LECTURE 8: OPTIMISING UPPER LIMB FUNCTION FOLLOWING STROKE

- **Understand the factors that can inhibit optimal recovery of arm function.**

  - Shoulder subluxation
    - Incidence as high as 81%
    - Downward traction leads to stretching and lengthening of soft tissues, particularly the joint capsule.
    - Difficult to treat once it has occurred.
    - Consequence: ↓ function, ↑LOS, pain
    - Risk factors: severe UL paralysis, ↓supraspinatus function, sensory loss, haemorrhagic stroke.
    - Assessment: palpation of suprahumeral space (measured using finger widths), Callipers, X-rays.
    - Management:
      - **Prevention**- assessment of patients risk (weak abductors, ER), education, visual reminders "mind my arm".
      - **Positioning in bed & in sitting**- never roll on affected side, support affected side.
      - **Train muscles around shoulder**
      - **Electrical stimulation**
      - **Support devices-** slings, strapping.





  - Shoulder pain
    - Common sequel to stroke (~84% patients).
    - Shoulder pain is a substantial cause of poor recovery of upper limb function.
    - Pain may be localized to shoulder or present in other parts of the limb. Causes;
    - Changes in muscle, capsule and ligamentous length → adhesive capsulitis.
    - Changes in muscle stiffness (including hypertonicity in some patients) joint contracture.
    - Glenohumeral subluxation.
    - Trauma to unprotected arm.
    - Pre-existing injury or degenerative disease.
    - Complex regional pain syndrome (also called causalgiaor sympathetic reflex dystrophy).
    - Thalamic syndrome (Central post stroke pain).
    - Handling by staff or family.
    - Lifts or transfers using arms as a lever can be damaging.
    - Passive movements: avoid impingement of tissues between the head of humerus and the acromion. Rarely used in stroke patients.

    - Lack of anti-gravity support for a flaccid limb, and this is accentuated in the patient with neglect.
    - Prevention;
        - Scant evidence
        - Train muscles around shoulder joint (+ electrical stim).
        - Prevent damage through poor handling (protocols, education).
        - Maintain optimal muscle length (avoid protective positioning).

- <u>Loss of flexibility & mm. shortening</u>
    - Due to prolonged periods of immobility.
    - Anticipated in;
        - Shoulder int. rotators and adductors
        - Elbow/wrist/finger flexors
        - Forearm pronators
        - Thumb adductors/webbing
    - Impedes recovery of function.
    - Alters both active and passive mechanical properties.
    - Loss of sarcomeres and joint ROM.
      Prevention strategies;
    - Active practice/motor training
    - Splints
    - Plastering and serial casting
    - Passive strategies such as positioning.
    - Passive movements (little evidence to support efficacy).
    - ES to end of range

Examples of positioning

YES

NO

- <u>Hand & finger oedema</u>
    - Occurs in approx 16% of patients following stroke.
    - Due to:
        - loss of mm physiological pump
        - immobility
        - dependant positioning
    - Treatment/prevention:
        - Training forearm mms
        - Elevation
        - AME/Masman pumps
        - Pressure garments
        - Binding/stringing
        - ES (see manual for parameters)

- <u>Impingement</u>
    - Scapulohumeral rhythm- ratio of glenohumeral to scapulothoracic joint motion during elevation.
    - S-T joint accounts for 1/3 of 180º of arm elevation.
    - Upward rotation of scapula serves 3 important functions:
        - Rotates glenoid fossa up and ant/lat, maximising upward/lat. Reach.
        - Optimises length-tension rel'ship of shoulder abductors.
        - Maintains volume in sub-acromial space.
    - Structures can become trapped in subacromial space when narrowed- therefore important to emphasise correct shoulder mechanics.

- **Measures of UL function.**
    - MAS (valiated & sensitive. Includes quality of movements).
    - Jebsen Taylor test (Gross & fine motor- functional).
    - ARAT (action research arm test).
    - Purdue peg board (limited to fine motor).
    - CHEDOKE (measure of independence- doesn't reflect quality of movement).
    - Useful other measures;
        - Timed ability to sustain mm activity.
        - Ability to elicit mm activity through range.
        - Time to complete rep

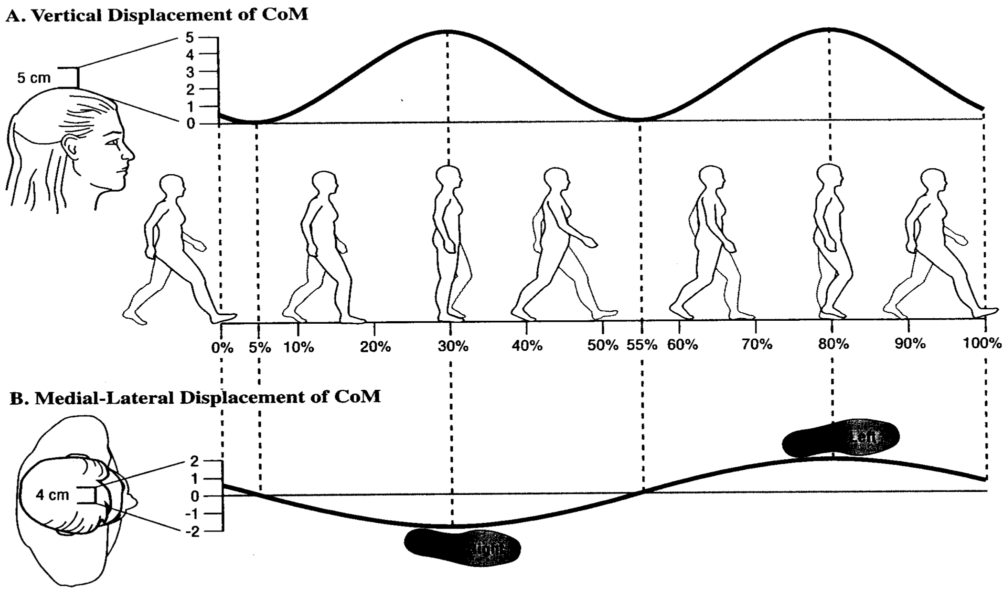
- **Consider various options for upper limb re-education following stroke.**
    - Accurate analysis of movement problems: essential components.
    - Remember to consider hand dominance and age.
    - Integrate what is known about the requirements for normal movement with what underlies the dysfunction.
    - Repetition essential
    - Task –related training incl. bimanual and strength components.
    - Forced –use
    - Opportunity to practice: volume, intensity and flexibility of training.
    - Adjuncts: robotics, mental rehearsal, virtual therapy, MT, group therapy.
    - Flexibility;
        - Change the mode of contraction – isometric, eccentric, concentric.
        - Change patient position.
        - Change mm length.
        - Train with a variety of objects: size, wt, texture, shape.
        - Alter the speed and predictability.
        - Practice both uni and bimanual tasks.
    - Repetitive exercises to activate weak muscles;
        - Training needs to begin with patient practising muscle activation and regaining ability to generate sufficient force.
        - Physiotherapists may need to search for muscle activity by modifying conditions of patient practice.
        - Patient needs to be encouraged to do repetitions until strength is sufficient for task-related activities (up to 20 or until fatigued).
    - Forced use (CIMT);
        - Constraint induced movement therapy (CIMT).
        - Discourages use of unaffected extremity through some form of constraint (e.g. sling) and encourages active use of hemiparetic arm.
        - Evidence supports UL improvement long term, demonstrates cortical reorganisation.
        - Time consuming.
        - Require a degree of strength (MAS- 3 on item 6, 1 on item 7).
    - Sensory Training
        - Sensory impairment occurs in 25-50% of patients following stroke.
        - Often neglected in rehab.
        - Improvements are specific to the type of training undertaken.
        - Accurate assessment
            - Nottingham sensory assessment scale

        - Proprioception
    - Somatosensory retraining;
        - Teach perception using vision and the intact limb.
        - Grading progression of stimuli.
        - Attentive exploration with vision occluded.
        - Identification of touches/numbers/letters drawn on hand/arm.
        - Discrimination of shape, weight and texture of objects placed in the hand
        - Finding the affected thumb when blindfolded.
        - Passive drawing

LECTURE 9: NEUROLOGICAL GAIT

- **Review and understand the biomechanics of normal gait.**
    - Weight acceptance/ limb loading
        - Most demanding task
        - Involves transfer of weight, shock absorption and maintenance of forward progression.
    - Single limb support
        - One limb supports entire body weight and provide truncal stability.
    - Limb advancement
        - Requires foot clearance and limb swing

    - Often have problems with all 3 areas.
    - If someone has problem with loading (heel strike to foot flat) should address this first.
    - Hyperextension on loading common issue
    - Single limb support- watch for pelvic rotation and flexion.
    - Normal= 5 cm displacement vertically and 2-4cm laterally.
    - Closed Kinetic Chain: stance phase. When the limb is weight bearing movement of a distal joint influences the positions of the joints proximal to it.
    - Open Kinetic Chain: swing phase. When the limb is non-weight bearing movement of a proximal joint influences the position of the joints distal to it.
    - The total energy required to move the body forward during gait is the sum of the positive and negative energy changes**.**
    - Positive energy= concentric, negative energy= eccentric; absorption.
    - Muscles act over brief periods.
    - Mm. Involved more in deceleration than progression.
    - Changing the speed of gait alters mm activation patterns.
    - Grade III muscle strength required for normal walking.
    - Soft tissue stretch contributes significantly to power bursts- Reduces the active energy required e.g. hip flexors at terminal stance, ankle PF.
    - Passive contributions increase with gait speed.
    - PF not necessary for gait initiation- initiated by decreased torque in PF which changes centre mass shifting body forward (“controlled falling”).
    - Takes about 3 steps for steady state/normal gait to be reached.



- **Recognize some of the common anomalies seen in hemiplegic gait.**
  - Decreased walking velocity
  - Decreased step/ stride lengths
  - Uneven step and stride lengths
    - ↓ Stance phase and ↑ swing phase in affected leg.
    - Unaffected leg compensates with ↑ stance phase and ↓ swing phase.
  - Increased stride width (normal ~ 6cm).
  - Toe strike.
  - Decreased amplitude of movement.
  - UL flexion and adduction, decreased swing.
  - Use of arms for support and balance.
  - Gait is laborious (requiring effort).
  - 8° pelvic rotation is normal- necessary to increase step length.
  - To advance the affected limb:
    - Hip hiking
    - Trunk lean to contralateral side
    - Circumduction
    - Excessive hip and knee flexion
    - Vaulting
  - Common deficits in swing phase:
    - ↓ Hip flexion.
    - ↓ Knee flexion to 'shorten' the leg for toe clearance as the leg swings forward.
    - ↓ankle dorsiflexion as a contribution to toe clearance
    - ↓ Knee extension and ankle dorsiflexion for heel contact (foot flat or toe first and short step length).