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FRACTURES OF RADIAL HEAD AND THEIR TREATMENT

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During the last two decades it has become usual to treat undislocated radial head fractures conservatively and severely comminuted, dislocated fractures surgically, by excision of the head of the radius. In addition, early active motion has been used in the treatment. The attitude to fractures of the head of the radius seems to have been significantly influenced by Böhler (1951), who recommended excision when the fragment is larger than one-third of the radial head. Charnley (1961), on the other hand, advocated conservative treatment if there is the slightest doubt concerning the therapy. The importance of early mobilization was emphasized by Neuwirth (1942), Mason & Shutkin (1943), Charnley (1961), and Adler & Shafton (1963). On the other hand, Radin & Riseborough (1966) found that early mobilization may cause dislocation and clearly poorer end results in those cases in which the fragment constitutes half of the radial head and was not initially dislocated.

Prompt excision of the head of the radius in comminuted cases was advocated by Hitzroth (1912), Cutler (1926), Bohrer (1933), Carstam (1951), Castberg & Thing (1953), Mason (1954), and Arner, Ekengren & Schreeb (1957). Removal of a fragment was considered sound therapy by Carstam (1951) and Arner, Ekengren & Schreeb (1957), while this method was strongly rejected by Murray (1940), Watson-Jones (1955), Wagner (1955), and Charnley (1961). In children it seems advisable not to remove the head of the radius, since growth disturbances are likely to result (Murray 1940, Roosvall 1941, Böhler 1951, Carstam 1951, Watson-Jones 1955, Blount 1955).

It should be mentioned that comminution is often worse than the radiograph reveals (Watson-Jones 1955, Wagner 1955, Charnley 1961). In addition, Watson-Jones drew attention to the possibility of fracture

of the capitellum, responsible for later extension-flexion deficiency and the possible presence of a rupture of the capsule at the ulnar aspect. Charnley (1961), too, discussed the possible role of ruptures of the collateral ligament and capsule in the development of extension deficiency, while he believed that pro-supination deficiency results from injury of the radial head. Changes as described above were observed by Arvidsson & Johansson (1955) in arthrographies of radial head fractures. Quigley (1949) recommended aspiration as an initial measure and prompt excision if, after the puncture, limitation of motion and crepitation are observed in connection with passive motion. However, late excision of the radial head is not recommended in the literature owing to poor results (Hitzrot 1912, Murray 1940).

Attention has been attached to the secondary changes that may occur in the wrist following excision of the radial head. Shortening of the radius may cause subluxation of the ulna (Brockman 1930, Lewis & Thibodeau 1937, Dougall & White 1957, Taylor & Connor 1964). Curr & Coe (1946) were the first to describe a case in which subluxation of the distal head of the ulna was primarily present in connection with fracture of the radial head. In 1951, Essex-Lopresti described two such cases.

As is shown in the foregoing, there is considerable diversity of opinion concerning the therapy. Although conservative treatment and early mobilization have become widely adopted, at least in borderline cases, it still seems uncertain whether conservative or surgical treatment is the best. The effect of the duration of immobilization on the results of treatment has not been analysed. The occurrence of dislocation in connection with early mobilization and its significance are other points which seemed to deserve closer study.

MATERIAL

The series consists of patients with fracture of the head of the radius treated at the Clinic for Orthopaedics and Traumatology during the period 1961-1965. Follow-up examinations were attended by 209 patients, i.e. 130 women and 64 men. There were 4 patients who belonged to the group of children during the time of treatment, although the epiphyseal line was already closed. Epiphyseolysis was observed in 11 children.

The age of the patients ranged from 5 to 78 years: 6.2 per cent of patients were under 15 years old, 17.2 per cent 15-24 years old, 72.3 per cent 25-64, and 4.3 per cent over 65. Females outnumbered males 2 to 1. The radial head was fractured in 55 per cent, the left radial head in 45 per cent. There were no obvious sex differences.

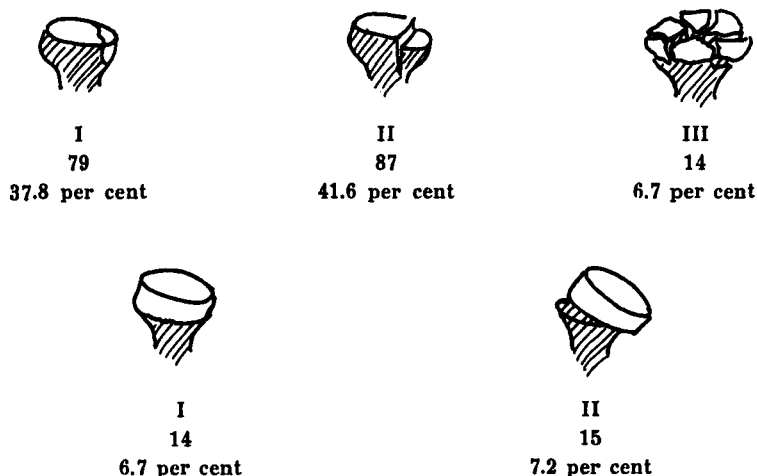


Figure 1. Classification of the fractures of the radial head by degree of severity. I: No dislocation. II: Dislocated. III: Comminuted.

The distribution of the various types and classifications of fractures are shown in Figure 1. As regards the size of the fragment, in the majority of cases the latter was $\frac{1}{2}$ or $\frac{1}{3}$ of the radial head. A fragment size of $\frac{1}{4}$ or $\frac{1}{5}$ was infrequent. The last subgroup consists of cases in which the fracture was in the neck of the radius (in children epiphyseolysis).

Twenty-five patients showed a total of 31 concurrent fractures or dislocations (29 in the elbow joint and 2 Colles' fractures), which may have influenced the end

Table 1. A total of 31 concurrent injuries possibly influencing the end results in 25 patients with fracture of the radial head

Colles fracture of radius	2
Fracture of ulna	2
Fracture of olecranon	2
Fracture of coronoid process	6
Fracture of capitellum	2
Fracture of lateral humeral condyl	3
Fracture of lateral humeral epicondyl	2
Fracture of medial humeral epicondyl	2
Dislocation of elbow joint	10
Total	31

Table 2. *Methods of treatment in the present series*

Adults	Type of fracture	Treatment	Number		
Adults	I	Conservative	90	149	
	II		59		
	II	Excision of radial head	8	16	
	III		8		
	I	Removal of fragment	1	2	
	II		1		
	II	Late excision of radial head	1	2	
	III		1		
	<i>Multiple injuries in elbow joint</i>				
		II	Conservative	16	25
	II	Excision of radial head	4		
	III		5		
Children	I	Conservative	2	15	
	II		2		
	Epiphyseolysis	Open reduction	6		
	Epiphyseolysis		5		
Total			209		

* The epiphyseal line closed.

results of the radial head fractures, and were consequently considered as a separate group. The concurrent injuries are listed in Table 1.

TREATMENT

Table 2 shows the distribution of the series by type of treatment. The treatment was predominantly conservative and included early mobilization. The 50 patients with fracture of degree I were always, those 59 with fracture of degree II usually, conservatively treated. Excision of the head of the radius was performed in 8 cases in group II. All patients in group III were surgically treated. Late excision after two to three months was performed in 2 cases. In the 25 cases in which a fracture of the radial head was treated in connection with the treatment of concurrent injuries in the elbow joint, the procedures carried out included reduction of luxations, osteosynthesis, etc. The head of the radius was excised in 9 instances and conservatively treated in 16. The duration of immobilization was often longer than in the cases

Table 3. Fractures of degree I (no dislocation). Conservative treatment

Estimation of the results	 1/3	 1/2	 2/3	 1/1	Total	%
Good	33	25	1	9	68	75.6
Fair	2	10	1	4	17	18.9
Poor	2	2	0	1	5	5.5
Total	37	37	2	14	90	100.0

showing radial head fractures alone and was dependent on the concurrent injury.

As regards the epiphyseolytic fractures in children, the line of treatment was conservative, a first attempt always being made with closed reduction. Six patients were treated conservatively, 5 operatively.

The results were regarded as good if there was no pain and limitation of movement was a maximum of 10 degrees in one direction; fair if there was occasional pain or limitation of movement by 10 to 30 degrees in one direction; poor if there was continuous pain or limitation of movement by more than 30 degrees. Radiographs were not taken into account in the clinical evaluation, since the clinical results may be better than the radiograph suggests.

Conservative Treatment

The clinical results in the group with fracture of degree I are shown in Table 3. The results were somewhat poorer in subgroup 1/2 than in subgroup 1/3. Table 4 shows the results in those patients with fracture of degree II who were conservatively treated. The results were better in subgroup 1/2 than in subgroup 1/3.

The results showed no correlation to age. The distribution over the different age groups was very even.

In addition, the effect of the method and duration of immobilization on the results of treatment was analysed in group I in the subgroups in which the fragment size was 1/3 and 1/2 of the radial head. As already mentioned, it has been stated in the literature that early active motion therapy may cause secondary dislocation if the fragment is 1/2 of the radial head. For this reason the results in the two subgroups in question are analysed separately.

Table 4. Fractures of degree II (dislocation). Conservative treatment

Estimation of the results	 $\frac{1}{3}$	 $\frac{1}{2}$	 $\frac{2}{3}$	 $\frac{1}{1}$	Total	%
Good	27	15	2	2	47	79.7
Fair	7	0	2	1	9	15.2
Poor	1	1	1	0	3	5.1
Total	35	16	5	3	59	100.0

Table 5 shows the results in the subgroup with a fragment size of $\frac{1}{3}$ of the radial head. Immediate or early mobilization was used in 14 cases. Seven of these patients were treated entirely without an arm sling, while in the remainder the arm sling was used for one week but was removed every day to enable motion therapy. As may be seen in the Table, dislocation was observed after immediate or early mobilization in $\frac{5}{14}$ cases, after two to four weeks' immobilization in $\frac{5}{11}$ patients. The results in the group with a fragment size of $\frac{1}{2}$ of the radial head and no primary dislocation are shown in Table 8: among the patients treated by immediate or early mobilization, $\frac{3}{8}$ showed dislocation, $\frac{2}{9}$ cases dislocated after one week's treatment with a plaster case, and $\frac{11}{20}$ after three to five weeks. The various groups are small, but the results show the same trend irrespectively of whether the fragment

Table 5. Effect of method and duration of immobilization on secondary dislocation. Initially no dislocation was present and the fragment was $\frac{1}{3}$ of the radial head

No. of cases (no dislo- cation)	Immobilization		Secondary dislocation (radiological evidence)	Clinical results			
	Method	Time (weeks)		Good	Fair	Poor	
14	Arm sling	0-1	—	9	8	1	0
			+	5	4	1	0
12	Plaster cast	1	—	10	8	2	0
			+	2	2	0	0
11	Plaster cast	2-4	—	8	8	0	0
			+	3	3	0	0
37				37	33	4	0

Table 6. Effect of method and duration of immobilization on secondary dislocation. Initially no dislocation was present and the fragment was $\frac{1}{2}$ of the radial head

No. of cases (no dislocation)	Immobilization		Secondary dislocation (radiological evidence)	Clinical results		
	Method	Time (weeks)		Good	Fair	Poor
8	Arm sling	0-1	—	5	3	2
			+	3	3	0
9	Plaster cast	1	—	7	6	1
			+	2	1	1
20	Plaster cast	2-5	—	9	7	1
			+	11	5	4
37				37	25	9

was $\frac{1}{3}$ or $\frac{1}{2}$. The tendency towards dislocation seems to be greater when early mobilization are used. The lowest frequency of dislocation was noted after one week's immobilization in a plaster cast. These observations apply only to the radiological state. The clinical results were not impaired owing to secondary dislocation. There were no poor results in those cases in which the fragment constituted $\frac{1}{3}$ of the radial head and only 2 poor in the group with a fragment size of $\frac{1}{2}$.

In group II, $\frac{19}{59}$ primary dislocations disappeared and showed correct position at the follow-up examination.

Excision of the Radial Head

The head of the radius was excised in 25 cases, but only 16 of these showed radial head fractures alone. Nine patients had other concurrent injuries and fractures of the elbow. These cases are considered separately.

Excision of the radial head is mainly performed in order to prevent limitation of pro-supination, when there is a risk of adhesion of the fragments to the annular ligament. In the group of 16 patients showing fracture of the radial head alone, there was no limitation of pro-supination in 7, whereas a deficiency pro-supination by 20 degrees was present in 4, deficiency by 30 degrees in 2, and by 40, 70, and 80 degrees in 3. These cases cannot, however, be compared to the conservatively treated ones because of the difference in severity of the fractures. Among those patients who had other injuries in the elbow joint, only

one showed complete pro-supination as an end result. The remaining 8 showed limitation by 10 to 95 degrees. These results bore a correlation to the concurrent fracture and the total injury.

There is a question as to whether a sufficient portion of the radial head had been removed and as to whether the end results were influenced by this factor. According to the radiographical evidence, excision was not sufficiently extensive in $\frac{5}{16}$ cases. In these, the end result was fair; there remained a limitation of pro-supination by 20, 30, and 30 degrees, respectively. Among those who had had a sufficiently extensive operation, 7 showed complete pro-supination, while 3 had a limitation by 20 degrees and a further 3 had a deficiency of 40, 70, and 80 degrees, respectively.

Complications Due to Excision of the Radial Head

Radio-ulnar subluxation is a complication much discussed in the literature. In the present series it was encountered in 3 instances after excision of the radial head in cases showing fracture of this structure alone and in 3 operatively treated cases in the group with fracture of the radial head concurrent with other injuries in the elbow joint. The displacement ranged from 3–5 mm. In all of the cases the trauma was rather violent. Two patients showed luxation of the antebrachium and one a fracture of the coronoid process. The type of fracture of the radial head does not seem to be decisive. Subjectively there was nothing abnormal in the wrist. All these patients showed normal motion of the carpus.

Radio-ulnar synostosis was encountered in two patients, one of them after partial excision of the radial head. Apparently a lesion of the interosseous membrane and haematoma were the cause. Valgus position has been mentioned in the literature, but in the present series there was only one such case, a patient showing 15 degrees worse valgus position on the operated side. Nearthrosis of the ulna was observed in one patient. In connection with excision of the radial head a small marginal protuberance had remained, which had later become articulated. Secondary osteoarthritis was observed in only two patients, who had sustained very severe multiple injuries of the elbow joint. None of the patients showed myositis ossificans.

The clinical results in the 16 cases of fracture of the radial head alone are shown in Table 7: the fracture was of degree II in 8 cases, of degree III in 8 cases. The size of the fragment appears in the Table.

Table 7. Cases of fracture of degrees II and III, in which the head of the radius was excised

Estimation of the results	 $\frac{1}{3}$	 $\frac{1}{2}$	 $\frac{2}{3}$	 $\frac{1}{1}$	 III	Total
Good	2	1	0	0	3	6
Fair	1	1	0	0	4	6
Poor	2	1	0	0	1	4
Total	5	3	0	0	8	16

The groups are small and no conclusions can be drawn concerning the factors responsible for the poor results. It should be born in mind, however, that the operatively treated fractures as a rule were more severe than the conservatively treated injuries of the same degree. The fragment was larger and dislocation worse.

The results in those 9 cases in which fracture of the radial head was concurrent with other injuries in the elbow joint are shown in Table 8. Since the latter injuries were often more significant and required separate operative procedures, the results cannot be considered representative for fractures of the radial head. The end results were in part dependent on the concurrent injury, which sometimes was extensive damage to the joint involving soft tissue lesions and rupture of the capsule and ligament with intra- and extra-articular haematomas. The results were clearly poorer than in the group with radial head fracture alone, treated by excision of the radial head.

Table 8. Results of treatment after excision of the head of the radius in cases showing fracture of the radial head and concurrent injuries in the elbow

Estimation of the results	 $\frac{1}{3}$	 $\frac{1}{2}$	 $\frac{2}{3}$	 $\frac{1}{1}$	 III	Total
Good	1	1	0	0	0	2
Fair	0	0	0	0	0	0
Poor	1	0	0	1	5	7
Total	2	1	0	1	5	9

Fractures in Children

This group consists of patients in whom the epiphyseal line was still open. Age as such was not a criterion, since there is wide variation in regard to the age at which the epiphyseal line closes. In planning the treatment it is very important to consider the risk of growth disturbances. Six patients on whom closed reduction was performed were followed up. The result was good in 4 cases, fair in 1, and poor in 1. In 4 cases surgical reduction was performed after unsuccessful closed reduction. In these cases the results were good in 1, fair in 1, and poor in 2. In addition, there was one patient who showed dislocated fracture of the head of the radius. Operative reduction was performed and the annular ligament was sutured. The clinical result was good.

DISCUSSION AND CONCLUSIONS

The results of conservative treatment were very good. The results of operative treatment were not equally good, but it should be borne in mind that the fractures which were operatively treated were severe, dislocation and comminution being worse than in the conservatively treated cases. They were clearly not comparable. The immobilization time after excision of the radial head was in some cases unnecessarily long. The results showed no correlation to the immobilization time.

The tendency towards dislocation seems to be greater when early mobilization is used in fractures of degree I. The observations seem to indicate that one week's immobilization in a plaster cast is the best method of preventing secondary dislocation in the treatment of fractures in which the fragment is $\frac{1}{3}$ or $\frac{1}{2}$ of the radial head. The number of cases with a fragment size of $\frac{2}{3}$ of the radial head was too small to allow of any conclusions and no patient with fracture of the neck of the radius was treated by immediate mobilization. The clinical results showed no clear correlation to the use of immediate or early mobilization nor to the use of a short or long period of immobilization. The clinical results were not impaired owing to secondary dislocation by early mobilization in fractures of degree I, contrary to Radim & Riseborough (1964).

In explanation of the good results after one week's immobilization in a plaster cast and the more pronounced tendency towards dislocation after more protracted plaster cast immobilization, it may, perhaps, be suggested that when complete bony union has not yet occurred, active motion therapy of the elbow joint may force the fragments to settle in

the correct position, especially if it is instituted after a week, when a wrapping has formed. In some cases the fractured head of the radius moves inside a smooth, intact annular ligament. It may explain the disappearance of 19 primary dislocations in 59 cases of degree II. The view pronounced above concerning the role of active mobilization applies sometimes in fractures in other connections as well.

The results of this study seem to indicate that conservative treatment is justified in most cases of radial head fracture. Operative treatment seems to be indicated only in fractures with severe comminution. Most fractures of degree II can be successfully treated by conservative methods, but in the absence of a material for comparison it cannot be stated that cases with a marked dislocation of the fragment should be so treated.

The results of treatment were clearly impaired by the presence of concurrent injuries in the elbow joint. Such cases have caused confusion in many reports previously.

The results showed no correlation to age.

The few complications after excision of the radial head did not generally influence the end results.

SUMMARY

The series consists of 209 patients with fracture of the radial head treated at the Clinic for Orthopaedics and Traumatology during the years 1961–1965. The treatment was predominantly conservative. Active motion therapy was commenced early. The effect of the duration of immobilization on the results of treatment is discussed. The clinical results showed no clear correlation to the use of a short or long period of immobilization. The observations seem to indicate that one week's immobilization in a plaster cast is the best method for preventing secondary dislocation. On the other hand, the clinical results were not impaired owing to the occurrence of secondary dislocation after early mobilization. Conservative treatment seemed justified in most cases of radial head fractures. Excision of the radial head was indicated only in fractures with severe comminution.

REFERENCES

- Adler, B. A. & Shafton, G. W. (1963) Radial head fractures. Is excision necessary? *J. Trauma* 4, 115–136.
- Arner, O., Ekengren, K. & Schreeb, T. (1957) Fractures of the head and neck of the

- radius. A clinical and roentgenographic study of 310 cases. *Acta chir. scand.* 112, 115-134.
- Arvidsson, H. & Johansson, O. (1955) Arthrography of the elbow-joint. *Acta radiol. (Stockh.)* 43, 445-452.
- Blount, W. P. (1955) *Fractures in children*. Williams & Wilkins, Baltimore.
- Bohrer, J. V. (1933) Fractures of the head and neck of the radius. *Ann. Surg.* 97, 204-208.
- Brockman, E. P. (1930) Two cases of disability at the wrist joint following excision of the head of the radius. *Proc. roy. Soc. Med.* 24, 904.
- Böhler, L. (1951) *Die Technik der Knochenbruchbehandlung*. Maudrich, Wien.
- Carstam, N. N. (1951) Operative treatment of fracture of the head and neck of the radius. *Acta orthop. scand.* 19, 502-526.
- Castberg, T. & Thing, E. (1953) Treatment of fractures of the upper end of the radius. *Acta chir. scand.* 105, 62-69.
- Charnley, J. (1961) *The closed treatment of common fractures*. Livingstone, Edinburgh & London.
- Curr, J. F. & Coe, W. A. (1946) Dislocation of the inferior radio-ulnar joint. *Brit. J. Surg.* 34, 74-77.
- Cutler, C. W. (1926) Fractures of the head and neck of the radius. *Ann. Surg.* 83, 267-268.
- Dougall, A. M. & White, J. (1957) Subluxation of the inferior radio-ulnar joint complicating fracture of the radial head. *J. Bone Jt Surg.* 39-B, 278-287.
- Essex-Lopresti, P. (1951) Fractures of the radial head with distal radio-ulnar dislocation. Report of two cases. *J. Bone Jt Surg.* 33-B, 244-247.
- Hitzrot, J. M. (1912) The treatment of simple fractures. A study of some end results. *Ann. Surg.* 55, 338-367.
- Lewis, R. W. & Thibodeau, A. A. (1937) Deformity of the wrist following resection of the radial head. *Surg. Gynec. Obstet.* 64, 1079.
- Mason, J. A. & Shutkin, N. M. (1943) Immediate active motion in the treatment of fracture of the head and neck of the radius with a review of one hundred cases. *Surg. Gynec. Obstet.* 76, 731-737.
- Mason, M. L. (1954) Some observations on fractures of the head of the radius with a review of one hundred cases. *Brit. J. Surg.* 42, 123-132.
- Murray, R. C. (1940) Fractures of the head and neck of the radius. *Brit. J. Surg.* 28, 106-118.
- Neuwirth, A. A. (1942) Nonsplinting treatment of fractures of elbow joint. *J. Amer. med. Ass.* 118, 971.
- Quigley, T. B. (1949) Aspiration of the elbow joint in treatment of fractures of the head of the radius. *New Engl. J. Med.* 240, 915-916.
- Radin, E. L. & Riseborough, E. J. (1966) Fractures of the radial head. *J. Bone Jt Surg.* 48-A, 1055-1064.
- Roosvall, A. (1941) Uber Fractura Colli Radii bei Kindern. *Acta chir. scand.* 85, 540-546.
- Taylor, T. K. F. & O'Connor, B. T. (1964) The effect upon the inferior radio-ulnar joint of excision of the head of the radius in adults. *J. Bone Jt Surg.* 46-B, 83-88.
- Wagner, C. J. (1955) Fractures of the head of the radius. *Amer. J. Surg.* 89, 911-913.
- Watson-Jones, R. (1955) *Fractures and joint injuries*. Livingstone, Edinburgh.