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Elbow dislocation in children. A retrospective study

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Introduction

Traumatic elbow dislocations are rare in children but first among all pediatric joint dislocations, and represent about 3%- 6% of all elbow injuries [1]. They occur most frequently around 10 years of age [1, 2]. The outcome is good most of the time with full recovery of elbow function. Complications are rare but include vascular and nervous injuries [3].
The classification of the type of dislocation is referred to the position of the proximal radio-ulnar joint with regards to the distal part of the humerus [1]. The dislocation can be posterior, anterior, medial or lateral, and rarely divergent or convergent [1].
The most common dislocation is posterior and an associated fracture is described in 50-70% of the cases [4,5].
A fracture of the medial epicondyle, also named epitrochlea, occurs in 30-40% of elbow dislocations [1, 5-7].
Diagnosis concerning an eventual fracture can be difficult because of the occurrence of the ossification centers and their subsequent fusion [4, 5, 7]. The first ossification center to appear is the capitellum, at the age of one or two. Then follows the radial head between two and four years of age, the medial epicondyle at four to six years, the trochlea at nine to ten years with the olecranon from nine to eleven years and finally the lateral and then medial epicondyle at ten to twelve years [4].
Most of the time the pediatric elbow is incompletely ossified when the injury occurs. Recognizing the severity of the injury requires a high index of suspicion especially with regards to treatment [8].
There is ample descriptive literature focusing on different types of dislocation with and without concomitant fractures [1, 7, 9], but the relationship between problems encountered during reduction, type of dislocation and long-term outcome are not yet clearly defined.
The aims of this study were to identify various factors influencing the outcome of children who suffered an elbow dislocation.

Material and Methods

Data source and definitions

Following approach of the ethical committee all children below 16 years who had elbow dislocations with or without concomitant fractures between the 1st January 2000 and the 1st June 2013 were retrospectively included in this study at the UPCOT department of the Pediatric Hospital in Lausanne. Monteggia lesions and recurrent dislocations were excluded. The age at injury time, the type of dislocation, the type of concomitant fracture, the treatment (surgery or conservative), the duration having a long arm cast and the evolution of the range of motion (ROM) in time were recorded and analyzed. All imagery (RX) was re-viewed and confronted to the pre-operative and post-operative diagnosis.
Functional outcome was evaluated by direct measures of the ROM at the end of the treatment. Flexion and extension ROM was retrieved from measured data during follow-up appointment.
When known, the mechanism of injury was recorded. Medical records were reviewed with regards to the description of the reduction process and possible difficulties in achieving adequate repositioning of the joint. The dislocation was classified according to

the position of the ulna into posterior, anterior, lateral, medial or divergent. The proximal radio-ulnar block was assessed with regards to possible divergent dislocation. Any associated fracture was identified and classified according to the AO classification of long-bone fractures and its treatment modality recorded.
The standard of care that directed the management of those injuries in our hospital were pre- and post-reduction radiography, reduction under general anesthesia and CT-scan when in doubt regarded associated fracture. The simple medial epicondyle fractures identified prior to reduction were treated surgically, except when back to the anatomical position following the closed reduction. The patients with minimal displaced fractures were treated non-surgically.
The recommended immobilization was two weeks in a long-arm cast. This time was extended to four weeks if a fracture was present.
The clinical follow-up was done by "Neutral-0-Method" for measuring the ROM. We reviewed all data concerning the elbow joint function in flexion and extension as in pronation and supination. The data about the stability of the elbow in varus and valgus was also collected and the vascular and neurologic function was considered. All those findings were compared to the corresponding data of the non-affected side.
In our data review more than 10° of elbow motion limitation was considered significant based on the study of Carlioz and Abols's [2] which described four different categories regards the recovery in ROM:
If the final loss in ROM is less than 10° it can be considered as an excellent outcome. Between 10°-30° it is described as a good outcome. Between 30° and 45° it is a fair outcome and above 45° of final loss in ROM is considered as a poor outcome.
Progression of recovery during time was also analyzed.
Patients with lack of data regards they ROM recovery were excluded of our statistical analysis. As we had not enough data concerning the deficit in pronation and supination we did not analyze this data. The same applies to the deficit in varus and valgus.

Statistical analysis

Continuous variables were presented as mean±SD if their distribution is approximately normal and as median (IQR[1] or Q1-Q3) range otherwise. The means were compared using the t-test and differences in medians were evaluated using the Mann-Whitney test. Categorical data were expressed as frequency (percentages) and were compared using the $\chi 2$ test or Fisher's exact test, when appropriate. We used the Spearman correlation when we assessed the deficit as a continuous variable. Furthermore, due to the fact that an important part of the sample presented no deficit (Figure 1), we evaluated the influence of different factors on the loss of amplitude using both, a univariate and a multivariate zero-inflated Poisson regression model.
The zero-inflated Poisson regression was used being the most appropriate test to analyze two components with regards the ROM. The first one was the presence or the absence of ROM deficit (zero component), while the second factor was related to the amount of ROM deficit when clinically relevant (Poisson component). The loss of amplitude could thus be modeled as a function of specific variables that reflected either one or both of the mechanisms. The standard errors were computed using robust interference in order to account for the presence of outliers and the instability introduced by the mixture components model [25, 26]. Baseline and clinical

[1] In descriptive statistics, the **interquartile range** (**IQR**), also called the **midspread** or **middle fifty**, is a measure of statistical dispersion, being equal to the difference between the upper and lower quartiles [28].

characteristics were only included in the multivariate model, when the coefficient presented a p-value<0.250 in both the zero and the Poisson component of the univariate model. The variable selection was performed separately for both components of the zero-inflated Poisson regression model: the zero component only included the variables where the coefficient presented a p-value < 0.250 in the univariate model, whereas the Poisson component included the variables from both components. All hypotheses were two-sided and a p-value < 0.05 was deemed statistically significant. The analyses were performed using Stata version 13.1.

Results

Baseline characteristics and clinical outcomes

Among the 83 identified children, 2 with recurrent dislocation and 8 with a Monteggia lesion were excluded. Among the remaining 73 children, there were 30 girls and 43 boys (1:1.2), including one boy with bilateral non-simultaneous dislocations.
The median age of the patients at the moment of the injury was 10 years (IQR 9-13). The youngest child was five years old and the oldest one 15. There were 42 (56.7%) dislocations on the left side and 32 (43.2%) on the right side.
In three cases the dislocation was reduced spontaneously although one of the three was only partially spontaneously reduced and was finally hard to reduce.
Amongst the 74 cases of dislocations, 44 (59.4%) were treated conservatively, including 43 (58.1%) under general anesthesia and one (1.3%) under conscious sedation. Thirty patients (40.6%) needed intraoperative repositioning as also osteo-synthesis.
The median duration of immobilization was 4 weeks (IQR: 1). The ablation of the osteo-synthesis material was performed after a median of seven weeks (IQR: 3.25). At the moment of the ablation of the osteo-synthesis material all fractures were healed.
Among the 58 patients having a full data collection concerning the evolution of their ROM (table 1), 22 (37.9%) had a significant loss of ROM.

[Fig. 1]

The most common movement limitation was combined limitation in flexion and extension (11 patients; 19%). There were seven patients (11.6%) who had only an extension deficit and two (3.5%) who had only deficit in flexion. The medium ratio of ROM deficit was 28°.

[Table 1]

When the ROM deficit was ≥10° the patients also had a longer follow up, with a median of 22 weeks (IQR 12-52) vs. 12 weeks (IQR 8-52) when the outcome was good. There were 15 patients (68.2%) with a concomitant fracture and a poor outcome considering their ROM and 20 patients (55.5%) with good outcome. Four children had complications and a ROM deficit (18,2%) and 10 (27.8%) presented complications although they had no ROM deficit.
Out of 58 patients, six (11.3%) had a complicated reduction and three (13.6%) of them had a significant ROM deficit as the other three (8.3%) had a good outcome.

[Table 2]

An isolated elbow dislocation was found in 28 (37.8%) cases.
Posterior dislocations were the most common ones, with 42 cases (56.7%).
There were seven lateral (9.45%), one anterior (1.3%) and one divergent dislocation (1.3%). There were 23 cases (31.1%) without precisions regards the type of dislocations.
Amongst the 42 posterior dislocations, 37 had a complete ROM follow up: 16 had a significant deficit (≥10° of loss in ROM) and 21 had an excellent ROM recovery. With regards to the six lateral dislocations, two had a significant ROM loss and one had a good ROM recovery. The other three lateral dislocations had no data concerning ROM recovery. The medial, anterior and divergent dislocations had all three no significant deficit in regards of their ROM.

Amongst the 74 cases of dislocation, 46 (62.2%) had an associated fracture. When a concomitant fracture was documented, 29 patients (63%) presented a fracture of the epitrochlea and eight a fracture of the lateral epicondyle (17.4%). There was one fracture of the epitrochlea combined with a fracture of the lateral epicondyle, one fracture of the capitellum, one fracture of the coronoid process, one fracture of the capitellum and the coronoid process, one of the humeral plate, one of the distal radius, one metaphysal and radial neck fracture, one fracture of the radio-ulnar metaphysis and one osteo-ligamental avulsion.

Considering the evolution of ROM recovery with a concomitant fracture of the elbow joint, 17 patients were treated with simple closed reduction and a cast, amongst which five (31.2) presented a deficit in ROM and seven (43.7%) had a good outcome regards their ROM.
29 patients (63.6%) with a concomitant fracture were treated with surgery and eleven (25%) presented a deficit in ROM, 13 (29.5%) did not.

[Table 3]

There were complications in 16 cases (23.5%) out of 68 with regarding follow-up (table 3, Fig. 5). Eight patients (11.8%) presented neurological complaints, and two (1.5%) severe calcifications with a loss in his ROM of 25°, whom which one had a concomitant fracture and the other one didn't. There was one patient with bicipital tendinitis one year after injury. There were also three patients (4.4%) with instability; all of them had a concomitant fracture of the epitrochlea, of which one was treated conservatively. One of the two treated surgically presented chronic pain after five years. Two patients (2.9%) presented vascular injury. One of them had a dissection of the humeral artery and the other patient had an occluded humeral artery. The patient with the dissection was referred to vascular surgery, treated with venous bridging and had a good outcome.

[Table 4]

Amongst the 42 posterior dislocations, 40 (85.4%) had full data concerning complications (Table 4). Seven (77.8%) of the suffered from complications and 34 patients (87.2%) had no complications. Regards the six lateral dislocations, two had complications. One of them had also a deficit in ROM, the other one had no data

concerning his ROM recovery. The medial, anterior and divergent dislocations had all three no complications.

Patients with isolated elbow dislocation

There were 28 patients (37.8%) who had simple dislocations without concomitant fractures. Within those patients there were ten girls (35.7%) and 18 boys (64.3%). The median age was 10.5 years (IQR: 8-13.5).
All patients were treated conservatively except for one patient who had a humeral artery dissection.

Among the 28 patients, two had a medial laxity and a positive Tinnel-test.
Within those 28 patients two had complications (7.1%): One with bicipital tendinitis and one with artery dissection.

Of the 28 patients with isolated elbow dislocation, 23 had full data collection concerning the ROM measurements. The most common movement limitation was combined limitation in flexion and extension (21.7%; five patients). There were three patients (13%) who had an extension deficit only and none with an isolated deficit in flexion. No patient presented a deficit in hyperextension.
Seven patients out of 23 (30.4%) revealed relevant movement deficiency, e.g. equal or more than 10° of amplitude loss. Sixteen fully recovered (69.6%).
The maximum ROM deficiency was 80° with a medium ratio of 33°.

Patients with associated elbow fractures

There were 46 cases (62.2%) that had elbow dislocations with concomitant fractures. There were 20 girls (43.5%) and 26 boys (56.5%). The median age was of 10 years (IQR: 9-13).

[Fig 6]

The most common fracture was the fracture of the epitrochlea with 29 cases (63%) of which one had also a radial neck fracture. Second most common fracture was the fracture of the lateral epicondyle (eight patients; 17.4%).
Within the 46 cases of associated elbow fracture, 38 had complete data collection concerning the ROM measurements. The most common movement limitation was combined limitation in flexion and extension (17.4%; eight patients). There were five children (14.3%) who had only an extension deficit and two who had only a deficit in flexion (5.7%). Two patients had an isolated deficit in hyperextension.
There were 17 patients out of 37 (45.9%), with significant movement deficiency.
20 fully recovered (54%).
The maximum movement deficiency was 35° with a medium ratio of 17.3±8.8°.
Of the 46 cases of dislocation with concomitant fracture, three had complications (6.5%): One patient with articular instability, one with initial paresthesia and one with laxity and an irritation of the ulnar nerve provoking paresthesia. Both patients suffering from paresthesia fully recovered.
17 patients were treated non-surgically, with closed reduction and immobilization (37.0%) and 29 were treated with surgery (63.0%).

Patients with associated fractures treated conservatively

Of the 16 patients treated conservatively, the data about the loss of ROM was available for 12. There were nine fractures of the epitrochlea, one of the olecranon, one supracondylar, one radial head, one coronoid and three other king of fractures.
Six of the conservatively treated fractures (46.2%) had a loss of ROM between 10° – 35°. The average ROM deficit among the 12 patients was 16±8.3°.

Patient with associated fractures and surgery procedures

Within the 29 who benefited surgery, the loss in ROM was available for 24. Eleven had a loss in their ROM (45.8%) and among them the maximum loss was 30° and the minimum 10° (the average ROM deficit was 18±8.2°).
There was no statistically significant difference between patients treated non-surgically and surgically concerning their ROM recovery (p=0.622).

Factors influencing the deficit in ROM

The influence of the different factors on the outcome was analyzed using zero-inflated Poisson regression and by considering the loss in flexion, extension and hyperextension. If we look at the deficit in ROM as a continuous variable (Fig. 1), more than 50% of the children had no deficit at all (median of deficit in ROM=0; IQR=0-15).

[Table 5 and 6]

Each additional year influences the recovery negatively (Poisson component). This effect of age appears when controlling for other factors (p=0.003), as shown in Table 6 presenting the multivariate model. Each additional year of age increases by 1.1° the loss in amplitude (p=0.003). Having a complicated reduction reduces by 0.55° the expected amount of loss in amplitude (p=0.001) while holding all other variables in the model constant. A concomitant fracture reduced by 0.70 the expected degrees of loss in amplitude (p=0.014).

The time of full elbow motion recovery

During the first 4 weeks after injury, more than 50% of our patients had a limitation in the ROM of 80°.
In the following two to three weeks, more than 50% of our patients had a total deficit of 40° and dropped beyond 40° two month after injury.

[Fig. 2-4]

Discussion

Results compared to literature

A traumatic dislocation of the elbow is a quite rare event in childhood although it is the most common among all pediatric joint dislocations.
This retrospective review includes fairly large retrospective elbow dislocation data because our hospital is a referral center but also a primary care center.
Only 10 patients (12%) were lost on follow up, which is low and illustrates the quality of care and commitments of patients and parents to come to the follow up.
As found in the literature there were also more male patients (58.9%) who had elbow dislocations than females (41.1%) and mean age of elbow dislocation was 10.6±2.7 years as described in literature [8,10].
The luxation was posterior (56.7%) most of the time and needed active closed reduction in 85.1% of the cases. There was often a concomitant fracture associated to the dislocations (62.2%). This data is similar to what was described in literature [6, 10].
Similarly the most common fracture affected the epitrochlea (63%). The second most common affected the lateral epicondyle (17.3%). By injury of the epitrochlea there is rarely a growth disturbance [11], as it does not interfere with longitudinal growth and because the cartilage cap of the epiphysis is thicker than in other articulations [4]. Never the less it should be noticed that the injured epitrochlea corresponds to ligamentary injury and causes instability and a tendency to repeated dislocation [12], as also a high risk for ulnar neuropathy [23].
There were 3 cases of instability of which one with chronic pain after 5 years. An appropriate treatment of this kind of lesion should be assessed with for example physiotherapy. There was no long-term ulnar nerve injury, although 29 patients had a fracture of the epitrochlea.
Consistent with previously published reports, the most common adverse sequel of simple elbow dislocation is the combined loss of flexion and extension. The same applies to the most common sequel of complicated elbow dislocation.
In the literature the most common squeal is a loss of extension [13].
Reduction was difficult only in cases of pediatric elbow dislocation with an associated fracture. A cause for difficult reduction found in literature may be a cartilaginous flap lifted from the articular surface of the ulna or other soft-tissue interposition [3, 4]. If a concomitant fracture is present, special attention should be paid during the recovery period, as it has an influence on the full recovery of the ROM.
Although it is outlined in literature that if there is a surgery procedure the ROM recovery is less good [5], it should be mentioned that is not possible to tell if this is caused by the surgery or by the displaced fractures causing more damage to the joint or reflecting a more severe injury mechanism.
This study did not allow to judge were there should be proceeded to surgery or not. Although the statistical analysis revealed some gain in the ROM of children who suffered from elbow dislocation with a fracture or children treated by surgery this gain was not clinically significant, never the less this confirmed that an associated fracture or surgical treatment were not associated with a poor final ROM. However operative-treatment is absolutely necessary in displaced fractures [8]. There is a discussion concerning when to proceed to surgery regards minimal displaced fractures. For minimal displaced fractures (<2mm) it is often advised to treat non-operatively [14,15, 19, 20] although there are discussions to proceed to surgery even for minimal displaced fractures [16,1].

We applied radiographies in anterior-posterior and in lateral view. A study from Kwan and Chul [22] suggested that an internal oblique view was also necessary for an optimal evaluation of the amount of displacement and stability of lateral condylar fractures. Further radiological evaluation such as CT or MRI was mainly performed to better assess the fracture of the condyles and allow appropriate management. In very young children MRI may help in evaluating the non-ossified medial epicondyle.
The computer tomography is especially useful if the fracture is partial or if there are various fragments that can superpose [19].
Osteo-chondral lesions associated with elbow dislocation are quite rare but should be always looked for. Any abnormal bony interposition in the elbow joint mandates further imaging such as MRI looking for osteo-chondral lesions-[18].
MRI may show cartilaginous fragments and reveals the importance of magnetic resonance to evaluate the articular surfaces and integrity of ligaments and capsular structures [5].
Our most serious complication, the vascular injury, occurred in a case with posterior dislocation without any concomitant fracture. The radial artery was occluded and an MRI showed a dissection. The child was referred to vascular surgery for a venous graft and had a good outcome.
The other vascular injury occurred in a dislocation with an open fracture. The hand was warm but the radial pulse was absent. The day after injury a Doppler was performed and revealed a permeable artery. After two years an ultrasound showed vast collateral network.
Two vascular injuries were encountered, which is in accordance with literature very rare [2, 21].
As in the two described cases of this series, brachial artery can be injured with closed or open elbow dislocation with our without an associated fracture. The radial pulse should always be assed following elbow dislocation and if absent further imaging should be performed.
In our study an associated fracture and a complication were not associated with a poorer final ROM. One hypothesis would be that the follow up of those patients was maybe more thorough and that they benefited of more intense physiotherapy.
Concerning the elbow immobilization the minimal duration was 1.5 weeks and maximum 6 weeks.
Afterwards two months of mobilization were necessary to observe a median ROM limitation of 38.2°(IQR: 7 – 70°). Interestingly the literature supports long-term full recovery of ROM [23], although it is more discrete [10].

Concluding on this data, reduction was difficult only in cases of pediatric elbow dislocation with an associated fracture. Concomitant fractures, surgery procedures and complications were not associated with a poor outcome and two months of mobilization were necessary to observe a median ROM limitation of 38.2°(IQR: 7 – 70°).

What could be done in further research

It would be interesting to evaluate the patients on a long term after injury, to see if there is any further recovery possible. Another question is if the patients who recover more slowly are predictive for a poorer outcome and should have more intense rehabilitation.

Concerning the evolution of recovery in time it could be interesting to analyze if the patients with a poor evolution after those critical 2 month could benefit of intense physiotherapy.
In further investigations patients may be contacted to collect new data a few years after injury and evaluate the cases with the Mayo Elbow Performance Score [27].

Limitations

As it was a retrospective study there was incomplete data concerning follow up for some patients, the exact measurements of the amplitude of movement as the comparison with the other arm. There was a regular follow-up, which included many appointments and few patients were lost during this time.
The Data came from one single institution with good written transcription of clinical assessment and possible adverse events. The management was homogeneous and performed by trained surgeons.
Never the less the ROM was not measured systematically or only mentioned as normal and the information about difficult reduction was scarce.

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Tables and Figures

Table 1: Distribution of cases with or without ROM deficit with regards to gender, age, difficulty in reduction, concomitant fractures, complications, length of immobilization and duration of follow-up

	Overall	With ROM deficit	Without ROM	p-value
N (%)	58	22 (37.9)	36 (62.1)	
Girls: n (%)	23 (38.3)	10 (45.4)	13 (36.1)	0.665
Age (years): median (IQR)	10 (9-12.5)	11 (9-12.5)	9 (8-12.5)	0.124
Difficult reduction: n (%)	6 (11.3)	3 (13.6)	3 (8.3)	0.683
Concomitant fracture: n (%)	35 (60.3)	15 (68.2)	20 (55.5)	0.233
With complications: n (%)	14 (23.3)	4 (18.2)	10 (27.8)	0.368
Cast BAB (weeks): median (IQR)	4 (3-4)	4 (3-4)	4 (3-4)	0.468
Follow up (weeks): median (IQR)	12 (8-52)	22 (12-52)	12 (8-52)	0.553

Table 2: Distribution of type of dislocation with and without ROM deficit

Type of dislocation	n	With ROM deficit: n(%)	Without ROM deficit: n(%)
Posterior	37	16 (43.2)	21 (56.7)
Lateral	4	2 (50.0)	2 (50.0)
Anterior	1	0 (0.0)	1 (100.0)
Divergent	1	0 (0.0)	1 (100.0)

Table 3: Distribution of complications with regards to age, gender, difficult reduction, concomitant fracture, cast duration and follow-up

	Overall	With complications	Without complications	p-value
N (%)	68	16 (23.5)	52 (76.5)	
Girls: n (%)	27 (39.7)	9 (56.3)	18 (34.6)	0.122
Age (years): median (IQR)	10 (9-13)	10.5 (9-13)	10 (8-12)	0.389
Difficult reduction: n (%)	7 (11.5)	3 (21.4)	4 (8.5)	0.335
Concomitant fracture: n (%)	44 (64.7)	13 (81.3)	31 (59.6)	0.113
Cast BAB (weeks): median (IQR)	4 (3-4)	4 (3-6)	4 (3-4)	0.302
Follow up (weeks): median (IQR)	12 (8-40)	24 (12-72)	12 (7-36)	0.037

Table 4: Distribution of type of dislocation with and without complications

Type of dislocation	n	With complications (%)	Without complications (%)
Posterior	40	7 (17.5)	34 (85.0)
Medial	1	0 (0.0)	1 (100.0)
Lateral	6	2 (33.3)	4 (66.6)
Anterior	1	0 (0.0)	1 (100.0)
Divergent	1	0 (0.0)	1 (100.0)

Table 5: Univariate zero-inflated Poisson regression analysis of ROM deficit regards gender, age, difficult reduction, concomitant fracture, complications and duration of immobilization

Characteristics	Poisson regression (95%CI)	p-value
Girl	1.10 (0.64;1.89)	0.735
Age (years)	1.07 (0.90;1.28)	0.434
Difficult reduction	0.52 (0.29;0.95)	0.034
Concomitant fracture	0.50 (0.28;0.90)	0.020
Complications	0.62 (0.33;1.16)	0.133
Cast BAB (weeks)	0.75 (0.54;1.05)	0.092

Table 6: Multivariate zero-inflated Poisson regression regards age, difficult reduction, concomitant fracture, complications and duration of cast.

Characteristics	Poisson regression (95%CI)	p-value
Age (years)	1.08 (1.03;1.14)	0.003
Difficult reduction	0.55 (0.39;0.80)	0.001
Concomitant fracture	0.70 (0.53;0.93)	0.014
Complications	0.82 (0.63;1.08)	0.153
Cast BAB (weeks)	0.84 (0.75;0.95)	0.004

Fig. 1: Distribution of patients with regards to their final ROM deficit (n=58)

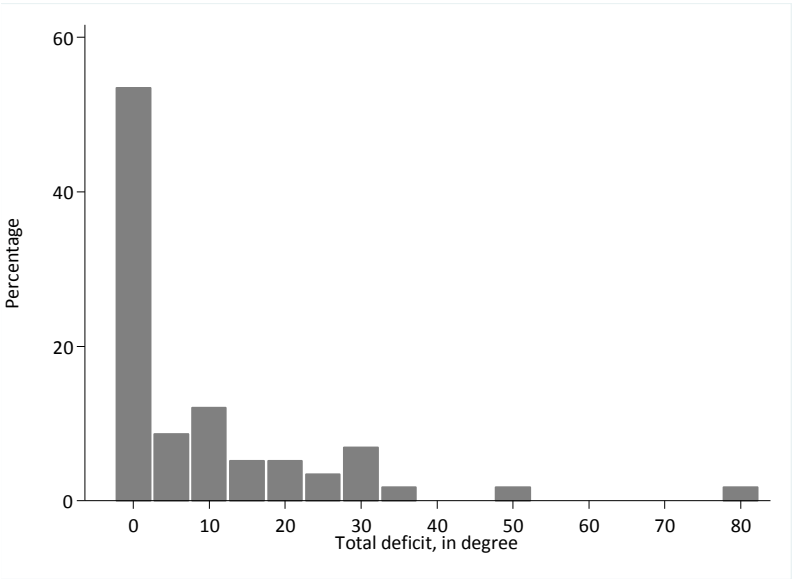


Fig 2. Evolution of the flexion angle over time

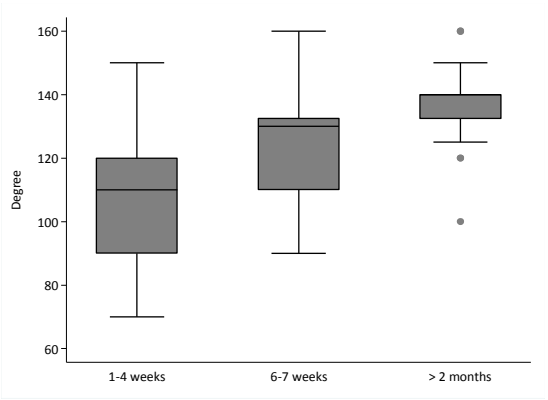


Fig 3. Evolution of the extension angle over time

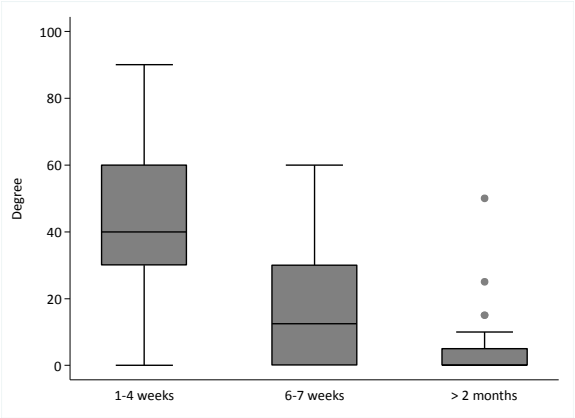


Fig 4. Evolution of total ROM limitation over time

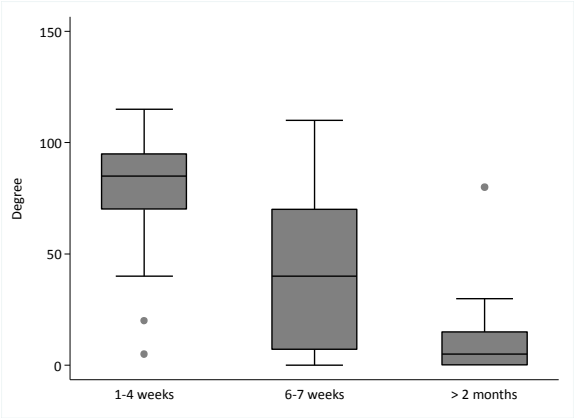


Fig. 5: Distribution of type of complications (n=16)

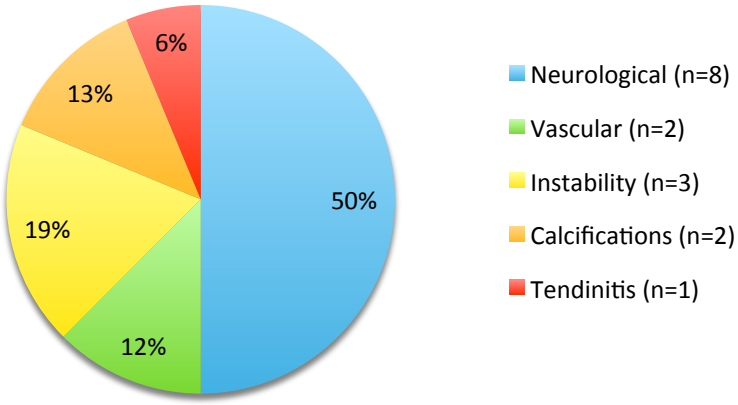


Fig. 6: Distribution of dislocations with and without concomitant fractures

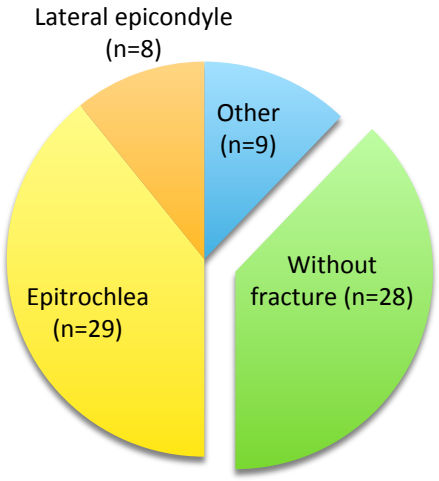


Fig. 7: Distribution of dislocations regards gender

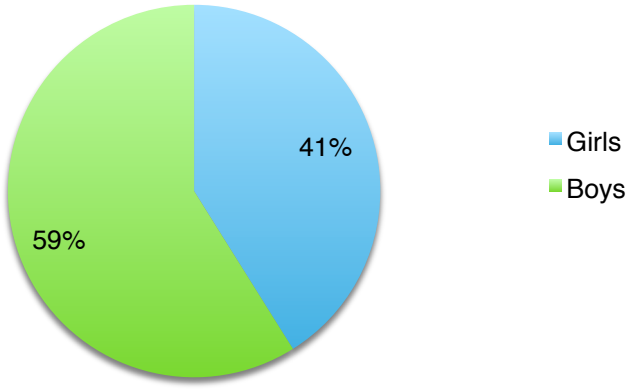
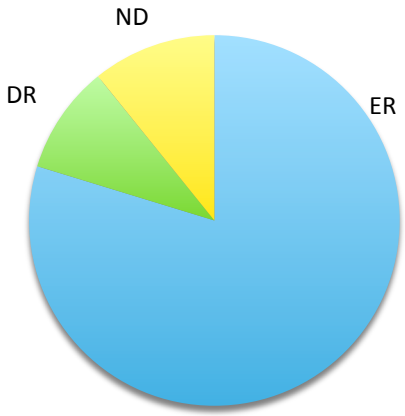


Fig. 8: Distribution of reduction of elbow dislocation regards difficulty



ER: Eased reduction (n=59) → always with concomitant fracture
DR: Difficult reduction (n=7)
ND: No available data (8)

Fig. 9: Distributions of dislocations regards posterior, anterior, lateral and divergent dislocations