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## Late Missed Monteggia Lesions – Reconstruction of the Humeroradial Joint

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### Abstract

**Objective:** Reconstruction of the humeroradial joint resulting in immediate functional stability.

**Indications:** Missed traumatic dislocation of the radial head. Congenital dislocation of the radial head.

**Contraindications:** Secondary dislocation of the radial head in instances of dysplasia or aplasia of the capitellum. Relative: deformation of the radial head in adults.

**Surgical Technique:** Open reduction of the radial head without reconstruction of the annular ligament. Osteotomy of the shaft of the proximal ulna and installation of an external fixator with open clamps. Three-dimensional correction of the ulna under visual control of the humeroradial joint until the radial head is relocated in its anatomic position.

**Results:** Between 01/1998 and 05/2001, we performed an osteotomy of the proximal ulna, external fixation, and open reduction of the radial head in 14 patients presenting with a late missed Monteggia lesion (Bado type I). The average age of the seven girls and seven boys at the time of reconstruction was 9 (5–15) years, the mean interval between index trauma and reconstruction amounted to 21 months (2 weeks to 7 years). Removal of the external fixator after an average of 12 (7–16) weeks. In twelve patients the reduction was maintained, and in two patients the radial head redislocated postoperatively. In one of these patients a closed reduction was successful, whereas in the other patient an open reduction was done and the external fixation modified. In both patients the joint position was maintained.

Preoperatively seven out of 14 patients showed a decreased range of motion; it improved postoperatively in most. A clinical and radiologic follow-up averaging 14 (3–44) months was possible in 13 patients. No complications were recorded.

### Key Words

Late missed Monteggia lesion · Ulnar osteotomy · External fixation

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### Introductory Remarks

A traumatic anterior dislocation of the radial head (Bado type I [2], Table 1) cannot occur without a simultaneous lesion of the ulna such as bowing of the ulna, the classic greenstick fracture, or a complete fracture [2, 8, 15, 19, 20, 25, 27, 28, 30]. Even when the dislocation has been missed, the fracture of the ulna consolidates, often under conservative care. The axial deviation is often minimal and corrects spontaneously during further growth. A relative lengthening of the radius when compared to the ulna occurs, particularly in children < 5 years of age, most probably due to the absent contact between radius and humerus.

The goal of the surgical reconstruction of the remote radial head dislocation is the correction of the malalignment of the ulna by an osteotomy and, if neces-

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**Table 1.** Monteggia fractures – classification according to Bado [2].

Type I	Anterior dislocation of radial head, anterior angulation of ulnar shaft fracture
Type II	Posterior dislocation of radial head, posterior angulation of ulnar shaft fracture
Type III	Lateral dislocation of radial head, proximal metaphyseal fracture of ulna
Type IV	Anterior dislocation of radial head, shaft fracture of ulna and radius

sary, correction of the length discrepancy. With few exceptions [1, 11, 16, 18], most authors agree with such an approach [3, 4, 6, 9, 12, 21, 23, 24]. The discrepancy of opinion relates to the indication for a reconstruction of the annular ligament [5]. In none of the published series did such an intervention lead to good results. Our own experience based on 15 attempts at reconstruction for missed dislocations led to poor results in 50% [13]. We therefore reconsidered our approach and opted for an ulnar osteotomy. The choice of the extent and plane of this osteotomy entails two problems: 1. We do not know the original axial deviation that led to the dislocation. The axial deviation as seen in the original anteroposterior (AP) and lateral radiographs cannot tell us the direction nor the extent of the displacement. Besides, malrotation can neither be diagnosed clinically nor radiologically. 2. The estimation of the axial deviation months to years after the injury is even more difficult given the spontaneous, growth-induced correction.

Plates or rods are limited in their ability to determine the direction of the osteotomy necessary for reduction of the radial head; their use does not allow to obtain the direction optimal for reduction of the dislocation. Additional soft tissue procedures, even the often chosen but obsolete method according to Witt [31, 32] do not solve this problem. The method of Witt forces the radial head in its proper place and holds it there with a transarticular wire. As repeatedly shown, these approaches lead to new problems such as wire breakage, infection, chronic epiphysiolysis, and growth disturbances [7, 17].

Only the radial head once properly reduced can determine the final direction and extent of angulation of the ulnar osteotomy. These prerequisites are met by a system such as an external fixator that allows unlimited motion in all planes. Difficulties in respect of timing: the earlier the reconstruction is done, the better the results [10, 13, 14, 18, 21–24, 26, 29]. During early correction one does not need to deal with length discrepancy, the

head has kept its original shape, and the patients are usually completely symptom-free and have a full range of motion postoperatively. The prognosis of late post-traumatic radial head dislocations is unknown. Therefore, we are unable to predict the late outcome and the occurrence of secondary symptoms, even in symptom-free patients. This is additional reason to recommend early reconstruction.

### Surgical Principles and Objective

Corrective osteotomy of the ulnar shaft and open reduction of the radial head. Retention of the fragments with an external fixator. No soft tissue reconstruction. Immediate stable reduction of the humero-radial joint allowing early movements. Restoration of shape and function of the elbow joint.

### Advantages

- Immediate mobilization of the reconstructed joint.

### Disadvantages

- In the presence of a discrepancy in length between radius and ulna, two interventions are necessary: first, a distraction osteotomy of the ulna to regain the proper length of the ulna and then, second, later an ulnar correctional osteotomy and open reduction of the radial head.

### Indications

- Remote, untreated traumatic radial head dislocation:
  - with functional disturbances and/or pain secondary to instability,
  - symptom-free patients in whom the dislocation has been diagnosed 1–2 years after the trauma.

### Contraindications

- Radial head dislocation secondary to a dysplasia or aplasia of the capitellum.
- Deformed radial head with recognizable convex shape of the radial head in adults.

### Patient Information

- No promise as to the function of the humeroradial joint.
- Possible loss of function.
- Late outcome uncertain.
- Risk of nerve and/or vessel injury.
- Risk of infection, particularly after screw loosening and neglect of fixator care.

- Fixator does not necessitate limitation of daily activities such as bathing.
- Screw loosening; may necessitate revision surgery.
- Duration of external fixation 8–16 weeks, until bony consolidation of osteotomy.
- Risk of delayed union or nonunion: cancellous bone grafting.
- Overgrowth in length of radius: two-stage surgery: distraction osteotomy of ulna and, later, corrective ulnar osteotomy. Decision often only possible during surgery. Discuss this point with parents.
- Show photos of patients with fixator (preferably demonstrating the function, Figure 1) to patient and/or parents.
- Discuss necessity for meticulous pin-site care.
- Discuss your previous experience with patient and/or parents.

#### Preoperative Work-up

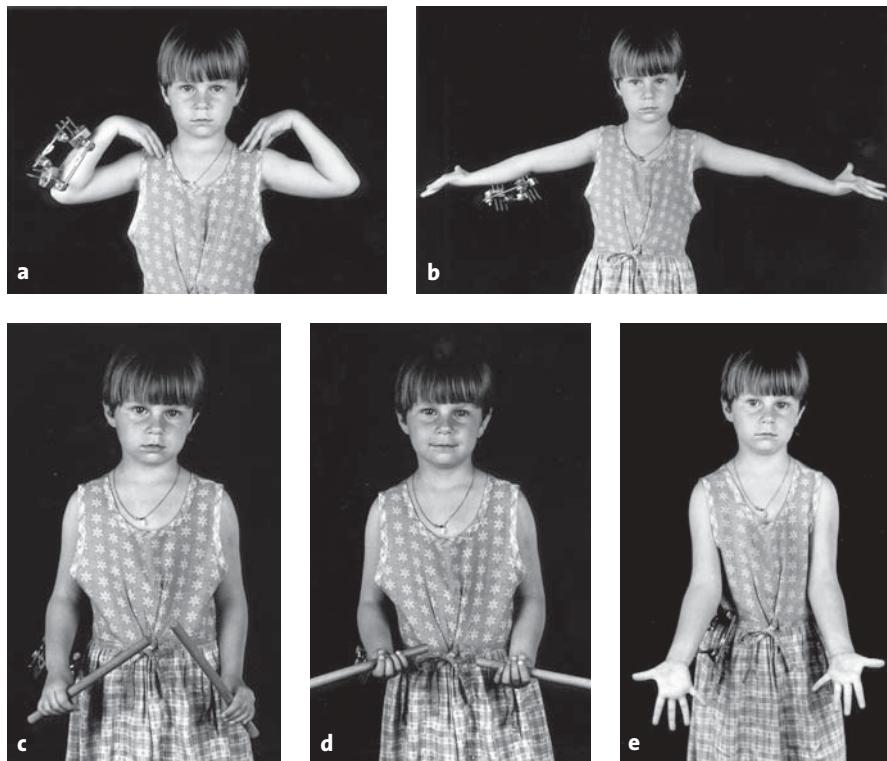
- Radiographs in two planes of both forearms including neighboring joints.
- Photographic documentation of function and aspect of the involved limb.
- Availability of image intensifier.

#### Surgical Instruments and Implants

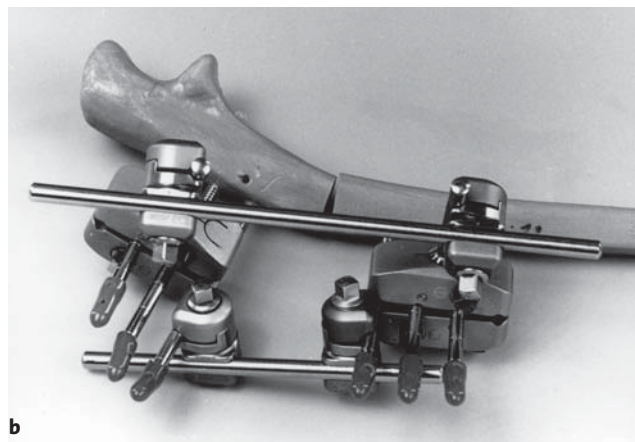
- External fixator “Hoffman II Compact II®” (Stryker-Howmedica).
- Six Apexpins®, 3 mm in diameter (self-drilling, self-tapping; Stryker-Howmedica Europe, P.O. Box 1568, 1820 Montreux, Switzerland; Figure 2).
- 2-mm drill bit.
- Chisel, 10 mm broad.

#### Anesthesia and Positioning

- Endotracheal or plexus anesthesia.
- Supine, arm table, tourniquet at upper arm.



**Figures 1a to 1e.** 5-year-old girl (patient No. 5), no plaster cast immobilization and early function permitted. Documentation of flexion (a), extension (b), pronation (c) and supination (d) as well as alignment of elbow (e) 4 weeks postoperatively with the fixator in situ.



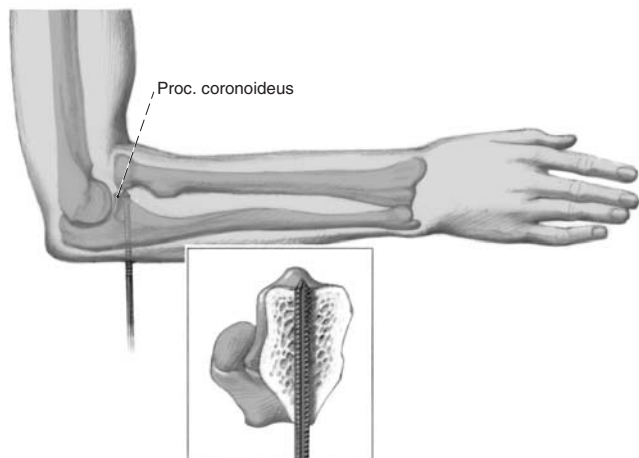
**Figures 2a and 2b.** Hoffman II Compact II® set.

a) Individual parts: two clamps; two bent connecting rods, six Apexpins®, 3 mm in diameter; two yellow-yellow rod-to-rod clamps; two yellow-gray rod-to-pin clamps; two rods.

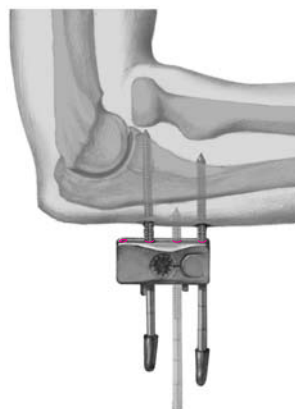
b) Assembled external fixator (see also Figure 13).

### Surgical Technique

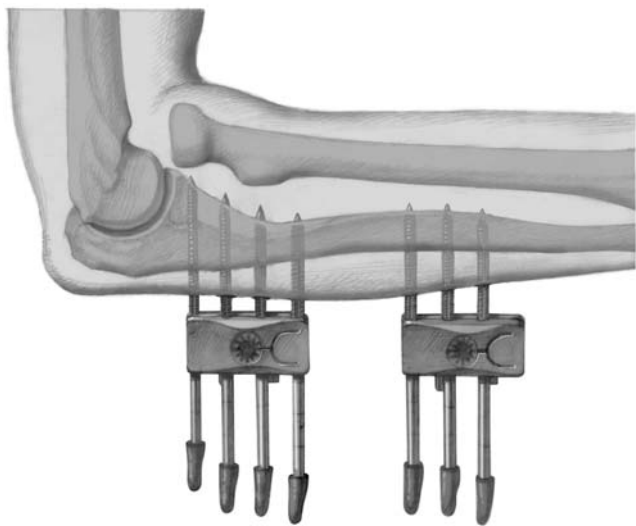
Figures 3 to 13



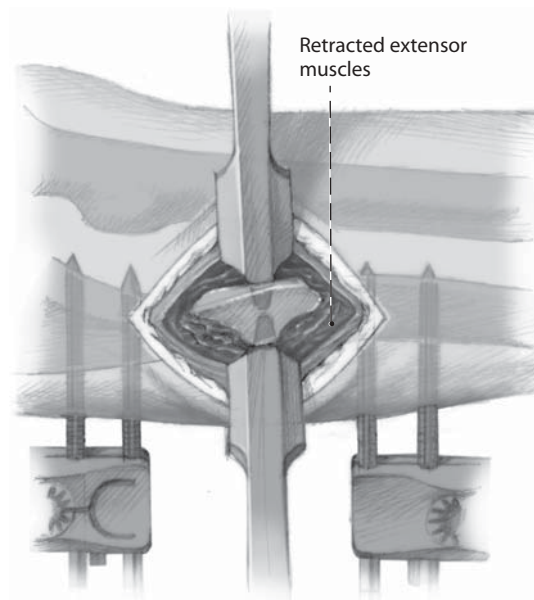
**Figure 3.** Installation of fixator: under image intensification stab incision and insertion of the first Apexpin perpendicular to the longitudinal axis of the ulnar shaft and close to the posterior border in direction of the anterior surface of the ulna. The tip of the pin must exit extraarticularly just distal to the coronoid process.



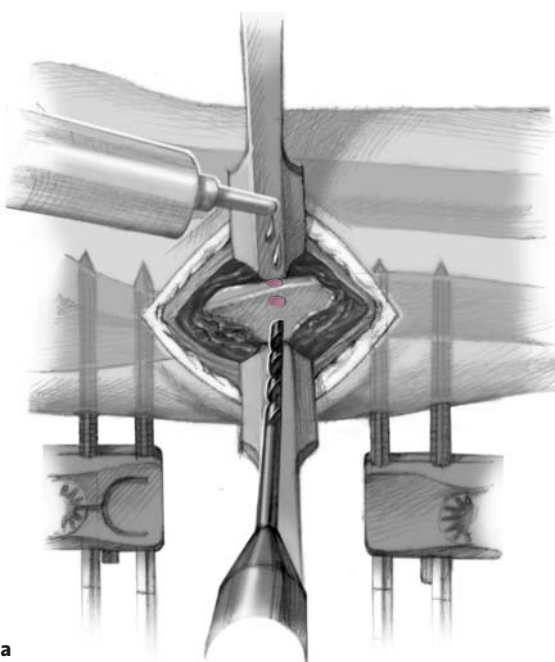
**Figure 4.** A 4-hole clamp is used as a template and inserted over the Apexpin. Through another stab incision, the pin that should be most distally situated is inserted through the clamp into the ulna. Finally, the middle pin is introduced through the clamp. All pins must find purchase in the opposite cortex.



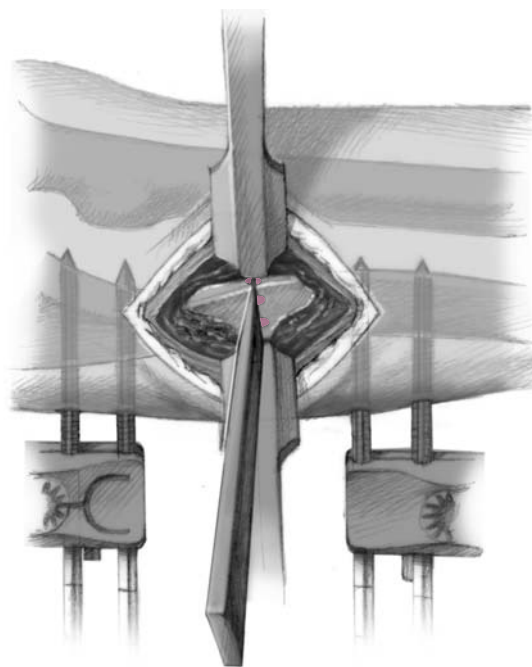
**Figure 5.** In patients > 10 years of age, a fourth Apexpin should be used. In this instance, the clamp has to be moved distally by one hole to allow insertion of the fourth pin, and this is done to avoid its intraarticular placement. Using the same principle, a second clamp is mounted freehand three fingerbreadths distal to the first clamp.



**Figure 6.** Subperiosteal exposure of the ulna through a 3-cm skin incision between both clamps and subperiosteal insertion of two small, blunt Hohmann retractors.



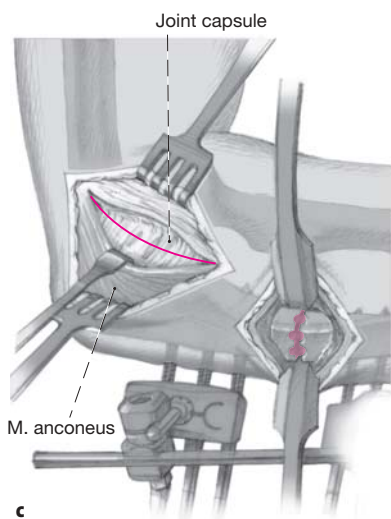
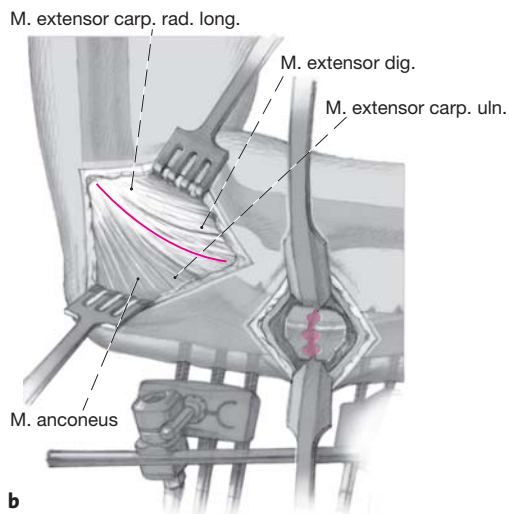
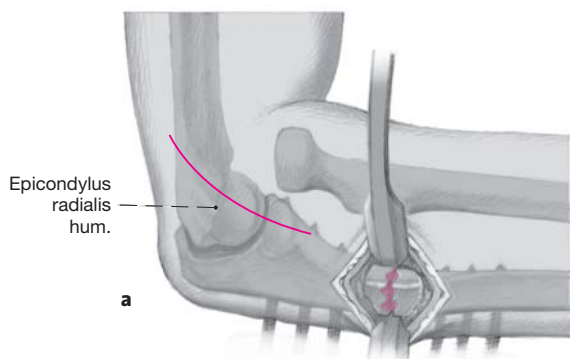
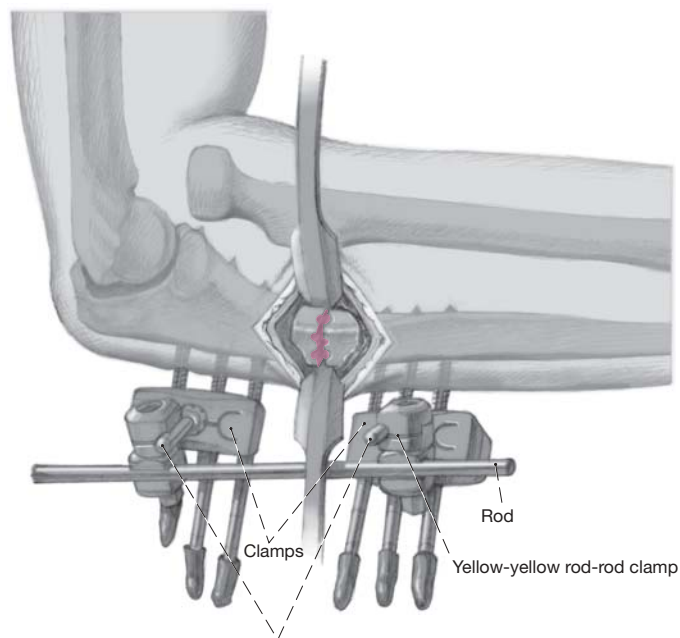
a



b

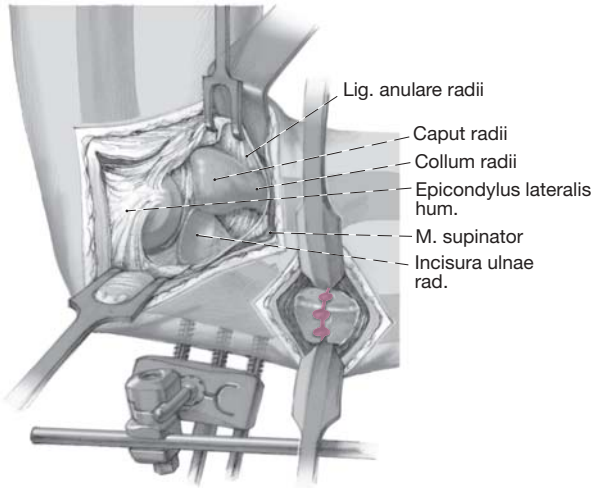
**Figures 7a and 7b.** Ulnar osteotomy. a) Drilling of three drill holes with a 2-mm drill bit under irrigation. b) Transverse osteotomy with a 10-mm chisel.

**Figure 8.** Temporary fixation using two bent attachment rods that are inserted into the star-like hole of each clamp and secured with a hex screw. Now two yellow-yellow rod-rod clamps are slid over the attachment rods. The longitudinal rod is then passed through the clamps bridging both clamps. The rod-rod clamps are mounted on both rods with click mechanism and fastened with a hex screw.

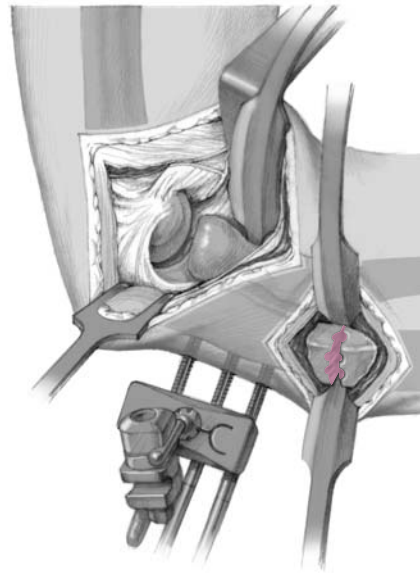


**Figures 9a to 9c.** Reduction of the radial head.

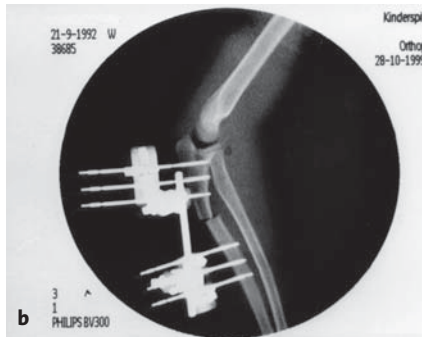
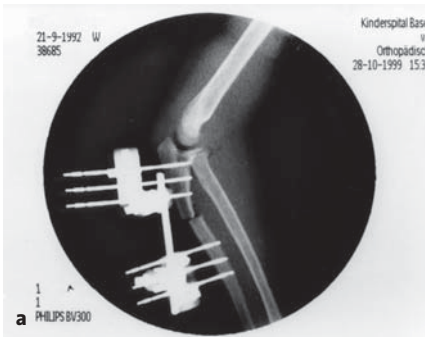
- a) Posteroradial longitudinal incision slightly anterior to the lateral epicondyle.
- b) Division of fascia and deepening between anconeus and extensor carpi ulnaris posteriorly and extensor digitorum and extensor carpi radialis longus anteriorly.
- c) After blunt retraction of the anconeus in a posterior direction, the humeroradial capsule joint is exposed. Longitudinal division of the capsule starting at its humeral origin and extension distally. Exposure of the dislocated radial head.



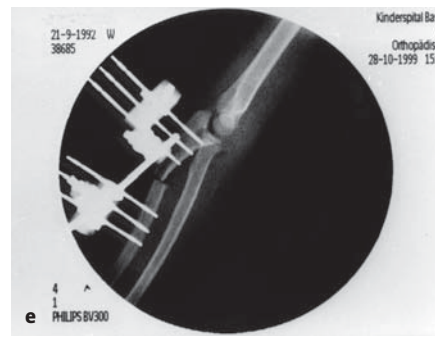
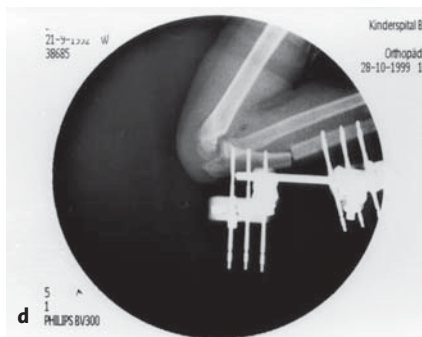
**Figure 10.** Complete excision with a rongeur of the often scarred remnants of the annular ligament up to the articular facet of the ulna. The radial head must be completely freed of scar and fat tissue.



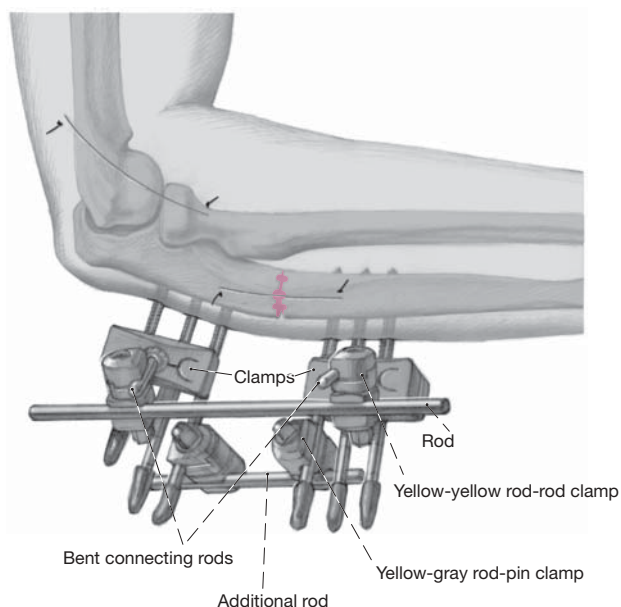
**Figure 11.** Loosening of the hex screw of the fixator to allow a posterior angulation at the ulnar osteotomy and a reduction of the radial head which had been dislocated anteriorly or anterolaterally. Tightening of the clamps with the ulna in a position of posterior angulation. With a blunt, small Hohmann retractor the radial head is kept in the reduced position.



**Figures 12a to 12e.** While holding the radial head in the reduced position with the Hohmann retractor, movements of pro- and supination are performed and the fixator is tightened. After removal of the Hohmann retractor, the exactness of the reduction, particularly during pro- and supination (a to c) and in full flexion and extension (d, e), is checked under direct vision. If during the extremes of these movements a tendency to dislocation is observed, the fixator is loosened, the head kept in a reduced position with a blunt Hohmann retractor, all movements are repeated up to their extremes, and then the fixator is tightened again.



It is sometimes necessary to repeat this maneuver a few times. It may also be necessary to manually increase the angulation of the ulna. Once the reduction of the radial head during pro- and supination under direct vision proves to be satisfactory, the movements of flexion/extension and pro- and supination are checked with the image intensifier in two planes and documented by radiographs.



**Figure 13.** Final tightening of the clamps. An additional gray-gold rod is attached to the pins with pin-rod clamps for improved stability. Resorbable sub- and intracutaneous running suture for closure of the incisions over the ulnar osteotomy and over the humeroradial joint. Around the pin sites, gauze strips are placed. No external immobilization.

**Postoperative Management**

- Immediately after surgery the patient can move his/her arm as much as tolerated. Physiotherapy is not prescribed. First dressing change on day 1. The patient can be discharged as soon as he/she and the parents are familiar with the pin-site care, usually on day 2 or 3.

- Fixator and wounds should be controlled weekly. First radiograph after 4 weeks and recording of the active range of motion. Depending on the findings, the next radiographic control is done 4–6 weeks later. After bony consolidation of the ulnar osteotomy, the external fixator is removed. Depending on the patient’s age, this is usually done under anesthesia, seldom only under sedation.
- Should the range of motion not improve considerably between first and second radiographic control, a careful physiotherapy under the guidance of an experienced physiotherapist should be instituted at the earliest after 8 weeks.

**Errors, Hazards, Complications**

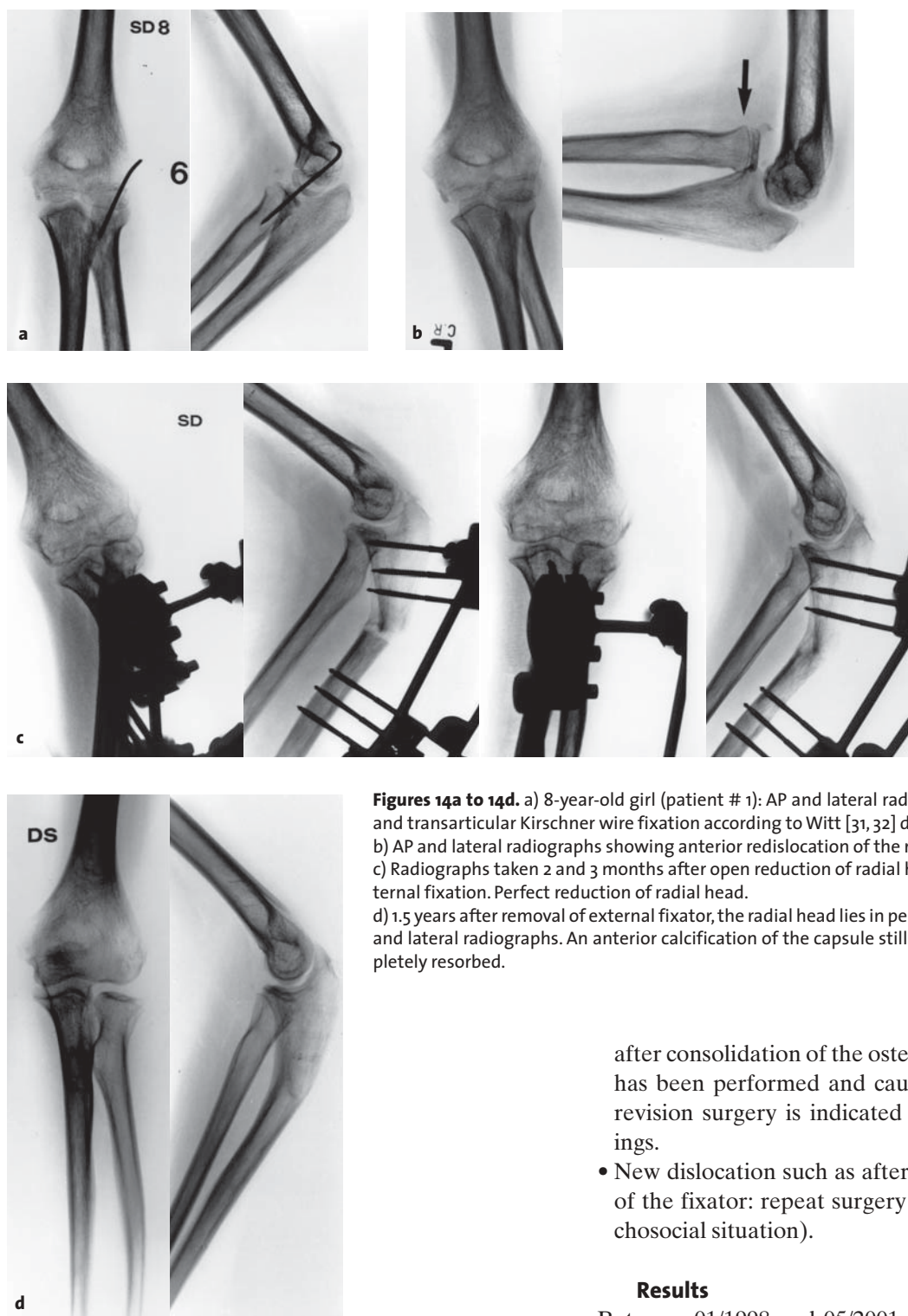
- Pin tract infection or pin loosening: depending on the time of occurrence:
  - change of pin sites and, if necessary, of fixator, curettage of the pin tract; antibiotic therapy based on culture and sensitivity studies;
  - removal of the pin, curettage of pin tract; antibiotic therapy and, if indicated, immobilization in a plaster cast until the osteotomy has consolidated;
  - improved pin-site care;
  - pin loosening without infection (occurs only after several weeks): pin removal and, if necessary, immobilization in a plaster cast until bony consolidation of the ulnar osteotomy.
- Secondary displacement of the osteotomy and, thus, secondary dislocation of the radial head during physiotherapy: do not prescribe physiotherapy and allow patients to move freely. Physiotherapy, if needed, only

**Table 2.** Results. f: female; m: male.

		Follow-up periode (months)	Age at surgery (years)	Interval between trauma and reconstruction	Radial head	Elbow flexion/extension preoperative (°)	Elbow flexion/extension at follow-up (°)	Forearm pronation/supination preoperative (°)	Forearm pronation/supination at follow-up (°)
1	f	14	8	6 months	Reduced <sup>a</sup>	130-20-0	110-10-0	60-0-80	40-0-90
2	m	7	8,5	15 months	Reduced	90-0-0	110-0-0	80-0-80	80-0-80
3	f	3	7	2 weeks	Reduced	100-0-0	140-0-0	90-0-80	90-0-80
4	m	21	7	5 months	Reduced	125-0-10	125-0-10	80-0-80	80-0-80
5	f	44	5	16 months	Reduced	150-0-10	150-0-10	90-0-90	90-0-90
6	f		5	6 months	Reduced				
7	m	11	9	10 months	Reduced	120-0-0	140-0-0	80-0-80	80-0-80
8	f	10	15	7 years	Reduced	150-0-0	150-0-0	90-0-80	90-0-20
9	m	18	9,5	5 years	Reduced	110-0-0	130-0-0	80-0-90	80-0-90
10	f	6	10	1 year	Reduced	140-0-0	140-20-0	80-0-80	80-0-80
11	m	17	6	7 months	Reduced	140-0-0	140-0-0	80-0-80	80-0-80
12	m	20	8	8 months	Reduced	150-0-05	150-0-5	90-0-90	90-0-90
13	f	5	10	2 years	Reduced <sup>b</sup>	130-0-10	140-0-10	80-0-90	80-0-90
14	m	7	15	3 years	Reduced	140-25-0	140-10-0	60-0-40	80-0-20

<sup>a</sup> after redislocation, repeated open reduction, and fixator adjustment; <sup>b</sup> after loss of reduction, repeated closed reduction, and fixator adjustment





**Figures 14a to 14d.** a) 8-year-old girl (patient # 1): AP and lateral radiographs after open reduction and transarticular Kirschner wire fixation according to Witt [31, 32] done elsewhere.  
 b) AP and lateral radiographs showing anterior redislocation of the radial head.  
 c) Radiographs taken 2 and 3 months after open reduction of radial head, ulnar osteotomy, and external fixation. Perfect reduction of radial head.  
 d) 1.5 years after removal of external fixator, the radial head lies in perfect position as seen in the AP and lateral radiographs. An anterior calcification of the capsule still seen in a) to c) has been completely resorbed.

after consolidation of the osteotomy. If physiotherapy has been performed and caused a loss of reduction, revision surgery is indicated depending on the findings.

- New dislocation such as after trauma in the presence of the fixator: repeat surgery (depending on the psychosocial situation).

**Results**

Between 01/1998 and 05/2001, we performed an open reduction of the radial head without ligamentoplasty, and a proximal ulnar osteotomy fixed with an external fixator in 14 patients presenting with a late missed Monteggia lesion (Bado type I). No postoperative immobili-

zation was used. An ulnar lengthening was only required in one patient; in all others the reduction of the radial head posed no problems.

At the time of reconstruction, the average age of the seven girls and seven boys was 9 (5–15) years, and the average interval between index trauma and reconstruction 21 months (2 weeks to 7 years). The external fixator was removed after an average of 12 (7–16) weeks. Clinical and radiologic follow-up of 13 children after an average of 14 (3–44) months. During the clinical follow-up the axial alignment, elbow flexion and extension, and pro- and supination were recorded (Table 2). One girl (No. 6) could not be examined clinically. However, radiographs after 12 months done elsewhere were available and showed a proper position of the radial head and a consolidation of the osteotomy. The examining colleague reported a full range of motion and symmetrical axial alignment of the elbows in this patient.

*Reduction of the radial head:* the reduction was maintained postoperatively in twelve patients. A loss of reduction occurred in two patients (No. 1 and 13). A closed reduction and a fixator adjustment were successfully done in one patient (No. 13) after 2.5 weeks, the other patient required an open reduction after 2 weeks (Figure 14).

*Elbow alignment:* the axial alignment of the elbows was clinically symmetric preoperatively as well as at the time of follow-up.

*Range of motion:* Seven out of 14 patients showed a limited range of motion preoperatively, involving mostly (five times) the flexion. The range returned to normal in four patients and was improved in one. Two patients had an extension lag preoperatively; it had improved at the time of follow-up. A preoperative limitation of forearm rotation deteriorated slightly in one patient, in another patient the pronation improved but was accompanied by an identical loss of supination. The range of motion decreased in four patients postoperatively (once in flexion, once in extension, once a 20° loss of pronation, and once a 60° loss of supination). No correlation could be found between loss of motion and age or interval between index trauma and reconstruction.

*Symptoms:* none of the patients complained about pain either preoperatively or at the time of follow-up.

*Aftercare:* a plaster cast was never used, and the patients were allowed to move their elbow in all planes postoperatively. Physiotherapy was never prescribed. Already during the hospital stay patients and parents were instructed on the daily pin-site care. They were

asked to bathe the arm daily after wound healing (usually after 14 days) or to take a shower.

*Complications:* no complication such as infection, nerve or vessel lesion or pseudarthrosis was observed. All patients were satisfied with the cosmetic and functional result.

Experiences with the described method have not been published by other authors, with the exception of two case histories [6]. Corrective ulnar osteotomies fixed with plates and immobilized in a plaster cast and annular ligament reconstruction with and without transarticular Kirschner wire show an elevated incidence of complications (plate breakage, limitation of range of motion, radioulnar synostoses) and an incidence of redislocation of approximately 25% [10, 16, 18, 23, 24].

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