Late-Onset Radial Nerve Palsy Associated with Conservatively Managed Humeral Fracture. A Case Report and Suggested Classification System

Amr Atef Abdelgawad, MD · Andrew Wassef, MD · Nabil A. Ebraheim, MD

Received: 6 January 2009/Accepted: 22 September 2009/Published online: 8 October 2009
© Hospital for Special Surgery 2009

Abstract Radial nerve palsy can occur with humerus fracture, either at the time of injury (primary) or during reduction (secondary). Late-onset radial nerve palsy (not immediately related to injury or reduction) has been very seldom reported in the English literature. We describe a case of late-onset radial nerve palsy, which developed 9 weeks after an attempted closed management of a midshaft humerus fracture. Exploration of the nerve was performed. The radial nerve was found to be stretched over the ends of the fracture. Open reduction and external fixation of the fracture with mobilization of the nerve from the fracture site lead to complete return of radial nerve function occurring by 3 months. We recommend exploration of cases of late-onset radial nerve palsy in contrast to primary or secondary radial nerve palsy, which can be treated conservatively. Our experience suggests that the cause of the palsy is a continuous ongoing pathology and not a single time event as in primary or secondary cases. Radial nerve palsies associated with humeral fracture should be classified as either primary (at the time of injury), secondary (at the time of reduction), or late onset (not related to either injury or reduction).

Keywords radial nerve palsy · classification · humerus fracture · external fixator · late onset

Each author certifies that he or she has no commercial associations (e.g., consultancies, stock ownership, equity interest, patent/licensing arrangements, etc.) that might pose a conflict of interest in connection with the submitted article.

Each author certifies that his or her institution has approved the reporting of this case, that all investigations were conducted in conformity with ethical principles of research.

A. A. Abdelgawad, MD (✉) · A. Wassef, MD · N. A. Ebraheim, MD
Orthopedic Department,
University of Toledo Medical Center,
3065 Arlington Avenue,
Toledo, OH 43614, USA
e-mail: amratef@doctor.com

Introduction

Radial nerve palsy is a common and well-known complication of humeral fracture. The incidence of radial nerve paralysis with humeral fracture is approximately 11% [1–3]. Radial nerve palsies with humeral fractures are usually classified as being either primary or secondary. Primary nerve palsies are palsies that occur at the time of the injury. Secondary palsies are those that occur with closed reduction and manipulation or open reduction and internal fixation [4–7]. Only a few cases of late-onset radial palsy (not immediately associated with open reduction or closed manipulation) are reported in the literature [8–10]. We report a case of late-onset radial nerve palsy that occurred 2 months after closed, non-operative treatment of a humerus fracture.

Case description

A 45-year-old woman had a left humeral fracture from a relatively low energy trauma (falling during work). The spiral fracture occurred at the junction of the proximal two thirds and the distal one third of the humerus. At initial examination, the patient demonstrated intact radial nerve function. The fracture was managed conservatively with a fracture brace. Her radial nerve function remained intact after application of the fracture brace and during her follow-up visits until 9 weeks after injury. She then began to complain of a progressive weakness of the wrist and hand extensors and presented a few days later with complete radial nerve palsy and wrist drop.

A radiograph of the humeral fracture at that time showed minimal healing and about 20° of varus deformity (Fig. 1).

The decision was made to explore the radial nerve. Intraoperatively, the nerve was found to be stretched over the proximal end of distal fragment but not incarcerated in the fracture callus. Regarding the fracture itself, some

Fig. 1. AP view of left humerus 2 months after the injury showing minimal healing and about 20° varus deformity

healing was encountered between the fracture ends; however, there was no solid union. The nerve was gently freed from the fracture site. The humerus fracture was fixed by unilateral external fixation. Some correction of the deformity was achieved, but periosteal stripping and dissection of the fracture callus to obtain anatomical reduction was not performed in order to not sacrifice the healing that was already achieved (Fig. 2). Postoperatively, the patient was allowed to use her arm in daily activities, with restriction of heavy lifting (more than 15 lbs). Physical therapy for active and passive range of motion was started immediately after surgery. Radial nerve function started to return after 3 weeks, and the patient regained full function by 3 months. The frame was removed after 2 months when there were signs of more complete healing on the X-ray (Fig. 3).

Discussion

Radial nerve palsy is a common complication of humeral fractures. It can usually be managed conservatively with no need for early surgical interference in most closed fracture cases [2, 4–7, 11]. Good functional recovery of the radial nerve can be expected after both primary radial nerve palsy (occurring at the time of humeral fracture) and secondary radial nerve palsy (occurred after closed manipulation or open reduction).

The literature describes some cases of radial palsy, which, with exploration, demonstrated the nerve to be

Fig. 2. AP views of the humerus 1 week after surgery with the external fixator in place

encased in the callus; however, these cases were primary or secondary palsies that fail to recover spontaneously and needed to be explored. These were not late-onset cases [1, 6, 11–13].

Late-onset radial nerve palsy with humeral fracture has been very seldom reported. Two cases have been reported

Fig. 3. AP view of the humerus showing healing of the fracture

postoperatively. Edwards and Kurth reported a case of radial palsy developing 6 weeks after open reduction and internal fixation of a humeral fracture. During re-exploration, the nerve was found to be transected and encased in the fracture callus. Rubbing of the nerve against the new bone was thought to be the mechanism of injury by the authors [9]. Ueda et al. described a case in the Japanese literature of delayed onset radial palsy after 3 years from a humeral fracture treated by an intramedullary nail. The authors found at the time of exploration that the nerve was compressed by the fracture callus [10].

Chesser and Leslie described another case of late-onset (3 months) radial nerve palsy after humeral fracture, which was managed conservatively with a brace. At exploration, the nerve was found to be entrapped by the lateral intermuscular septum. The septum was released with complete recovery of neurological deficit after 1 month [8]. Our case is similar to the case described by Chesser and Leslie in that it developed after a similar period in a patient being managed with a fracture brace. However, we think that the cause of palsy in our case was a traction injury to the nerve, as it was increasingly stretched over the fracture as the varus angulation increased during the period of brace treatment. Contrary to Chesser and Leslie's case, the callus formation in our case was minimal, and the fracture was not fully healed. The nerve traction that occurs in late-onset palsy is not the same as acute stretch that occurs with the trauma. This developing traction on the nerve is persistent and chronic in nature and may be related to increased fracture angulation and displacement. It is a continuous strain on the nerve and not a one-time injury.

We believe that late-onset radial nerve palsy should not be managed conservatively. In two of the previously described cases [9, 10], the nerve was found in the callus, and in our case as well as the case described by Chesser and Leslie [8], the nerve was stretched over but not incorporated within the callus. Because the insult (stretch) on the nerve was an ongoing continuous process and not a single event (as occur with the injury related radial nerve palsy), the palsy is unlikely to recover spontaneously. We believe that the nerve should be explored and released, as it is unlikely that the offending traction will improve with time. This is in contrast to the palsy that is related to the single event occurring at the time of fracture deformation. In that setting, the traction is transient, and the palsy is expected to improve with time. Furthermore, with late-onset palsy, if the fracture is allowed to heal, the nerve may be entangled in the healing process.

The radial nerve palsy associated with humeral shaft fracture should be classified into three main categories:

primary, secondary, and late onset. Primary cases are immediately related to the injury, and secondary cases are related to either closed or open reduction. Both primary and secondary cases can be managed conservatively with high expectation of excellent results and complete recovery. Late-onset cases are not directly related to either the fracture injury or reduction and occur rarely. Orthopedic surgeons should be aware of this rare type. We believe that the delayed type needs surgical exploration of the nerve because the mechanism of injury appears to be the development of an ongoing traction resulting from deformation caused by development of callus or from angulation of the fracture itself.

References

1. Pollock FH, Drake D, Bovill EG, Day L, Trafton PG (1981) Treatment of radial neuropathy associated with fractures of the humerus. *J. Bone Jt. Surg. Am.* 63 no. 2, 239–243
2. Shao YC, Harwood P, Grotz MR, Limb D, Giannoudis PV (2005) Radial nerve palsy associated with fractures of the shaft of the humerus: a systematic review. *J. Bone Jt. Surg. Br.* 87 no. 12, 1647–1652
3. Ekholm R, Adami J, Tidermark J, Hansson K, Törnkvist H, Ponzer S (2006) Fractures of the shaft of the humerus. An epidemiological study of 401 fractures. *J. Bone Jt. Surg. Br.* 88 no. 11, 1469–1473
4. Shaw J, Sakellarides H (1967) Radial-nerve paralysis associated with fractures of the humerus: a review of forty-five cases. *J. Bone Jt. Surg.* 49A:899–902
5. Kettelkamp D, Alexander H (1967) Clinical review of radial nerve injury. *J. Trauma* 7:424–432
6. Bostman O, Bakalim G, Vaniionpaa S, Wilppula E, Patiala H, Rokkanen P (1986) Radial palsy in shaft fracture of the humerus. *Acta. Orthop. Scand.* 57:316–319
7. DeFranco MJ, Lawton JN (2006) Radial nerve injuries associated with humeral fractures. *J. Hand Surg. [Am].* 31 no. 4, 655–663
8. Chesser TJ, Leslie JJ (2000) Radial nerve entrapment by the lateral intermuscular septum after trauma. *J. Orthop. Trauma.* 14 no. 1, 65–66
9. Edwards P, Kurth L (1992) Postoperative radial nerve paralysis caused by fracture callus. *J. Orthop. Trauma.* 6 no. 2, 234–236
10. Ueda N, Susuki K, Tanigawa A, Kuroiwa Y, Obayashi O (2001) Delayed radial nerve palsy following a humeral shaft fracture. *Rinsho Shinkeigaku.* 41 no. 6, 322–324
11. Shah JJ, Bhatti NA. Radial nerve paralysis associated with fractures of the humerus. A review of 62 cases. *Clin. Orthop. Relat. Res.* 1983; (172): 171–176
12. Duthie HL (1957) Radial nerve in osseous tunnel at humeral fracture site diagnosed radiographically. *J. Bone Jt. Surg. Br.* 39-B no. 4, 746–747
13. Amillo S, Barrios RH, Martínez-Peric R, Losada JJ (1993) Surgical treatment of the radial nerve lesions associated with fractures of the humerus. *J. Orthop. Trauma.* 7 no. 3, 211–215