REMOVAL OF FOREARM PLATES

A REVIEW OF THE COMPLICATIONS

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We studied 55 patients who had undergone elective removal of forearm plates between 1980 and 1986; 44 plates were removed from the radius and 37 from the ulna. Before removal only 20 patients (36%) had definite symptoms attributable to the plates, but 44 patients (80%) were advised by the surgeon to have the plates removed. In 22 cases (40%) the operation was followed by a significant complication. The complication rate was higher with junior surgeons and was permanent in 50% of cases.

It is recommended that forearm plates should be removed only if they are causing significant symptoms, and that the operation should not be delegated to the most junior surgeon.

Dynamic compression plate fixation is a standard method of treating displaced diaphyseal fractures of the adult forearm. Good results have been reported using the principles laid down by the AO group (Müller et al 1979). In most cases 3.5 mm dynamic compression plates are used and are removed after union has occurred. The presence of a rigid plate results in uneven distribution of stress along the bone, the plate acting as a 'stress protector', perhaps predisposing to fracture.

The optimum time for plate removal in the forearm is said to be 18 to 24 months after insertion. There is a transient reduction in bone strength following plate removal, so that restriction of activity is recommended or even a temporary splint. We report the outcome in 55 patients who had elective plate removal performed at three orthopaedic units in Bristol.

PATIENTS AND METHODS

Some 55 patients had their plates removed as an elective procedure; they were part of a study of 108 surgically treated cases of forearm fractures which have been reviewed by the authors. There were 42 male and 13 female patients; their ages at the time of removal ranged from 10 to 63 years (average 26.7). The left arm was injured in 33 patients and the right in 22. The plate was removed from the ulna in 11 patients, the radius in 18 and from both bones in 26. Follow-up varied from 3 to 78 months (average 35.1) after removal and the plates were removed 5 to 84 months (average 23.7) after insertion.

In each case the forearm plate was not removed until after the surgeon thought that the fracture had united clinically and radiologically. Eleven patients (20%) asked for the plates to be removed; the other 44 (80%) were advised by the surgeon or one of his staff to have the plates removed. Twenty patients (36%) admitted to having symptoms (none severe) which they attributed to the plates; these symptoms were proximity to skin (8 patients), barometric pain (8), exercise pain (7) and pain when the arm was knocked against something (7). The remaining 35 patients (64%) had no symptoms.

At review all the patients were questioned directly and also asked to complete a questionnaire. The forearm was examined for appearance, range of movement and neurological status. In all patients, the radiographs and cases notes were examined.

COMPLICATIONS

In 22 patients (40%) a significant complication occurred as a result of the removal operation (see Table I).

Wound sepsis. Wound sepsis was defined as having occurred if the wound had a clinically and bacteriologically proven infection which required a full course of antibiotics. It occurred in four cases; in all four the organism was Staphylococcus aureus and responded to oral flucloxacillin. Three of these patients had to be detained in hospital for 48 hours and the fourth for seven days before the infections were controlled. There were no cases of deep sepsis or osteomyelitis.
Poor scar. Five patients were disappointed that the scar which followed plate removal was much wider and more noticeable than the original scar; two had asked to see a plastic surgeon. Most of these five patients also had local sensory loss.

Nerve damage. In 16 patients the plate removal was followed by sensory loss; this varied from local skin anaesthesia around the wound (6 cases) to disturbances of a major nerve such as the median (3), the superficial terminal branch of the radial (6) and the ulnar nerve (1). None of these patients had a neurological injury at the time of the original operation. In 10 patients (58%) the sensory loss was still present at review and was considered to be permanent.

In addition, two of these patients had motor weakness: one a transient posterior interosseus nerve palsy and the other a median nerve palsy. A third patient had purely motor median nerve palsy. All three patients recovered normal motor function within three months although one complained of intermittent weakness of the thumb.

Of the 17 patients with nerve damage, 10 had fractured both forearm bones and six had Galeazzi fracture-dislocations. In all cases, the neurological problem was associated with an anterior approach to the radius, especially if the fracture was in the middle or distal thirds of the bone.

Recovery. The average time in hospital was 40 hours (range 3 to 168); it was 28 hours for the uncomplicated cases and 56 hours (24 to 168) for complicated cases. The average time off work was 3.4 weeks; for uncomplicated cases it averaged 2.1 weeks and for complicated cases 5.2 weeks. Full recovery took an average of 2.5 weeks in uncomplicated and 6.8 weeks in complicated cases.

Refraction. In two patients the bone refractured after plate removal. In the first, a 30-year-old man, the refracture followed minimal trauma 15 days after plate removal. The plates had been removed nine months after injury; the refracture occurred through the site of the original injury to the radius (Figs 1 and 2). Internal fixation with a dynamic compression plate and bone graft resulted in union. The second patient, a 50-year-old woman, refractured 14 days after removal, again with minimal trauma. In her case the plate had not been removed until 24 months after the injury, but she also refractured through the site of the original radial fracture (Figs 3 and 4). Neither patient had been told to restrict activity and neither had worn a protective splint after the operation. In both cases, the fracture had been considered united at the time of plate removal, and union was confirmed at operation. In the first case refracture might have been predicted because of the inappropriate use of long 4.5 mm rigid plates.

Experience of the surgeon. The relationship of complications to the experience of the surgeon was investigated. A consultant or senior registrar was considered experienced, registrars moderately experienced and junior registrars or senior house officers inexperienced. Using these definitions, 23 operations (41%) were performed by experienced surgeons, 15 (27%) by moderately experienced and 10 (18%) by inexperienced surgeons. The other seven (12%) were performed by locum surgeons or surgeons whose seniority was not known. Experienced surgeons had complications in 13% of their cases, moderately experienced surgeons had complications in 60%, and inexperienced surgeons in 100% of their cases.

DISCUSSION

Refraction is the commonest complication reported after plate removal. Dodge and Cady (1972) reported only one refracture in 40 cases in which plates had been removed 16 months after injury. However, Anderson et al (1975) reported eight refractures after minor trauma in 20 patients whose plates had been removed after only a few months; the incidence was reduced when plates had been left in for 12 to 18 months, and a protective splint worn for up to six weeks. More recently, Hidaka and Gustilo (1984) reported on seven cases of refracture in 23 patients, all but one of whom had had some form of protective immobilisation; the average time to refracture was three...
Table 1. Complications sustained by 22 patients following plate removal

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compared to rigid cobalt chromium alloy plates; these less rigid plates were comparable to AO semi-tubular plates. Bones which had had a flexible plate in position for nine months showed no difference in bone mass or porosity from those which had had the plates removed three months previously. Moyen et al (1978) concluded from this that the more flexible plates produce less osteoporosis beneath the plate, the stimulus to recover was less evident after the plate had been removed. This raises the question as to the necessity for removing less rigid plates. In Hidaka and Gustilo’s series none of the five fractures fixed with semi-tubular plates refractured after removal, but five of their six refractures had been fixed with six- or seven-hole 4.5 mm AO dynamic compression plates.

In our series there were two refractures, each through the previous fracture site. One plate had been removed very early (at nine months), but the other had a two-year delay. Both refractures occurred within a month of plate removal and neither patient had been protected or told to restrict activity. In both cases, there was a short oblique fracture of the radius at the junction of the middle and distal third; six of the seven fractures in the Hidaka and Gustilo (1984) series also were of the radius.

Hidaka and Gustilo (1984) suggested three probable causes for refracture: cortical thinning secondary to diminished load transfer, avascularity of the cortex, and an osteolytic process which weakens the bone beneath the plate. Refracture during the first three months is thought to occur because the thin avascular cortex is unable to withstand bending and torsional forces.

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The use of semi-tubular plates for diaphyseal forearm fractures has declined since 1975. Hadden, Reschauer and Seggl (1983) in their series of 111 forearm fractures reported nonunion in seven cases, six of which had been fixed with semi-tubular plates. Fisher and Hamblem (1978) commented on the likelihood of bending and fixation failure if semi-tubular plates are used for forearm fractures. As a result of such failures the AO group developed the 3.5 mm DCP plate which has better mechanical characteristics for forearm bones; in large adults a 4.5 mm plate may still be used for the distal radius and the proximal ulna, but where the bone is smaller a 3.5 mm DCP plate, or even a semi-tubular plate, should be used.

It is not known how long it takes a human radius to regain full strength after plate removal, but until that time splintage or bracing cannot be relied upon to prevent

Fig. 3

Figure 3 - Radiographs of a 50-year-old woman before removal of forearm plates; union was present.

Fig. 4

Figure 4 - Fourteen days after plate removal there was a refracture through the original radial fracture site.

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refracture. The AO group recommend normal use of the limb, but no athletic activity for the first three months, and no extreme activity for six months. This seems to be the safest policy, because excessive bracing following plate removal could increase the osteoporotic effect of immobilisation.

In our series the commonest complications were neurological. There was a high incidence of injury to the superficial branch of the radial nerve, but fortunately, injury to other major nerves was usually temporary. All our nerve injuries were associated with some variation of Henry’s (1973) anterior approach to the radius, which was used for distal as well as proximal fractures. The superficial branch of the radial nerve clings to a mobile wad of muscles (brachioradialis, extensor carpi radialis longus and brevis) proximally, and is largely protected if carefully retracted; distally it continues under cover of brachioradialis to the distal forearm. It is therefore vulnerable to injury throughout the entire length of the forearm (Fig. 5). When the plates are inserted, usually by an experienced surgeon, the nerve is readily identified, even in the presence of a haematoma; when the plate is removed, adhesions and fibrosis make identification more difficult. The AO group recommend a dorsal incision for approaching the proximal radius and a longitudinal dorsolateral incision for the rest of the bone (Ruedi, von Hochstetter and Schlumpf 1984). This is less likely to result in nerve injury and also facilitates applying the plates on the tension side of the bone.

Conclusion. This study has shown that elective removal of forearm plates carries a significant complication rate. Most patients do not have serious symptoms from the plates and unless they do we feel that the plates should be left in position; moreover, they should not be removed for at least 18 months after being applied. Their removal should not be delegated to an inexperienced surgeon and the presence of an anterior scar demands special care to avoid nerve injury. The more dorsally placed incision is recommended when fixing forearm fractures. After removal of a plate, restricted physical activity for up to three months is recommended and this may include wearing a light functional brace.

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REFERENCES


