Teriparatide (rh [1-34] PTH) Improved Osteointegration of a Hemiarthroplasty With Signs of Aseptic Loosening

ÁNGEL OTEO-ÁLVARO, MD; JOSÉ A. MATAS, MD; JUAN C. ALONSO-FARTO, MD

Incidences of osteoporosis and fragility fractures are constantly increasing, which are associated with increased morbidity and mortality. When these patients undergo surgery, a higher number of postoperative complications may be expected because of poor bone quality and delayed healing. As a result, poorer primary stability of the implant, initial loosening, and impaired fixation strength in different regions may be seen. In these patients, we can choose the most advanced implants, but it is necessary to stimulate bone biology to increase the stability of the implant. This article reports the result obtained in a patient diagnosed with osteoporosis with aseptic loosening of a hip hemiarthroplasty after treatment with teriparatide (rh [1-34] PTH). This drug is indicated for the treatment of osteoporosis in men and postmenopausal women with high fracture risk and glucocorticoid-induced osteoporosis, and is administered subcutaneously for 2 years. It has an anabolic effect through stimulation of the osteoblast population that increases trabecular connectivity, cortical thickness, and bone mineral content. In animal models, teriparatide improved implant fixation 2 to 4 weeks after administration, resulting in the thickening of bone trabeculae and increased bone mass in the peri-implant area. In this retrospective analysis of clinical data and radiographic and scintigraphic images, after 24 months of treatment, the patient experienced clinical improvement associated with the disappearance of radiographic signs of loosening and a decrease in pathological radiotracer uptake in the bone scan, which are signs of osteointegration after treatment with teriparatide.
Hip fractures are the most devastating complications of osteoporosis with a high rate of morbidity and mortality. When these patients undergo surgery, a higher number of postoperative complications may be expected, and when aseptic loosening occurs, we need to repeat surgery, which increases mortality. In osteoporotic patients, an anabolic agent, such as teriparatide, that modulates bone formation and bone remodeling, is an attractive option to reduce fracture risk, and may also improve the implant’s fixation.

**CASE REPORT**

An 80-year-old Caucasian man, a former smoker diagnosed with diabetes mellitus treated with oral antidiabetics, 3-vessel coronary artery disease with paroxysmal atrial fibrillation, and a vertebral compression fracture in L1, underwent surgery in 2001 for a displaced intracapsular fracture of the femoral neck of the left hip (AO/Orthopedic Trauma Association [OTA] B3.3). An uncemented Austin Moore hemiarthroplasty was placed.

The patient had reported progressive hip and thigh pain over the past 3 years with no new triggering trauma. Pain became severe (numerical rating scale 80/100 mm) and failed to improve with analgesic treatment consisting of naproxen 500 mg twice daily, acetaminophen 1 g 3 times daily, and tramadol 50 mg 3 times daily. Hip mobility was complete but painful. The patient walked with a limp, and the maximum distance until pain onset was approximately 100 m. Functional assessment of the operated hip using the Harris hip score yielded a score of 52.01, corresponding to a poor result (<70).

Hip radiographs (Figure 1) showed varus misalignment associated with signs of stress in the stem tip with medial and lateral cortical thickening with pedestal formation, radiolucent lines outlined by visible radiopaque lines mainly in the medial area all along the femoral stem, and loss of medial cortical density. The stem was considered unstable. There were no signs of subsidence of the femoral stem.

Ultrasound examination of the hip and thigh ruled out the presence of anechoic fluid collections and periosteal stripping.

A bone scintigraphic scan performed 2 hours after intravenous administration of 925 MBq of 99mTc hydroxy diphosphonate (99mTc-PHD) in an antecubital vein showed signs of implant loosening; occurrence of reactive cotyloiditis and increased radiotracer uptake in the tip of the femoral stem (Figure 2).

Normal results were found in laboratory tests, including white blood cell count and differential, C-reactive protein, and erythrocyte sedimentation rate (which allowed for ruling out infection), bone alkaline phosphatase, ionic calcium, phosphate, PTH, 25-hydroxy vitamin D, testosterone, 24-hour urine calcium, and TSH.

Dual-energy x-ray absorptiometry (DEXA) scan revealed values suggesting osteoporosis (lumbar spine DEXA scan T score -2.7; femoral T score -2.8; total hip T score -2.9). The patient was treated with teriparatide (rh [1-34] PTH) at a dose of 20 μg daily, plus supplemental calcium (1000 mg daily as calcium citrate), and colecalciferol (880 IU daily).

At 4 months of treatment, hip pain had disappeared, and thigh pain had decreased in severity (NRS score 40/100 mm), which allowed for discontinuation of analgesics. The patient’s limp improved, and the distance he was able to walk doubled.

At the end of treatment with teriparatide, the patient experienced occasional mild pain (NRS score 30/100 mm) in the thigh that did not prevent his activities of daily living and corresponded to a Harris hip score of 93 (excellent, 90-100). The radiograph (Figure 3) showed disappearance of prior radiolucent lines and filling of the space between the stem and the endosteal surface by bone tissue, with increased sclerosis of the pedestal. All of these are signs of osteointegration. The final scintigraphic image confirmed this finding, and was considered normal with no pathological radiotracer uptake (Figure 4).

**DISCUSSION**

The incidence of osteoporosis is constantly increasing, partly because of population aging and inadequate prevention. The main consequences of osteoporosis are fragility fractures, which are associated with increased morbidity and mortality when they occur in the hip and the thoracolumbar spine. When these patients undergo surgery, a higher number of postoperative complications may be expected because of poor bone quality and delayed fracture union. As a result, poorer primary stability of the implant, initial loosening, and an impaired fixation strength in different regions may be seen.

Austin Moore hemiarthroplasty is currently used relatively often in elderly people who have associated comorbidity and a low functional demand because of its low cost, a shorter operating time, low risk of intraoperative bleeding with lower transfusion requirements, and reasonable results. Looseing of the prosthesis mandates repeat surgery that markedly increases morbidity and mortality. Special attention should be paid to perform an adequate surgical procedure.
Pain after placement of a hip prosthesis tends to disappear within 1 year after implantation because bone growth stabilizes primary defects, sometimes after a minimal subsidence. Occurrence of thigh pain after implantation of a prosthesis suggests a potential loosening, which should be diagnosed using imaging techniques. Presence of radiographic signs of loosening (varus pivoting, subsidence, osteolysis, and lack of ossification in the fenes-tration hole of prosthesis) is common in advanced cases, and its early diagnosis is difficult.

In our patient, occurrence of inguinal and thigh pain 7 years after prosthesis implantation, associated with the described radiographic images, suggested the possibility of aseptic mobilization. Infection was ruled out based on the type of pain, the lack of abnormal laboratory test results, and diagnostic imaging methods.

There is some degree of controversy about the potential relationship between varus misalignment of the femoral implant and the occurrence of thigh pain. In 2006, Panisello et al. established that varus misalignment of the femoral stem could account for transmission of stress, and occurrence of thigh pain after evaluating radiographic images and DEXA scan in 69 patients for 5 years, in contrast to Rogers et al. and Morrey et al., among other authors, who evaluated large series of patients and found no relationship between them.

A 99mTc-PHD bone scan is an effective tool for early identification of prosthetic loosening. Bisphosphonates bind to the sites where mineralization of bone matrix is occurring, therefore reflecting osteogenic activity, which will also depend on regional blood flow and extraction rate after intravenous injection. In the case of prostheses, particularly hip prostheses, osteoblast activity increases during the first year after implantation as a result of integrating osteogenic processes. However, when this activity persists or its uptake level is increased, we should think of an event justifying osteoblast activity, which is usually prosthetic mobilization, and, in a lower proportion of cases, infection. The natural course of these conditions, over time, would not be towards decreased activity, as in our patient.

Teriparatide (rh [1-34] PTH) exerts an anabolic effect through stimulation of osteoblast activity, which translates into a net increase in cortical and trabecular bone and also improves their architecture. In 2001, Sripitiz and Aspensberg showed that, in animal models, teriparatide improved implant fixation using stainless steel screws 2 to 4 weeks after administration, increasing contact between the bone and the implant. In 2005, Sripitiz et al. showed that the effect of teriparatide occurred regardless of the implant used, but earlier, in porous implants, resulted in thickening of bone trabeculae and increased bone mass in the peri-implant area. Teriparatide could thus be considered as a potentially useful drug for improving integration of orthopedic implants.

Recently, Zati et al. reported a case of loosening in an uncemented total hip arthroplasty, where stabilization was obtained after 8 months of treatment with teriparatide.

Our patient experienced a marked clinical improvement from the first months after teriparatide was started. This improvement gradually increased in parallel to normalization of scintigraphic images, corresponding to a radiographic image of osteointegration.

**REFERENCES**


