Successful Treatment of Failed Ulnar Osteotomy by Concurrent Radial Osteotomy in a Forearm Malunion

Hyun Sik Gong, M.D., Seung Joon Lee, M.D., Young Ho Lee, M.D., and Goo Hyun Baek, M.D.
Department of Orthopedic Surgery, Seoul National University College of Medicine, Seoul, Korea

We present a patient with malunion of the ulna and radius, who experienced 2 consecutive healing failures after osteotomy of the ulnar malunion only. The purpose of the surgery was for cosmetic reasons. Healing was finally obtained when a seemingly minimal malunion of the radius was corrected as well. This case suggests concurrent correction of both bone forearm malunion may be required to ensure satisfactory healing.

Key words: malunion, osteotomy, forearm bone

Osteotomy of malunited fractures of the ulna and radius is generally indicated in cases with functional loss of motion, instability of the distal radioulnar joint, or unacceptable cosmetic deformity. A few studies have been performed on the outcomes of osteotomies for malunited fractures of the forearm. In these studies, patients had osteotomies of one or both forearm bones according to the degrees of the deformities. Trousdale and Linscheid recommended if both bones are mal-aligned that the more severely deformed bone be corrected first, and that if the radius is osteotomized first and rotation is smooth, the ulna can be ignored. However, it is unclear how much deformity of one bone can be ignored when the first osteotomy alone can achieve a functionally acceptable range of motion. We experienced a patient with malunion of both forearm bones, who experienced two consecutive healing failures after osteotomy of the ulnar malunion only, which was performed for a cosmetic reason. Healing was finally obtained when the seemingly minimal malunion of the radius was also corrected.

CASE REPORT

A 21-year-old man was referred to our clinic for repeated failure of corrective osteotomy of the right ulna performed at a local hospital. Six years previously, the patient had suffered fractures of ulna and radius of the right forearm and had undergone open reduction and internal fixation for the fracture at another hospital. However, fixation was performed for the ulna alone for unidentified reasons, and subsequently angulation deformities developed in the ulna and radius, although the fractures eventually healed (Fig. 1). Six months prior to presentation at our clinic, the patient requested correction...
of bowing of the ulna, and underwent corrective osteotomy at the local hospital. Because he had acceptable rotational motions with 45 degrees of supination and 60 degrees of pronation, and the chief complaint was deformity and not inadequate motion, the surgeon at the local hospital performed corrective osteotomy of the ulna only using a 3.5 mm reconstruction plate and screws (Fig. 2). At 6 weeks postoperatively, when a callus was seen, the patient started motion exercises and soon obtained the preoperative level of rotational motions. However, at 10 weeks postoperatively, he felt a sudden pain at the osteotomy site and the radiographic examinations revealed a broken plate and fracture of the osteotomy (Fig. 3). He then underwent reoperation at the same local hospital, with another longer reconstruction plate and screws plus an autogenous iliac bone graft (Fig. 4). After 8 weeks of long arm cast immobilization, when a callus was present, he began motion exercises, but at 10 weeks after the second operation, he felt a sudden pain again at the operation site. Radiographs revealed a breakage of the plate (Fig. 5).

When examined by us, the patient had 45 degrees of supination and 60 degrees of pronation in the involved side, and 90 degrees of supination and 70 degrees of pronation in the contralateral side (Fig.
The grip power of the affected side was 28 kg while the intact side was 37 kg. The ulna had 25 degrees of dorsal angulation and 14 degrees of radial angulation at the proximal 1/4 of its length, and the radius had 15 degrees of dorsal angulation at the same level. The patient was a non-smoker and did not have any general illnesses. We decided to perform osteotomies on both forearm bones. As the patient had near normal pronation and moderately limited supination, we did not consider rotational mal-alignment, and simply corrected the angular deformities. The ulna was corrected first and fixed with two plates (one with 7-hole the other with 5 hole dynamic compression plate) and screws. After this first surgery on the ulna, rotational motion of the forearm was smooth throughout preoperative ranges of motion. We then performed osteotomy of the radius, because we believed it likely that even the small angular deformity of the radius had adversely affected the stability of the ulnar fixation during forearm supination. The radius was corrected by open wedge osteotomy and fixed with a 7-hole plate and screws, and autogenous iliac cancellous bone was filled into the open wedge sites. After the radius osteotomy, supination improved to 70 degrees and pronation was maintained. The arm was immobilized for 6 weeks and then motion exercises were started. Healing progressed uneventfully and union was observed at 3 months. Finally, the patient achieved 70 degrees of supination and 60 degrees of pronation and the grip power improved to the normal side value at his 12-month follow-up (Fig. 7, 8).

DISCUSSION

In the presented case, after two consecutive healing failures of single Figure 6. Photographs showing forearm rotations prior to the last operation. The patient had 45 degrees of supination and 60 degrees of pronation in the involved side, and 90 degrees of supination and 70 degrees of pronation at the opposite side.

Figure 7. Radiograph taken 12 months after the last operation, showing union of the osteotomies in the radius and the ulna.

Figure 8. Photographs showing forearm rotations one year after the operation. The patient had 70 degrees of supination and 60 degrees of pronation in the involved side.
osteotomy of the more severe ulnar malunion, healing was finally obtained when malunion of the radius was also corrected and the ulna was securely fixed. Considering the proximal location of ulnar osteotomy, this repeated failure of fixation appears unusual. Brakenbury et al. reported that most ulnar nonunions occur at the junction of the middle and distal thirds of the shaft, which is related to a poor blood supply as the descending branch of the nutrient artery terminates at this level. Stern and Drury stated that this failure of healing might be due to the torsional forces exerted on the ulna during rotation. We suspect the cause of the repeated fixation failure was that the uncorrected deformity of the proximal radius had an adverse effect on the ulna by impinging it during the final degrees of supination motion exercises. The surgeon that first performed corrective osteotomy of the ulna may have done so because the chief complaint was ulna deformity and not insufficient supination. Although the supination and pronation motions were unchanged after single ulna osteotomy, because supination was not improved, we consider that the stress created by the malunited radius on the osteotomized ulna during supination exercises probably caused ulnar fixation failure. In addition, we believe the quality of the fixation of the previous operations may have been inadequate although 6 to 8 weeks of immobilization was done postoperatively, as 3.5 mm pelvic reconstruction plate (2.8 mm thickness) is considered weaker than the standard dynamic compression plate (3 mm thickness).

Many studies have been performed to investigate the effects of angular and axial malunions of the forearm bones on motion limitations caused by excessive tension in the interosseous membrane and bone impingement. Although recreating normal alignment and a normal amount of radial bow is desirable for maximal function, the cut-off value of angulation as a requirement for surgical correction still varies from 15 degrees for midshaft fractures to 40 degrees for fractures in the distal third. Matthews et al. in a cadaver study, reported that an angulation of 10 degrees or less did not alter forearm motion, but that angulation of 20 degrees in either the radius or the ulna resulted in at least a 30% loss of rotation. Tarr et al. also reported that deformities of 10 degrees or less resulted in minimal limitation of forearm rotation, but concluded that deformities of 15 degrees significantly reduced the amount of forearm rotation. Sarmentio et al. further confirmed that a clinically relevant loss of forearm rotation of less than 50 degrees of pronation and supination, which is required to perform most normal activities, was not achieved until at least 15 degrees of angulation is exceeded.

A few studies have been performed on the outcomes of single osteotomies or osteotomies of both forearm bones for malunited fractures of the forearm. Trousdale and Linscheid performed 20 radius osteotomies, 5 radius and ulnar osteotomies, and 2 ulnar osteotomies in 27 patients. They recommended that if both the radius and ulna are mal-aligned, the ulna be osteotomized first to establish alignment of the forearm, and the radius be osteotomized next to conform to the ulna, and on the other hand, if the radius is more severely mal-aligned then it be osteotomized first, and that if rotation is smooth with passive manipulation, the ulna can be ignored. However, no recommendation has been made regarding how much radial deformity can be ignored when the ulnar is osteotomized first and rotation appears functional. Furthermore, when rotation is marginally limited, it is difficult to determine whether further osteotomy of the other less-deformed bone is necessary, because residual limitation of motion can be caused by bony alignment, soft tissue contracture, or secondary joint changes in cases with a long period between initial injury and osteotomy. In the described case, during the first surgery, angular deformity of the radius was about 15 degrees and the patient had 45 degrees of supination and 60 degrees of pronation preoperatively, which did not change after ulnar osteotomy, which made it difficult to justify further correction of the radius. Furthermore, the resumed stability advantage offered by leaving the radius may have been considered to be helpful for promoting the healing of the nonunited ulna. Three-dimensional models and computer simulation systems may be necessary to assess whether a single osteotomy is sufficient and to determine the conditions under which this does not cause impingement.

This case suggests concurrent correction of both bone forearm malunion may be required to ensure satisfactory healing. Further studies are required to provide guidance on corrective osteotomy for malunions of both forearm bones.

REFERENCES


전완골 부정유합에서 요골과 척골 동시 절골술의 필요성

공현식 • 이승준 • 이영호 • 백구현
서울대학교 의과대학 정형외과학교실

전완골 간부 부정유합에서 변형이 심한 쪽만 교정할지 모두 교정할지는 이견이 있다. 저자들은 전완골 부정유합에서 상대적으로 변형이 심한 척골에 대해서만 미용적인 목적으로 절골술을 2차례 받았으나 골 유합이 되지 않아 의뢰된 환자를 보고하고자 한다. 저자들은 척골과 함께 요골에 대해서도 교정 절골술을 하였고 마침내 골 유합이 이루어졌다. 이 증례는 전완골 부정유합에서 요골과 척골 중 하나가 변형이 심하지 않더라도 동시에 교정하여야 만족스러운 골 유합이 이루어질 수 있음을 시사한다.

색인단어: 부정유합, 절골술, 전완골

접수일 2011년 10월 20일 게재확정일 2011년 10월 25일
교신저자 공현식
경기도 성남시 분당구 구미동 300, 서울대학교 의과대학 분당서울대학교병원 정형외과
TEL 031-787-7198, FAX 031-787-4066, E-mail hsgong@snu.ac.kr