



Evidence-Based Care Guideline

Loss of Elbow Motion Following Surgery or Trauma^a In children aged 4 to 18

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Target Population

Inclusions: These guidelines are intended for the use in patients aged 4 through 18 years of age who present with loss of elbow motion following surgery or trauma including the following:

- fracture of distal humerus
- supracondylar humeral fracture
- condyle and epicondyle fracture
- elbow dislocations
- olecranon fracture

Exclusions: These guidelines are not intended for use in patients with the following:

- radial head fracture
- radial neck fracture
- nerve damage associated with injury

Target Users

Include but are not limited to (in alphabetical order):

- Occupational Therapists
- Patients and families
- Physical Therapists
- Physicians

Introduction

References in parentheses () Evidence strengths in [] (See last page for definitions)

Currently within our institution, the standard of medical care for distal humerus fractures is to either manage

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Guideline 32, pages 1-9, December 21, 2007.

surgically with pin fixation as indicated followed by necessary immobilization or conservatively with simple immobilization without surgical intervention. Typically, patients are immobilized from 2 to 6 weeks as necessary to allow adequate bony healing. Once immobilization is discontinued, the patient is typically advised to participate in a home exercise program and return to orthopaedic clinic at a 4 to 6 week interval. If the patient demonstrates complications or loss of motion at this follow up, he/she is then referred to physical therapy (*Local Consensus [E]*).

Physical therapy and occupational therapy management typically includes all or part of four parameters, including exercise, manual therapy, modalities and splinting. Exercises typically include wrist, elbow and shoulder stretching, progressive resistive exercises for wrist, elbow and hand musculature and dynamic functional exercises for return to activity. With respect to manual therapy, active assistive and passive ROM, in addition to low load long duration stretching is implemented, as indicated. Modality usage typically includes cold therapy after treatment for management of inflammation and post therapy pain and effusion. In addition, superficial heating modalities are often used to help with muscle relaxation during low load long duration stretching. Finally, splinting (including static, static progressive and dynamic splinting) is implemented on an as needed basis, but not consistently across the population. While many of the therapists treat these patients with similar techniques, there is no set standard of care implemented with this patient load (*Local Consensus [E]*).

Objectives of this guideline are to:

- optimize elbow function through long term maintenance of increased active elbow range of motion
- increased elbow strength in children who have been immobilized after elbow surgery or trauma
- minimized time spent in therapy
- increase coordination and consistency of care provided by therapists
- maintain and improve family satisfaction

Etiology

Loss of elbow motion is a common complication following elbow fractures and dislocations (*Griffith 2002 [E]*). Twenty percent of dislocations, twenty percent of fractures and thirty-eight percent of fracture-dislocations

end up with elbow stiffness (*Griffith 2002 [E]*). Due to the nature in which kids fall by protecting themselves with an outstretched arm, 65 to 75% of all fractures in children occur in the upper extremity (*Lins 1999 [S]*).

Guideline Recommendations

History and Physical Exam

It is recommended that a thorough history will be taken from the patient and/or parent regarding:

- mechanism of injury
- type of injury
- any surgery-type of procedure
- immobilization (duration, date removed)
- functional goals of patient and family (*Local Consensus [E]*).

Clinical Assessment

Recommended assessment of the following:

- active (AROM) and passive range of motion (PROM) of shoulders, elbows, forearms and wrists
- joint end feel
- sensation
- visual inspection of surgical site
- girth measurements (if appropriate)
- strength of shoulders, elbows (if appropriate), forearms, wrists and grip (*Davila 2006 [S]*, *Local Consensus [E]*).

Recommended Outpatient Occupational and Physical Therapy Interventions

It is the recommendation of these therapists that the patient with a post-traumatic immobilized elbow with impaired motion and/or strength be referred for outpatient occupational or physical therapy interventions as soon as possible after the immobilization period. It has been shown that patients who have been allowed early mobilization or referred to physical therapy sooner have gone on to have, fewer complications, fewer residual symptoms, and faster gains in range of motion and strength than those who have delayed motion and/or therapy (*Nash 2004 [M]*, *Kepler 2005 [C]*, *Dias 1987 [C]*). The following clinical guidelines are based upon the best research available at this time related to the basic science

of healing and principles of rehabilitation. It is recommended that this will be utilized from day one when a patient comes out of their cast and incorporated into their plan of care.

It is recommended that a clinic based physical therapy plan be initiated, as indicated by the patient's current impairments. It is recommended that the patient and family are instructed in a home program of range of motion and strengthening and that they will be followed at least once weekly by physical therapy for progression of program until goals are met or patient's progress has plateaued (*Friedrich 1996 [C]*, *Griffith 2002 [E]*).

1) Inflammatory /Acute Phase (0 to 2 weeks after injury)

- **Recommended Goals:** Control pain, minimize and prevent edema, protect healing structures, maintain stability, maintain and progress (gently) range of motion (ROM).
- **Recommended ROM Interventions:** Begin active range of motion (AROM) and active assisted range of motion (AAROM) at the elbow when stability has been achieved; begin AROM of all non-involved joints; AROM and AAROM will promote healing of bone and articular cartilage, it will also help increase the tensile strength of soft tissues and minimize intra-articular adhesions (*Davila 2006 [S]*).
- **Recommended Strengthening Interventions:** Isometrics at the elbow musculature (only if not contraindicated); grip strengthening exercises (*Davila 2006 [S]*).
- **Recommended Modalities:** Superficial cold modalities to help reduce the acute inflammation (*Nadler 2004 [S]*).
- **Recommended Precautions:** It is recommended to avoid pronation/supination with collateral ligament involvement and avoid excessive pain and stress with AROM and AAROM (*Davila 2006 [S]*, *Local Consensus [E]*).

2) Fibroplastic/ Subacute Phase (2 to 8 weeks after injury)

- **Recommended Goals:** Continue to decrease edema, increase ROM, increase function, increase strength
- **Recommended ROM Interventions:** Continue with AROM and AAROM with increased force of contraction; recommended to begin *gentle* passive range of motion (PROM) at 6 weeks postop/injury (*Local Consensus [E]*); recommended

technique for PROM is be slow prolonged stretching with at least a 30 second hold, doing 4 to 5 repetitions (*Bandy 1994 [D]*).

- **Recommended Strengthening Interventions:** Progression to isotonic strengthening exercises (*Davila 2002 [E]*) for healing fractures, weightbearing exercises will help increase bone mineral density with healing bone (*MacKelvie 2002 [M]*).
- **Recommended Modalities:** Superficial heat (20 minutes) or ultrasound may be used immediately prior to stretching to increase tissue extensibility (*Draper 1998 [B]*, *Draper 1995 [C]*, *Taylor 1995 [C]*); superficial cold at end of session to reduce any acute inflammation of tissue (*Nadler 2004 [S]*).
- **Precautions:** It is recommended that the therapist take caution with amount of force applied to target tissue; PROM force will be within tissue tolerance (comfortable, short of pain) so as to lengthen and remodel the tissue, not cause inflammatory response (*Bandy 1994 [D]*) (*Davila 2006 [S]*).

3) Remodeling/ Return to Activity Phase (2 to 6 months after injury)

- **Recommended Goals:** To continue to increase ROM, strength and function; progress to sport specific exercises as indicated
- **Recommended ROM:** Continue with above interventions of AROM, AAROM and PROM; may introduce joint mobilization techniques if loss of motion can be attributed to joint stiffness (*Michlovitz 2004 [M]*, *Davila 2002 [E]*)
- **Recommended Strengthening:** Progressive resistive strengthening with weights and bands are appropriate
- **Recommended Modalities:** Superficial heat (20 minutes) or ultrasound (3MHz, 1.5 W/cm² for 7 minutes) can be used immediately prior to stretching to increase tissue extensibility (*Draper 1998 [B]*, *Draper 1995 [C]*, *Taylor 1995 [C]*); superficial cold at end of session to reduce any acute inflammation of tissue (*Nadler 2004 [S]*).
- **Precautions:** It is recommended that joint mobilization techniques be delayed until 6 to 8 weeks after injury or fracture union is evident (be in close contact with referring physician regarding implementation of this intervention) (*Local Consensus [E]*).

4) Splinting

It is recommended to wait until sufficient healing and fracture stability has occurred prior to initiating splinting to regain ROM in order to avoid pain, inflammation, ligamentous insufficiency, and heterotopic ossification (*Szekeres 2006 [O]*, *Chinchalkar 2004 [S]*). Splinting is most effective if initiated in the first 3 months, moderately effective from 3 to 6 months, and has variable effectiveness when initiated 6 to 12 months post injury (*Morrey 2002 [E]*).

Contraindications: poor skin quality, bony blocks, loose bodies, or any other intra-articular restrictions seen on x-ray. Discontinue splint use if sensory or motor changes occur with use (*Zander 1992 [C]*, *Morrey 2002 [E]*). Close communication with the referring physician is essential to ensure safe use of splinting and casting.

5) Recommended Timeframe for Splinting

- A) Inflammatory Phase (0 to 2 weeks), splinting and casting can be used to protect the joint (*Chinchalkar 2004 [S]*).
- B) Fibroplastic Phase (2 to 8 weeks) splinting and casting may be used to help restore or gain range of motion.
- C) Remodeling Phase (2 to 6 months) progressively increase ROM with splinting to enhance collagen orientation and plastic elongation of tissues (*Davila 2006 [S]*, *Chinchalkar 2004 [S]*).

6) Types of Splints

- A) **Static Progressive Splints:** These splints operate on principle of stress relaxation (*Gelinas 2000 [C]*, *Bonutti 1994 [D]*) and are used to regain ROM. Examples: Joint Active Systems (JAS), turnbuckle splints
Pro: can be worn for shorter periods of time, worn to patient comfort, adjustable tension. Operating on principle of stress relaxation, there may be less likelihood of irritation and inflammation (*Morrey 2002 [E]*). This type of brace may be more effective for gaining extension (*Davila 2006 [S]*). JAS makes one splint for flexion and extension
Con: Rely on patient to continuously adjust the splint

Static Progressive Splints Guidelines:

- 1) Recommend wear splint 30 minutes to 2 hours 3 to 4 times per day (*Bonutti 1994 [D]*, *Chinchalkar 2004 [S]*, *Davila 2002 [E]*).
- 2) Recommend 20 hours wear time, including use at night (*Gelinas 2000 [C]*, *Morrey 2002 [E]*).

- B) Serial Static Splinting:** (also includes serial casting and night extension splints)
Pro: night splints are recommended for use in combination with other splinting to help maintain gains made through the day (*Davila 2006 [S]*, *Chinchalkar 2004 [S]*).

Serial Static Splinting Guidelines:

Recommend night splinting to maintain gained motion and compliments use of static progressive stretches (*Chinchalkar 2004 [S]*). It is also helpful if flexion contracture is less than 30° (*Davila 2006 [S]*).

- C) Dynamic Splinting:** These splints operate on the principle of creep and usually requires 8 to 12 hours of wear time per session (*Bonutti 1994 [D]*).
Pro: may be more effective for gaining flexion during the Remodeling Phase (*Davila 2006 [S]*)
Con: Operating on principle of creep, this may cause inflammation, which may lead to additional swelling and scarring. Requires longer wear time (*Bonutti 1994 [D]*, *Morrey 2002 [E]*). Need separate splints for flexion and extension

Dynamic Splinting Guidelines:

No specific recommendations available in the peer reviewed literature. Dynasplint recommends extended wear time of at least 8 to 10 hours (*Dynasplint_Systems 1996 [E]*).

7) CCHMC OT/PT Recommendation for Splint and Brace Use:

- A) It is recommended that night splinting be considered for soft tissue restrictions if there is a lack of progress after 2 weeks of physical therapy.
- B) Also recommended is use of static progressive splint for flexion or extension contractures if there is a soft tissue restriction and there is a lack of sufficient progress after 2 weeks of intervention. One example of this type of brace

is the JAS. Static progressive is the splint of choice for this situation, however, dynamic splinting (*Dynasplint_Systems 1996 [E]*) can be considered if necessary (insurance will not reimburse static progressive splint, or MD will not refer this type of brace, patient/family preference or patient/family will not be able to utilize static progressive splint properly) (*Local Consensus [E]*).

8) Recommended Discharge Criteria

- A) Equal ROM of involved and uninvolved elbow
- B) Strength within functional limits or equal to the uninvolved extremity (*Local Consensus [E]*).
- C) Meet patient/family goals for occupational/physical therapy

9) Consults

- A) It is recommended that contact with the patient's medical doctor for a referral to OT for evaluation and possible splint fabrication if a patient exhibits significant lack of motion of the hand and/or wrist due to nerve damage (*Griffith 2002 [E]*, *Local Consensus [E]*).
- B) It is recommended that if a patient exhibits a hard end feel or has not shown progress for 4 to 6 weeks, they be referred back to their physician (*Davila 2006 [S]*, *Local Consensus [E]*).

10) Education

It is recommended that education for the patient and family:

- Begin upon initial evaluation and continue throughout the course of occupational/physical therapy services
- Be geared to the developmental age of the patient and the learning abilities of the family/caregivers
- Address relevant topics such as treatment plan, expected progress and outcomes, recreational and functional activities and selection of splinting/bracing options

Expected Outcomes

There is no consensus in the literature regarding what is an acceptable outcome in this population in terms of

regaining ROM (*Ong 1996 [C], Sibly 1991 [D], Morrey 1981 [O]*). It is the recommendation of this group that equal active ROM of the involved and uninvolved arm would be the ideal outcome as well as the patient having necessary ROM to perform desired activities. While we would strive for equal ROM and strength between extremities we must also realize the importance of the functional ability and desires of the individual and that modification can be made to help the child reach their goals (*Local Consensus [E]*).

Future Research Agenda

1. In children 4 to 18 what percentage of patients go on to have related to loss of motion and function of the involved extremity after elbow fracture and immobilization?
2. In children 4 to 18 with loss of motion due to injury and immobilization does time of initiation of outpatient therapy services impact overall outcome in terms of range of motion and functional ability?
3. In children 4 to 18 with loss of motion due to injury and immobilization does time of initiation of outpatient therapy services impact the amount of time spent in outpatient occupational/physical therapy and increase the need for bracing/splinting to regain ROM?

Appendix: Initial Clinical Questions used to guide search and selection of evidence

(note only priority items as deemed by the Guideline clinicians were focused on and not all questions below may be explicitly addressed by this guideline due to limited resources)

- 1) In children (4 to 18 year olds) s/p elbow fracture with immobilization is physical therapy/occupational therapy with bracing (JAS or Dynasplint) more effective than OT/PT alone in gaining full active elbow range of motion?
- 2) In children (4 to 18 year olds) s/p elbow fracture with immobilization is supervised OT/PT more effective than home exercise program alone in gaining full elbow ROM?
- 3) In children (4 to 18 year olds) s/p elbow fracture with immobilization is early intervention (within one week out of cast) more effective than delayed onset of OT/PT (after 4 week check with physician) in gaining full elbow ROM?
- 4) In children (4 to 18 year olds) s/p elbow fracture with immobilization is early intervention (within one week out of cast) more effective than delayed onset of OT/PT (after 4 week check with physician) in reducing the amount of time (weeks/months) spent in OT/PT?
- 5) In children (4 to 18 year olds) s/p elbow fracture with immobilization is early intervention (within one week out of cast) more effective than delayed onset of OT/PT (after 4 week check with physician) in avoiding the necessity of bracing/splinting?

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Development Process

The process by which this guideline was developed is documented in the [Guideline Development Process Manual](#); a Team Binder maintains minutes and other relevant development materials. The recommendations contained in this guideline were formulated by an working group of OT/PT therapists which performed systematic and critical literature reviews, using the grading scale that follows, and examined current local clinical practices.

To select evidence for critical appraisal by the group for the development of this guideline, Pubmed, OVID (Medline, Cinahl, All EBM Reviews- Cochrane DSR, ACP Journal Club, DARE and CCTR), Pedro, OT Seeker and OT CATS databases were searched to generate an unrefined, "combined evidence" database using a search strategy focused on answering clinical questions relevant to this Loss of Elbow Motion Following Surgery or Trauma (see Appendix) and employing a combination of Boolean searching on human-indexed thesaurus terms (MeSH headings using an OVID Medline interface) and "natural language" searching on searching on human-indexed thesaurus terms (MeSH headings using an OVID Medline interface) and "natural language" searching on words in the title, abstract, and indexing terms. Additionally a search was done on the on the web including the website www.google.com. Many search terms were used as seven therapists did the searching. The search was done from February to May of 2006. Terms that were used to search relating to the anatomy of the elbow were as follows: elbow, distal humerus, supracondylar, radial head, olecranon, upper extremity. These terms were combined with terms describing the pathology: injury, fracture, dislocation, trauma, adhesions, contracture. Other terms used include: immobilization, complications, therapy, splint\$, pediatric, rehabilitation, range of motion, stretching, goniometer, modalities, reliability and validity. The citations were reduced by eliminating duplicates, non-English articles, and articles deemed inappropriate for the purpose of this project. Various combinations of these terms were used of the above named databases and then

CCHMC Evidence Grading Scale			
M	Meta-analysis or Systematic Review	O	Other evidence
A	Randomized controlled trial: large sample	S	Review article
B	Randomized controlled trial: small sample	E	Expert opinion or consensus
C	Prospective trial or large case series	F	Basic Laboratory Research
D	Retrospective analysis	Q	Decision analysis

appropriate articles were retrieved, read, reviewed and appraised by members of the team. There were approximately 55 articles pulled from these searches that were culled by team members to find those that best aligned with this guideline's clinical questions (see Appendix). After the database search was exhausted, the team found other appropriate articles and book chapters by scanning the reference lists of the reviewed articles. The team decided that all levels of evidence would be appropriate as there was not much evidence relating to our specific population at the time of the search. During the course of the guideline development, additional clinical questions were generated and subjected to the search process, and some relevant review articles and adult literature were utilized

Appropriate companion documents have been developed to assist in the effective dissemination and implementation of the guideline. These are available electronically to occupational and physical therapists at CCHMC in the OT/PT shared drive

A search using the above criteria will be conducted at least once per year in search of any "invalidating evidence" that may be used as potential future citations for the guideline. If any "invalidating evidence" is found, the development team will review the evidence and/or reconvene to further explore the continued validity of the guideline and/or address the revision of recommendations as needed. This phase can also be initiated at any point that new evidence indicates a critical change is needed.

Recommendations have been formulated by a consensus process directed by best evidence, patient and family preference and clinical expertise. During formulation of these recommendations, the team members have remained cognizant of controversies and disagreements over the management of these patients. They have tried to resolve controversial issues by consensus where possible and, when not possible, to offer optional approaches to care in the form of information that includes best supporting evidence of efficacy for alternative choices.

The guidelines have been reviewed and approved by clinical experts not involved in the development process, senior management, other appropriate hospital committees, and other individuals as appropriate to their intended purposes.

The guideline was developed without external funding. All Team members and Clinical Effectiveness support staff listed have declared whether they have any conflict of interest and none were identified.

Copies of this Evidence-Based Care Guideline (EBCG) and its companion documents are available online and may be distributed by any organization for the global purpose of improving child health outcomes. Website address:

<http://www.cincinnatichildrens.org/svc/alpha/h/health-policy/ev-based/default.htm> .

Examples of approved uses of the EBCG include the following:

- copies may be provided to anyone involved in the organization's process for developing and implementing evidence-based care guidelines
- hyperlinks to the CCHMC website may be placed on the organization's website;
- the EBCG may be adopted or adapted for use within the organization, provided that CCHMC receives appropriate attribution on all written or electronic documents; and
- copies may be provided to patients and the clinicians who manage their care.

Notification of CCHMC at HPCEInfo@cchmc.org for any EBCG, or its companion documents, adopted, adapted, implemented or hyperlinked by the organization is appreciated.

NOTE: These recommendations result from review of literature and practices current at the time of their formulations. This Guideline does not preclude using care modalities proven efficacious in studies published subsequent to the current revision of this document. This document is not intended to impose standards of care preventing selective variances from the guidelines to meet the specific and unique requirements of individual patients. Adherence to these recommendations is voluntary. The physician in light of the individual circumstances presented by the patient must make the ultimate judgment regarding the priority of any specific procedure.

For more information about this guideline, its supporting evidence and the guideline development process, contact the Division of Occupational Therapy and Physical Therapy at: 513-636-4651 or OTPT@cchmc.org.

References

Note: When using the electronic version of this document (as found available in our searches / resources), “[🔗](#)” refers to journal articles that have a hyperlink to the PubMed abstract.

A second hyperlink [_____](#) below the reference will access a PDF of the full article for those who have access to the CCHMC network.

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