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## ORIGINAL ARTICLE

# Outcomes after operative treatment of elbow contractures in the pediatric and adolescent population

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**Background:** The role of elbow contracture release in the very young is unclear, with existing studies reporting conflicting results. This study evaluated the long-term results after open elbow contracture release in patients aged younger than 18 years.

**Methods:** Between 1994 and 2012, 32 patients underwent open elbow contracture release at a mean age of 13.8 years (range, 5-18 years), and their outcomes were reviewed. The primary cause was traumatic in 30 patients (4 radial head/neck fractures, 5 intra-articular distal humeral fractures, 11 extra-articular distal humeral fractures, 10 complex fracture-dislocations), and the mean time from the index injury to contracture release was 16.3 months (range, 3-82 months). The cause in 2 patients was nontraumatic (1 osteochondritis dissecans, 1 congenital). The mean follow-up period was 66 months (range, 7-202 months).

**Results:** At the latest follow-up, total arc of motion improved from 69° to 123° ( $P < .0001$ ), with a mean increase of 54° ( $P < .0001$ ). The function arc was >100° in 28 patients (88%), and 29 patients (91%) achieved >20° of improvement in their arc. Twelve patients (38%) underwent a gentle manipulation under anesthesia at a mean of 2.7 weeks (range, 1-5 weeks) for early recurrence of stiffness. There were 3 complications (1 deep infection, 1 hematoma, 1 humeral fracture through the external fixator pin site). No patients lost motion after surgery.

**Conclusion:** Elbow contracture release in the pediatric and adolescent population can provide significant improvements in range of motion similar to that achieved in adults. The improvements in motion are durable.

**Level of evidence:** Level IV; Case Series; Treatment Study

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The development of elbow contracture after trauma or developmental elbow conditions is common and has been

reported to occur in up to 6% of supracondylar distal humeral fractures and in 31% to 45% of radial head/neck fractures.<sup>7,14,15</sup> Given the potential limitations in recreational and daily activities, this may carry significant effect and implications for children in their most formative years.

Arthroscopic and open contracture release for elbow stiffness have provided significant improvement in range of motion in up to 95% of adult patients.<sup>1,12,14</sup> However, the results in

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the pediatric age group are often thought to be less favorable and less predictable for various reasons. There is a paucity of data in the current literature reporting the outcomes after contracture release in younger patients, with the few existing studies reporting conflicting results.<sup>2,6,14</sup>

Two previous studies in the adolescent population reported favorable outcomes, with a mean improvement of 54° observed in both studies.<sup>1,6</sup> However, in contradistinction, in a relatively large series of patients all aged younger than 21 years, Stans et al<sup>14</sup> demonstrated less favorable and less predictable results, with less than 50% of patients achieving a functional arc of motion (range, 30°-130°) at the time of the latest follow-up.<sup>14</sup> As such, whether the same degree of improvement in the pediatric and adolescent population could be expected as seen in adults is still unclear. Therefore, the aim of this present study was to review our results of children and adolescents, aged younger than 18 years, who underwent an open elbow contracture release for stiffness.

## Materials and methods

### Patients

Between August 1994 and April 2012, 42 patients, all aged younger than 18 years at the time of surgery, underwent an open elbow contracture release by the senior author (R.N.H.). At the latest follow-up, 10 patients with fewer than 6 months of clinical review could not be contacted. This left 32 patients (17 males and 15 females), with a mean age of 13.8 years (range, 5-18 years) and a mean follow-up of 66 months (range, 7-202 months). At the time of contracture release, 7 patients were aged younger than 10 years, 9 were between 10 and 14 years, and 16 were between 15 and 18 years (Table I).

Elbow contractures developed in 30 of the 32 patients secondary to trauma. The etiologies are outlined in Table II. Two patients had nontraumatic contractures, consisting of osteochondritis dissecans in 1 patient and congenital elbow contracture in the other. Before their contracture release 37 patients (84%) had undergone at least 1 prior operation.

The indications for contracture release were any or all of flexion/extension arc of less than 100°, failure of intensive physiotherapy of at least 3 months, or a clear mechanical block to motion that would not be amenable to bony remodeling or physiotherapy. In our series,

**Table I** Patient demographics

Variable	Mean (range) or No. (%)
	(n = 32)
Age, y	13.8 (5-18)
<10 y	7 (22)
10-14 y	9 (28)
15-18 y	16 (50)
Gender	
Male	17 (53)
Female	15 (47)
Previous trauma	30 (94)
Prior surgery	27 (84)
Follow-up, y	5.5 (0.5-16.9)

**Table II** Causes of contracture

Variable	No. (%)
	(n = 32)
Post-traumatic contractures	30 (94)
Extra-articular fractures	
Radial head/neck fracture	4 (13)
Distal humeral fracture	11 (34)
Intra-articular fractures	
Distal humeral fracture	5 (16)
Complex fracture-dislocation	10 (31)
Other contractures	2 (6)
Osteochondritis dissecans	1 (3)
Congenital	1 (3)
Patients who had previous surgery	27 (84)

30 of the 32 patients (94%) had a flexion/extension arc of less than 100°. One patient had predominantly a reduced rotational arc (60° of pronation/supination), and 1 patient was a gymnast and had a 30° flexion contraction, thus limiting her ability to compete. The mean time to surgery from the index injury was 16 months (range, 3-82 months).

### Surgical technique

The approach for contracture release was largely dictated by the pathology and nature of the contracture. The goal in the medial or lateral approach was to obtain adequate exposure while sparing the collateral ligaments. The medial "over-the-top" approach, as described by Hotchkiss and Kasparyan,<sup>10</sup> was exclusively used in 13% of the patients, and the midaxial (universal) lateral approach<sup>13</sup> was used in 31%. In 54% of the patients, the medial and lateral approaches were both necessary.

We believe, as do many other authors, that neurolysis of the ulnar nerve plays a very important role in patient outcomes after contracture release, in particular the prevention of the development of delayed onset ulnar neuropathy.<sup>4</sup> Overall, 21 patients (66%) underwent an ulnar nerve neurolysis and anterior subcutaneous transposition, and this was performed almost routinely in all patients where the medial approach was used. In complex contractures, the radial and median nerve were both visualized early and protected throughout the course of the operation to avoid iatrogenic injury.

The hypertrophic and scarred capsule is then excised, anteriorly and posteriorly, and all bony impediments to range of motion are removed, with the goal to obtain full range of motion intraoperatively. Where stability of the elbow joint is compromised as a result of extensive soft tissue releases or excision of heterotopic bone surrounding the collateral ligaments, a dynamic external fixator (Compass Universal Hinge; Smith & Nephew, Memphis, TN, USA) is applied. This was required in only 2 patients and was removed after approximately 6 weeks. Swelling is minimized with the use of Evicel fibrin sealant (Ethicon, Somerville, NJ, USA) to augment hemostasis, and the incisions are closed over large drains.

### Postoperative protocol

The use of postoperative splinting depended on the nature of the contracture and the stability of the elbow after contracture release. In patients who had a stable elbow and predominantly a flexion contracture, an anterior splint was used overnight to maintain the contracture release,

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