CASE REPORT

Radial shaft stress fracture after internal fixation using a titanium plate

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SUMMARY

A 22-year-old man, a boxer, presented with acute right forearm pain after striking a punch mitt. The patient had sustained a diaphyseal fracture of the right radius 19 months previously and was treated by minimally invasive plate osteosynthesis using a titanium reconstruction plate. Radiography revealed stress fractures beneath a proximal screw hole of the plate. The forearm was protected in a splint for 6 weeks and the fracture healed. Titanium plates are superior to stainless steel plates, due to various properties of titanium including corrosion resistance and biocompatibility. Removal of such plates is not routinely performed in our hospital, but plate removal may be warranted for patients who actively participate in certain sports.

BACKGROUND

Open reduction and plate fixation is the generally accepted treatment for most forearm shaft fractures in adults. In agreement with other reports,^{1–6} we usually do not remove the plates after the fracture has united. In this article, however, we report that plate removal should have been considered in a patient who sustained a radial shaft stress fracture beneath the titanium plate as a result of forceful boxing activity.

CASE PRESENTATION

A 22-year-old man, a boxer, sustained an isolated diaphyseal fracture of the right radius when banging into a wall during exercise (figure 1) and was treated by minimally invasive plate osteosynthesis (MIPO) using a 3.5 mm straight reconstruction titanium plate and 3.5 mm solid bicortical screws (DePuy ACE Sàrl, Switzerland; figure 2). Six months later, the fracture had healed (figure 3) and the patient resumed his boxing activity. Nineteen months after the injury, he noticed exercise-related pain in his right forearm, and after a week, he experienced acute pain in his right forearm when he struck a punch mitt. No swelling or deformity was observed in his forearm, but he presented with tenderness on the radial side of the middle forearm.

INVESTIGATIONS

Plain radiographs of the radius revealed a fracture beneath a proximal screw hole of the plate, at a different site from the original fracture (figure 4A–C).

DIFFERENTIAL DIAGNOSIS

The differential diagnoses included implant loosening and infection. However, we had not observed a

Figure 1 Initial radiographs of the forearm showing diaphyseal fracture of the right radius.

radiolucent zone around the plate and screws in the radiographs, which would have indicated screw loosening. In addition, skin reddening was not observed, and haematological investigation revealed that the C reactive protein (CRP) level and total white cell count (WBC) count were normal. “A normal level of CRP and WBC could not have

Figure 2 Radiographs of the forearm after minimally invasive plate osteosynthesis was performed.

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Figure 3 Radiographs of the forearm 6 months after the surgery. Bone union was observed.

ruled out infection, but it did not implicate the presence of an infection.”

TREATMENT

The forearm was protected in a sugar tongs-type splint, and exercise was prohibited until the bone union was completed.

OUTCOME AND FOLLOW-UP

Four weeks later, callus formation was observed at the fracture site, and 6 weeks after splinting, the fracture was healed and the splint taken off (figure 4D, E). We planned to remove the plate 24 weeks later, but the patient was lost to follow-up.

DISCUSSION

Plate fixation is generally acknowledged as a standard surgery for forearm bone fractures in adults. The advantages of plate fixation are its ability to maintain the length and the physiological curvature of the forearm bones, and to provide good stability against rotational stress.

We usually perform MIPO for radial shaft fracture if the displacement is small and easy to correct. The advantages of MIPO are a good cosmetic appearance with small incisions, and periosteum preservation to promote bone union. We perform MIPO as follows. Under a fluoroscope, an approximately 2 cm skin incision is made a few centimetres distal to the fracture site, along the line from Lister's tubercle to the lateral epicondyle of the humerus. The periosteum on the posterior side of the radius is exposed between the extensor digitorum communis tendon and the musculus extensor carpi radialis brevis. A submuscular space is created using an elevator, and the plate is inserted through the distal skin incision. The plate is positioned so that its proximal screw holes are aligned with the 2 cm proximal skin incision. The alignment and rotation of the fracture site are verified under the fluoroscope, and cortical screws are inserted into the proximal and distal sides of the plate for optimal fixation. Finally, before closing the wound, we carefully check to confirm that soft tissue is not trapped between the plate and the bone.

Figure 4 (A and B) Radiographs 19 months after the initial surgery. Although the fracture is not obvious in the anteroposterior view, the stress fracture is clear in the lateral view (arrowhead). Note that the site of the stress fracture was different from the site of the initial diaphyseal fracture (arrow). (C) A high-magnification view of the boxed area in panel B showing a stress fracture (arrowhead). (D and E) New bone formation was observed 4 weeks later (D), and the fracture was healed 6 weeks after splinting (E). Arrowheads indicate the site of the stress fracture.

Debate continues over the need for removal of the plates. Some groups insist that plate removal should be recommended, because the rigid plates hinder remodelling of the fracture area and absorb some of the normal load, resulting in a loss of bone strength due to cortical thinning and osteoporosis.^{7 8} However, the material used in those studies was stainless steel. Titanium is more flexible than stainless steel, resulting in a decrease in osteoporosis and stress shielding beneath the plates.^{9 10} In fact, no cortical thinning or osteopenia has been observed in the radiographs of more than 50 patients who have undergone titanium plate fixation in our hospital. In addition, plate removal increases the risk of complications, including refracture, wound sepsis, scarring, and nerve and blood vessel damage. It can also be a physical, social and economic burden for patients. For all of these reasons, after we treat adult forearm bone fractures using titanium plates, we usually do not remove the plates after the fracture has united. Many other groups have similarly advocated that routine plate removal should be avoided.^{1–6}

Stress fracture occurring in a healed fracture treated by plate fixation is extremely rare. Only one case has been reported of a stress fracture occurring beneath the plate, which was in the forearm of a 26-year-old man.¹¹ Six months after a diaphyseal radius fracture was treated with internal fixation using a 3.5 mm dynamic compression plate, a stress fracture occurred beneath the proximal end of the plate as a result of weight training. However, the plate in that case was stainless steel. Therefore, the present study is the first report of a stress fracture under a titanium plate.

The cause of the stress fracture in this study was thought to be an excessive mechanical load resulting from boxing training that was transformed into bending stress along the curvature of the radius, and that stress was concentrated on a proximal screw hole of the plate. Another possible cause is that a slight displacement of the fracture remained after the initial fixation. However, since the radiographs 19 months after the surgery indicated that sufficient bone union and remodelling of the original fracture was entirely completed (figure 4), this cause seems unlikely. Furthermore, because the site of the stress fracture was different from that of the original fracture (figure 4), it is more likely that the stress fracture was attributable to concentrated bending stress on the proximal screw hole than to fragility of the original fracture site.

In this case, the differential diagnosis is infection. To rule out the possibility, we recommended that the patient receive a biopsy and take CT or MRI. However, he rejected the recommendation for a personal reason. During the follow-up, antibiotics were not prescribed, and the CRP level and WBC count in haematological investigations were normal. We could not rule out the possibility of infection, but it was highly unlikely in this case. However, it is of great importance to keep the possibility of infection in mind if a fracture associated with implants occurs.

The outcome of the present case suggests that even if the material is titanium alloy, plate removal may be needed for patients who actively participate in certain sports, to prevent stress fracture. If the plate is removed, the limb should be protected for 4–6 weeks, and patients should be instructed to abstain from all sports for 3 months, and from sports that affect limb motion for 6 months,

in accordance with Arbeitsgemeinschaft für Osteosynthesefragen (AO) group recommendation.⁴ Notably, this is only one case of stress fracture, and more study is needed with a number of cases to evaluate the efficacy of plate removal for athletes in general. In any event, it is important to explain the advantages and disadvantages of plate removal to the patient when considering this procedure.

Patient's perspective

It is my pleasure to contribute to the development of medicine if my case is used for the paper.

Learning points

- ▶ A 22-year-old man sustained a radial shaft stress fracture beneath the titanium plate as a result of forceful boxing activity.
- ▶ The forearm was protected in a splint, and 6 weeks later, the fracture was healed and the splint was taken off.
- ▶ Although removal of such plates is not routinely performed, plate removal may be warranted for patients who actively participate in certain sports.

Contributors NN wrote a draft. KY provided treatment to the patient. TS reviewed and edited the draft.

Competing interests None declared.

Patient consent Obtained.

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