

Case Report

Combined therapy of vascularized pedicle bone grafts and tantalum rods for tantalum rod implantation failure

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Abstract: Tantalum rod implantation is widely used in the clinical treatment of early femoral head necrosis. Femoral heads treated by this procedure often collapse due to expanded necrotic areas, and in some patients the tantalum rods pierce the bone surfaces. Currently, total hip arthroplasty (THA) is frequently performed for tantalum rod implantation failures; however, THA is often associated with revision and infection risks. Especially for younger patients or other patients with good hip joint space and femoral head cartilage, a conservative repair procedure may be more appropriate for femoral head salvage. In 2009, a patient with tantalum rod implantation piercing was admitted to the Affiliated Zhongshan Hospital of Dalian University. The surgeon performed combination therapy with a vascularized pedicle bone graft and tantalum rod in this patient. After 7 years of follow-up, the patient is recovering well. We report herein a summary of the method and experience of this new procedure to provide a new way of thinking and method for tantalum rod implantation failure.

Keywords: Tantalum rod, vascularized pedicle bone grafts, femoral head necrosis, THA

In recent years, avascular necrosis of the femoral head has increased in incidence and is occurring in younger patients. For patients with early stage femoral head necrosis, conservative treatment is an ideal choice. Currently, the early treatment methods include core decompression and stem cell transplantation [1-4], but in recent years, with the development of biological materials, a new tantalum metal rod implantation method is widely used.

The tantalum metal rod for clinical application has a porosity of > 80%, a structure which is similar to the structure of trabecular bone, thus the tantalum metal rod has good biocompatibility and mechanical properties. Clinically, the tantalum metal rod is implanted into the area of femoral head necrosis for early- and middle-stage treatment to prevent collapse of the femoral head and take advantage of the biological properties to mediate bone growth and achieve femoral head repair [5-8]. Based on the prolonged follow-up data, the femoral head has increased necrosis after treatment with tantalum metal rods and a corresponding increase in collapse. In some cases, the tantalum rods pierce the surface. For patients with tantalum

rod implantation failure, the current basic approach is arthroplasty after removing the tantalum rod. THA is a mature technology that allows patients to obtain satisfactory results in the early stage, but this surgical approach for some younger patients will result in multiple revisions. In addition, for some patients with a good hip joint space and femoral head cartilage status, it is better to perform conservative treatment as THA is very aggressive.

This case report involves a patient with tantalum rod implantation failure and surface piercing. Fortunately, her hip joint space and femoral head contour maintained an acceptable appearance. We designed combined therapy with a vascularized pedicle bone graft and tantalum rod repair and achieved satisfactory results with 7 years of follow-up. The course of treatment was documented with patient consent, and the methods and experience were described as below.

Case report

A 58-year old female patient was admitted into the orthopedics of this hospital at Oct. 29,

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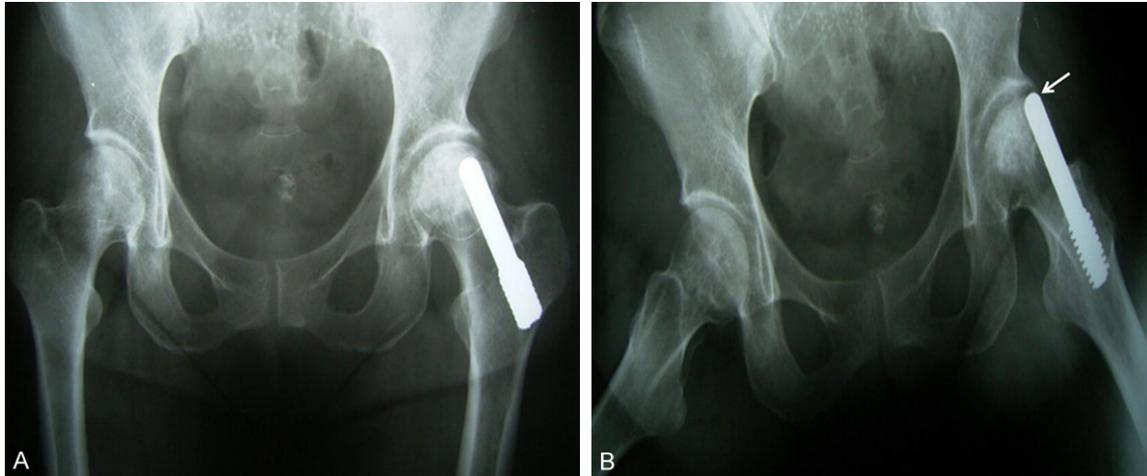


Figure 1. A. Preoperative anteroposterior dual hips DR. B. Preoperative frog posture dual hips DR.

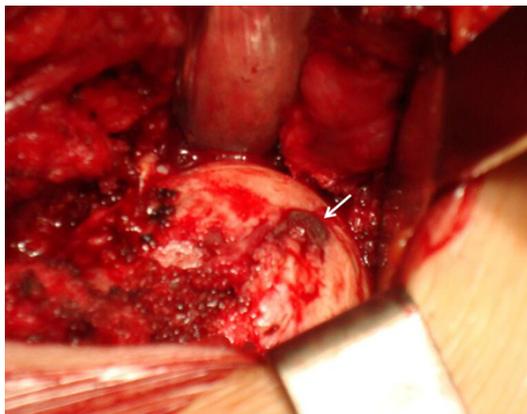


Figure 2. Tantalum rod piercing observed in operation.

2009, she had the main complaint of “9 months of left hip pain and activity limitation after left femoral head necrosis surgery”. Her left femoral head tantalum rod implantation was performed in the other hospital, but she had post-operative left hip pain which was increased during activity but slightly relieved after rest, and these symptoms were progressively increased in those 9 months. The admission examination showed a 8 cm length of left hip anterolateral incision scar, no swelling. There was deep tenderness below the midpoint of the left inguinal ligament, a positive percussion pain in left greater trochanter and an axial percussion pain of lower limb. Left hip joint activity: flexion 90°, stretching 2°, internal rotation 10°, external rotation 10°, adduction 10°, abduction 15°. Positive internal rotation compression test and test of “4” were positive, Harris score [9] was

54.4 points. Double hip anteroposterior and frog posture DR showed: uneven bone density in left femoral head, tantalum rod piercing to femoral head surface, non-narrow joint space (**Figure 1**). No surgical contraindication was found in the examination performed for this patient, and she received a combined therapy of vascularized pedicle bone grafts and tantalum rod revision after obtaining an informed consent form her. The specific operation was shown as follows:

After combined block anesthesia was established, the patient was placed in the right lateral position, and prepped and draped for surgery. The ipsilateral hip was bolstered to 45° for an incision on the lateral hip. The incision was made 2 cm below the anterior superior iliac spine, and extended to the greater trochanter to form a double “S”-shaped incision, approximately 8 cm in length. After cutting the skin, subcutaneous tissue, and fascia, forceps were introduced into the gap between the tensor fascia lata and gluteus medius. The tissue was cut on the adherent area of the iliac bug on the trailing edge of the tensor fascia, and opened to the proximal side. The ascending branch of the lateral femoral circumflex artery was identified within the muscle mass, then a retrograde separation was performed to the internal muscle porta of the tensor fascia lata to ensure vascular pedicle length and half-way ligation of the iliac crest branch. An antero-graduate separation of the gluteal muscle branch was performed until the stop point of condemns. The separation process reserved 1-cm muscle sleeves and cut off 1.5 cm × 2.5 cm ×

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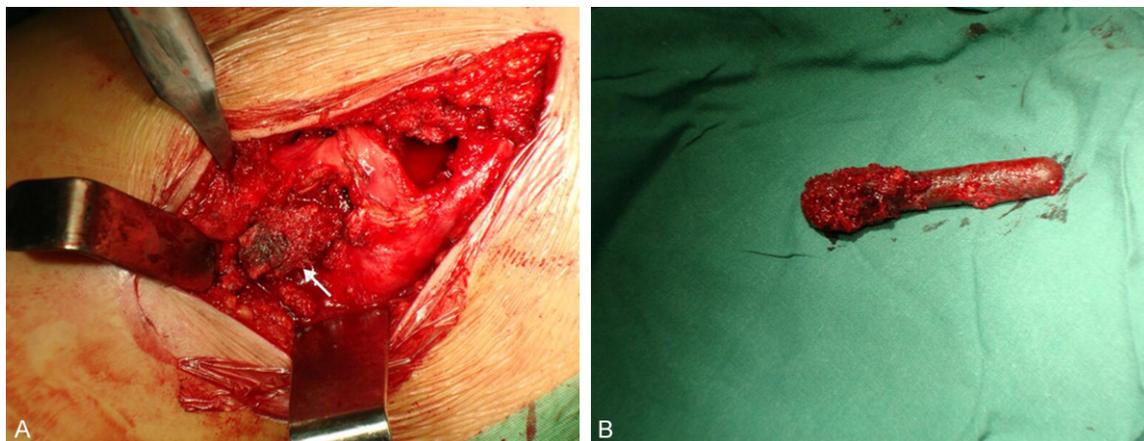


Figure 3. A. Knock to remove tantalum rod. B. Removed tantalum rod for re-implantation.

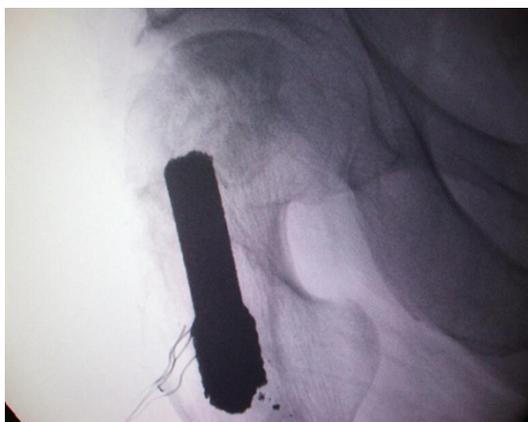


Figure 4. Intraoperative flap and tantalum rod position.

1.5 cm of the greater trochanter, which was then protected with saline gauze. The tensor fascia lata was pulled to the anterior aspect to expose the hip joint capsule for a “cross” incision. The anterolateral joint capsule was removed, then the left leg was drawn to expose the tantalum rod piercing the cartilage (**Figure 2**). The exposed tantalum rod was tapped with a proper force so that the tantalum rod could be removed for revision (**Figure 3**). A 2.0 cm × 2.0 cm window was made with a bone knife at the junction of the head and neck. A high-speed drill was used to clear the necrotic bone mass and granulation tissue in the femoral head to the cartilage. After implantation of cancellous bone, the vascularized greater trochanter was screwed into the window at the head and neck for embedding in the cancellous bone of the femoral head and appropriate force compaction. One-fourth of tantalum rod was cut off

after the rod was measured. The remaining tantalum rod was tapped in into original channel until the rod reached bone flap, then the channel was closed with bone wax. Intra-operative C-arm fluoroscopy showed the position of the bone flap and tantalum rod (**Figure 4**). The upper end of the joint capsule was sutured, and the wound was closed layer-by-layer. Post-operative direct radiography (DR) for antero-posterior and frog posture showed a femoral head bone flap bulge, and the tantalum rod was supported under the flap (**Figure 5**).

The patient engaged in continuous passive motion exercises 2 days after surgery to gradually restore joint mobility, and to avoid soft tissue and muscle adhesions at the surgical site. After 3 months, re-examination of the dual antero-posterior hip bone with DR showed good in-growth, and no displacement of the tantalum rod position was observed (**Figure 6**). After 7 years, re-examination showed that the femoral head shape and hip joint space were normal, the in-growth of bone flap was complete, the tantalum rod supported the flap, and recovery was good (**Figure 7**). No pain or joint movement impairment was reported by the patient. The Harris score was 81.7 points.

Discussion

The existing treatment methods for tantalum rod implantation failure are limited, of which THA is most commonly used. Because most patients who receive tantalum rod implantation for the first time are in an early stage of femoral head necrosis and between 20 and 40 years of age, if the surgeon directly performs THA, the

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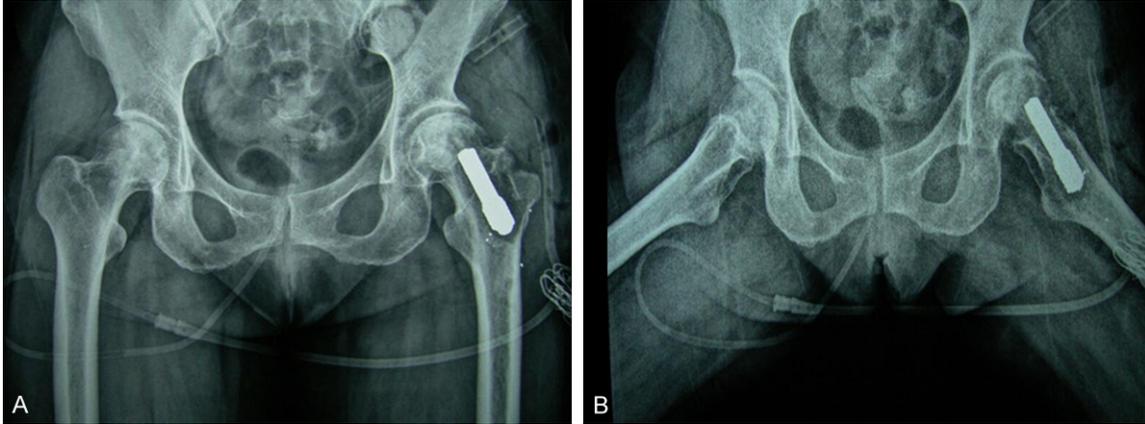


Figure 5. A. Postoperative anteroposterior dual hips DR. B. Postoperative frog posture dual hips DR.



Figure 6. Anteroposterior dual hips DR at postoperative 3 months.



Figure 7. Anteroposterior dual hips DR at postoperative 7 years.

patients will likely need multiple revision surgeries, which will greatly increase the difficulty of hip revision and the incidence of post-opera-

tive complications. Thus, such patients will experience significant economic, physical, and psychological burdens. After tantalum rod implantation failure, some patients still have a normal joint space, femoral head shape, and articular cartilage, and performing a THA would be considered excessive.

Even if tantalum metal rods have good biocompatibility and bone-mediated properties, not all patients are able to achieve the desired effect. Tantalum rod piercing after implantation is due to weak-repairing ability of osteonecrosis at the implantation site. The site has no direct blood supply, thus requiring a lengthy process of creeping substitution, which leads to tantalum rod penetration from an avascular necrosis area to the femoral head surface during the interaction between human body gravity and the supporting force of tantalum metal rods. Most of the conservative surgical treatments for avascular necrosis should resolve the following problems: (1) reducing pressure within the femoral head; (2) clearing femoral head necrosis within the bone lesion area and inducing new bone formation; (3) improving or reconstructing the femoral head blood supply; and (4) restoring femoral head shape and providing mechanical support for the collapse zone. Therefore, the blood supply should be considered first in patients with implantation failure, and a method should be developed to provide sufficient blood supply to the bone necrosis, thereby providing a good repair environment [10, 11].

Our hospital has extensive experience in the application of vascularized bone grafts for the

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treatment of femoral head necrosis [12]. The vascularized pedicle selected for this surgical procedure was the gluteal muscle branch of the transverse branch of the lateral femoral circumflex artery because this pedicle is located superficially and is likely to be exposed and separated. The gluteal muscle branch of the transverse branch of the lateral femoral circumflex artery generally does not vary under normal circumstances, is easy to identify, and contains separate vessels with a sufficient blood supply so as to establish contact around the lesion for revascularization and provide an adequate femoral head blood supply [13]. One-third to one-half of the femoral head is necrotic bone when the tantalum rod pierces the upper part, and the cartilage surface has been broken or damaged, so surgery should be performed to thoroughly remove bone necrosis of the upper femoral head and fracture of the articular cartilage. Windowing was performed at the head neck junction to remove necrotic bone and reduce the original intramedullary pressure. The necrotic bone and granulation tissue were removed using a high-speed drill until the cartilage. The necrotic bone must be thoroughly cleaned, which directly determines new bone regeneration and repair of the necrosis [7]. After removal of necrotic bone, the cancellous bone and bone flap were implanted for firm compaction, and the implanted cancellous bone and bone flap can provide mechanical support for the femoral head to promote femoral head shape recovery [14]. Our previous study confirmed that the clinical application of implanting vascularized bone flaps for middle-to-advanced conservative clinical treatment has a great success rate [15]. Finally, the depth finder was used to measure the desired length for tantalum rod re-implantation to cut off the excess part of the removed tantalum rod. The procedure not only completely removed the necrotic bone and restored the normal contour of the femoral head, but also provided mechanical support and facilitated repair of the femoral head for revascularization and bone regeneration after revision. According to the 5-year follow-up data of ARCO II-IV patients after combined therapy with vascularized pedicle bone grafts and tantalum rod revision, the total head salvage rate was 87.5%, as follows: 95% in stage II; 92% in stage III; and 63.6% in stage IV. Therefore, we believe that combined therapy with vascularized pedicle bone grafts and tan-

talum rod revision is an efficacious treatment [16]. It should also be noticed that if the necrotic area is large, a vascularized pedicle flap is recommended. The double vascularized pedicles have a richer blood supply, a larger flap blood supply range, and can significantly improve the blood supply for the revision area and shorten the blood supply reconstruction process after implantation. Indeed, even if one of the dual vascularized pedicles does not work or is insufficient, the influence on the bone flap is limited [17]. The selection of re-implanted tantalum metal rods can be determined by the patients according to the patient's family economic situation due to the higher prices of tantalum metal rods. Thus, most families will have a great burden if they should purchase a new tantalum rod, and we try our best to reuse the removed tantalum rod, but if the economic condition of the patient permits, we recommend a new tantalum rod for a better outcome.

For patients with tantalum rod implantation failure, we recommend salvaging the femoral head of the patients if possible to delay or avoid THA, especially for younger patients. In this case report, although the patient was 58 years of age, she had a normal joint space and femoral head shape, so we selected conservative treatment and achieved satisfactory results during 7 years of follow-up.

Disclosure of conflict of interest

None.

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