

BRK 26: Orthopaedic Surgery for the Upper and Lower Limb in Children with Cerebral Palsy

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UPPER EXTREMITY

“The upper extremities are sometimes held down by preponderating action of pectorals, teres major and teres minor, and latissimus dorsi; the elbows are semi-flexed, the wrist partially flexed, pronated, and the fingers incapable of perfect voluntary direction.” William J. Little – 1862

EVALUATION of the Upper Extremity in Children with Cerebral Palsy

- 1. Rule out other treatable diagnoses**
- 2. Understand the patient/family goals in order to ****Individualize care******
- 3. Multi-disciplinary approach**
- 4. Identify associated neurologic disorders * recognize contraindications to surgery***

Goals of Examination

- 1) Evaluate spasticity vs. joint contracture
- 2) Functional status qualification and quantification
 - Motor and sensory
 - Activities of daily living, hygiene
- 3) Other contributing factors
 - Cognitive / IQ, Vision, hearing, speech, Seizure disorder, movement disorder,
 - Level of motivation, behavioral disorders

Key Points in Examination of the Upper Extremity

Resting posture, Spasticity, Motor, Active ROM, Contracture, Passive ROM

Strength, Sensibility, Hygiene, Functional pattern

“Typical spastic deformity” = Shoulder IR, Elbow flexion, Forearm pronation, Wrist and digital flexion, Thumb in palm deformity

Assessment: Spasticity

Elastic. Stretching → resistance and increased strength. Present at rest. Exacerbated by voluntary movement, pain, fatigue, emotion, Exaggerated reflexes, Synkinesis (hand-shoulder), Ashworth Scale of Muscle Tone

Assessment: Motor Function

Voluntary motor control = #1 PREDICTIVE OF SURGICAL OUTCOMES

Weakness of antagonists (extensors, EPL, supinator, ext rotators)

Spastic muscles

Shoulder: internal rotators (Subscapularis, teres major, latissimus)

Elbow: flexors (biceps, brachialis, brachioradialis)

Wrist: flexors, ulnar deviators (FCU > FCR > palmaris)

Fingers: flexors (Intrinsics and Extrinsics)

Thumb: (adductor pollicis, FPL, FPB, Opponens, 1st dorsal interossei)

Synkinesis (thenar muscles + elbow extension)

Assessment: Fibrous contracture

Permanent, fixed, Motor block, Spasticity vs. contracture, Flexors, adductors, pronator, Lidocaine, alcohol, phenol, Botox, Inject nerve trunk or motor end plate

Assessment: Joint ROM

PROM usually ok in kids (vs adults), Difficult to isolate joint itself, SHOULDER, ELBOW, WRIST, FINGERS, THUMB, Some HYPERmobile joints

Assessment: extrapyramidal neurologic conditions

Athetosis, Involuntary rhythmic oscillatory movement, Chorea, Rapid contortions , Parkinson's – Primary or Secondary, Tremor, hypertonia , cogwheeling, akinesia

CLASSIFICATIONS

MACS / Type of Spasticity

Zancolli E: overall function/appearance Structural and dynamic bases of Hand Surgery.

House: Thumb deformities JBJS (1981) 63-A;216-25

FUNCTIONAL EXAM TESTING

Numerous tests with objects/toys

Jebsen test, AHA, SHUEE, Video recording, Bimanual activity, Dynamic EMG , 3D Kinematics and Motion Analysis Dynamic EMG, etc.

Quality of Life Questionnaires

INDIVIDUAL CARE, GOAL DIRECTED TREATMENT DECISION MAKING, No validated questionnaire by the child for upper extremity function in CP, Parent questionnaires are inconsistent

TREATMENT of the Upper Extremity in Children with Cerebral Palsy

1. Spend time emphasizing that NO treatment will cure or magically reverse condition
2. Help set realistic goals for outcome of any proposed treatment
3. **Most studies shows cumulative effect of multidisciplinary operative and non-operative treatments**

Goals of Treatment

1. Independence with ADL's
2. Communication
3. Mobility
4. Pain control
5. Prevention of progressive deformity
6. Psychosocial issues
7. APPEARANCE = *COSMESIS* = ? *REPOSITIONING* ?

BOTULISM TOXIN

Blocks pre-synaptic acetylcholine release, Temporary reduction in spasticity, Improve position

Allow antagonist strengthening, Prevent contracture

Consistent reduction in spasticity and muscle stiffness

Indications: Muscle spasticity in absence of fixed deformity. Perioperative pain, spasticity

Requirements: Presence of active antagonist muscles. Motivation/cognition. Younger patients

Results: 3-5% “golden responders”, 70% clinical responders, Minimal or non-responders

? Long term effects, muscle damage

Contraindications: Fixed contractures, No control of antagonists, Learned non-use, Sensory impairment

SURGERY Upper Extremity Surgery in CP

Only 10% of patients undergo UE surgery: 50% functional improvement, 50% hygiene, position

NORMAL ANATOMY

Predictive Outcome Factors

1. Voluntary upper extremity use
2. Sensibility
3. Cognitive function IQ > 50 ?
4. No athetosis or dyskinesia
5. *****PICKING THE RIGHT GOALS*****

Key Strategies of Surgery

-Improve function by rebalancing and stabilizing

-Release of spastic muscles

-Augmentation/transfers to antagonist muscles

-Fuse joints that require stability to increase function across them

-Prevent hygiene problems by improved resting posture

- TIMING of surgery ****Controversial****

SHOULDER:

Subscapularis/pectoralis release

Humeral rotational osteotomy

External rotation muscle releases and lengthenings

ELBOW:

Dynamic vs. Fixed

Biceps Z-lengthening, Brachialis fractional lengthening, Capsular release, Musculocutaneous neurectomy / sympathectomy

FOREARM:

Flexor-pronator slide, PT tenotomy, PT rerouting/transfer

WRIST:

***Increasing digital extension may help wrist extension**

***Limiting wrist may limit digital flexion, May lose tenodesis effect**

FCU -> ECRB ECU -> ECRB FCU -> EDC PT -> ECRB BR -> ECRB

Arthrodesis, Proximal row carpectomy

FINGERS:

Type I: Active extension with wrist extended

- flexor fractional lengthening vs. no tx

Type II: Active extension with wrist flexed

- fractional lengthening + wrist extension augmentation

Type III: No active extension of digits

- FCU > EDC

Flexor-pronator slide, Fractional lengthenings, Z-lengthenings, Superficialis-to-profundus (STP) transfer

Bony shortening (e.g. proximal row carpectomy), Arthrodesis, PRC

Key considerations

Tendon transfers often used when spastic

Lengthenings weaken muscle-tendon units

If both FCU and FCR involved, one should be kept in continuity

Pre-op and Intra-Operative testing of tenodesis sets surgical technique

Arthrodesis NOT salvage

THUMB

Great detriment to hand function

Multifactorial causes

4 key elements to evaluate:

- 1) Spastic flexors/adductors
- 2) Flaccid extensors/abductors
- 3) Hypermobility MCP joints
- 4) Web space contracture

Operative principles:

- 1) Release spastic flexors/adductors
- 2) Augment extensors/abductors
- 3) Stabilize MCP joint
 - 1) ARTHRODESIS
 - 2) CASULODESIS
- 4) Release 1st web space contracture

ALL IN ONE

“The loss of a lower extremity is a great privation, but experience shows that the deprivation of the use of the arm and hand is felt as a far greater affliction; so much the greater therefore must be the reward of him or her who, by adding to the common stock of knowledge on the remedy of this, can so largely contribute to the welfare of his or her fellow creatures.”

~ William Little