying material, are much harder than it, and relatively fragile. Resistance to the alloy's wear is related to these carbides' dispersion [8]. Metal particles generated in metal -on-metal bearing measure 20-80 nm, and they are substantially smaller than those of polyethylene [9,10].
The amount of particles produced in one year is around 6.7 x 1012 – 2.5 x 1014. This is 13-500 times more than the amount produced by metal-on-polyethylene bearings [10]. The big aggregate of particles can have both local and systemic effects. With metal-on-metal prosthesis, local reaction of the tissues, calculated based on the number of histiocytes, is approximately a grade less than the reaction with metal-on-polyethylene bearing [9,10].
Since metal particles are smaller than polyethylene particles, the amount of histiocytes recruited to store the particles is lower. Metal particles enter the histiocytes through pinocytosis and not through phagocytosis. This could alter cellular response. Additionally, Co-Cr particles are more cytotoxic, therefore cells are incapable of generating the same inflammatory response. The liberation of these particles increases Chrome and Cobalt levels in erythrocytes, serum and urine [11].
In vitro studies demonstrate a dose-dependent response to metal particles: low or moderate levels stimulate release of cytokines that can cause osteolysis.
High concentrations are cytotoxic leading to cellular death and tissue necrosis [12]. Usually metal-related osteolysis is less severe than polyethylene-related osteolysis [13]. Cr and Co particles have demonstrated that they could provoke malignant tumours in animal models [14,15], increasing the concern about the risk of similar effects in humans. There's ambiguity of clinical evidence regarding this subject. Nickel is the most common allergenic metal in humans, followed by Cobalt and Chrome. Cell-mediated response types usually related to hypersensitivity reactions to orthopaedic implants (hypersensitivity or allergy) are classified as type IV delayed-hypersensitivity [16]. Incidence of hypersensitivity to metal, estimated by patch test (PT) on patients with functioning or malfunctioning implants, is 25%, approximately double the studied population. Average incidence of hypersensitivity to metal among patients with a failed implant is approximately 50-60% [17].
This increase in prevalence of sensitivity to metal among patients with a failed implant hypothesizes that allergy to metal could contribute to the loosening of the implant. Nevertheless, there isn't a clear link between the incidence of hypersensitivity to metal and durability of the implant, infection, cause of removal, or pain. Thus far, the role of hypersensitivity to metal in implant loosening is still not well defined. Specific types of implants with more potential to release metal in vivo could, theoreti-

cally, provoke hypersensitivity to metal (for example metal-on-metal articular surfaces or, less likely, friction-related corrosion of the metal in modular cones). Although many generic patch tests and commercial kits are available for standard antigenic substances, the concern for epidermal tests to study the immune response to orthopaedic implants is increasing.

A study reports 19 cases of periprosthetic tumours; most of them were malignant histiocytomas [18]. Another study reports 4 cases of soft tissue sarcoma near prosthetic implants [19]. Epidemiological studies regarding malignant tumours distant from implants show an increased risk of lymphoma and leukaemia related to older generation metal-on-metal implants [20]. V. Belloti et al. [21] stated in their article: in revision surgery, operation report and removed prosthetic components are an important part of clinical history. Operation report must contain description of periprosthetic soft tissues and, in case some fluid or mass is found, documentation of the specimen, description of the type of fixation, eventual presence of wear of articular surfaces or of the Morse-type cone and, if possible, a report of what is done with the removed implant. Ideally, removed implants should be sent to laboratories specialised in metal-on-metal implants.

Currently, there are no specific clinical data that guide the surgeon to treat patients presenting with painful total hip arthroplasty with friction-related corrosion in modular conical junctions, both head-neck and neck-modular stem junction. According to current limited information, certain principles and treatment strategies of the patients must be considered. As soon as the diagnosis of local adverse reaction of the tissues is confirmed, conservative treatment is not recommended, even though a new surgery is difficult and stressful for both surgeon and patient. As reported for metal-on-metal implants, formation of pseudotumours with soft tissue destruction is reported in patients with friction-related corrosion of the conical metallic junction, even though only in few cases.

In severe cases, these pseudotumours can make the abductors completely absent or, through mass effect, damage surrounding nerves or vessels. Basically, the longer the metal debris' source is present, the worse the damage to soft tissues can be. Consequently, a surgical treatment is recommended when all other causes of pain are excluded and if a local adverse reaction of the tissues caused by metal corrosion (or other source of metal debris) is suspected. As usual, before undergoing surgery, the patient must be informed about the risks of the non-operative treatment compared to surgery. Preoperative planning, and in particular bone quality assessment, play an essential role in choosing the prosthesis size, and in the general decision of whether or not to utilize a conservative implant [22].

Revision surgery must follow the principle of minimizing every metallic modular conical junction. The immune system can produce a local adverse reaction of the tissues through hypersensitivity. Local biology, for some still unknown reason, can support friction-related corrosion. Acetabular components can usually be preserved if they are fixed properly and in a good position [23].

Conclusions

Wear and toxic metal ion formation make metal-on-metal THRs unusable, even though they have a good articular range of movement. It's useful to screen patients with these implants every year with blood tests and x-rays, in order to prevent situations like the one we found.

In addition, these patients necessitate a valid surgical treatment performed by expert hands, appropriate follow-up, and rehabilitation.

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