Brunnstrom concept

Presented by,

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PT

History…

- Developed by Signe Brunnstrom, a physical therapist from Sweden
- Theoretical foundations:
  - Sherrington
  - Magnus
  - Jackson
  - Twitchell

ASSUMPTIONS

1. Reflex- Hierarchical theory
2. Lower level reflexes get modified & rearranged into purposeful movements through influence of higher centers
3. Reflexes & primitive movement patterns can used to facilitate the recovery of voluntary mvts.

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4. Proprioceptive and exteroceptive stimuli can be used to evoke desired motion or alter tone
5. Recovery of voluntary movts occur in sequence
6. Newly produced correct movements must be practiced to be learned
7. Practice within the context of daily activities enhances learning process

Premise

- When the CNS is injured, as in CVA, an individual goes through an “evolution in reverse”
  - Movement becomes primitive, reflexive, and automatic

- Changes in tone and the presence of reflexes are considered part of the normal process of recovery

Principles of treatment

- Facilitate the patient's progress throughout the recovery stages
- Use of postural and attitudinal reflexes to increase and decrease tone of muscles
- Stimulation of skin over the muscle produces contraction
- Resistance facilitates contraction

Basic limb synergies

- Mass movement patterns in response to stimulus or voluntary effort or both
  - Gross flexor movement (**flexor synergy**)
  - Gross extensor movement (**extensor synergy**)
  - Combination of the strongest components of the synergies (**mixed synergy**)

- Appear during the early spastic period of recovery

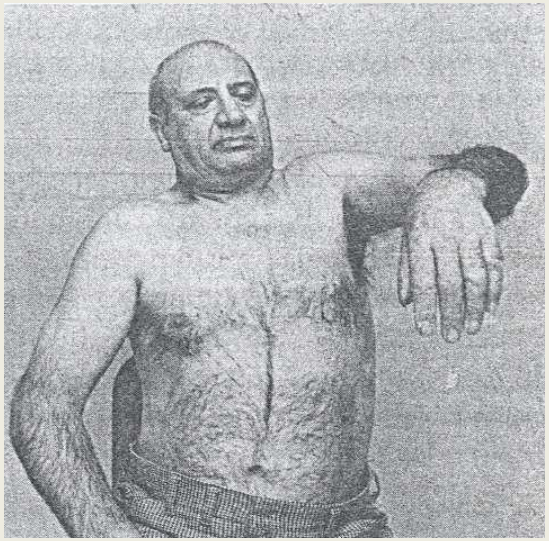
Important! (Limb Synergies)

- Muscles are neurophysiologically linked and cannot act alone or perform all of their functions
- If one muscle in the synergy is activated, each muscle in the synergy responds partially or completely
- Patient cannot perform isolated movements when bound by these synergies

Flexor synergies: UE

• Scapula	Retraction and/elevation
• Shoulder	Abduction & external rotation
• Elbow	Flexion
• Forearm	Supination
• Wrist	Flexion
• Fingers	Flexion
• Dominant	Elbow flexion
• Weakest rotation	Shoulder abduction & external

Flexor synergies of upper limb



extensor synergy of upper limb

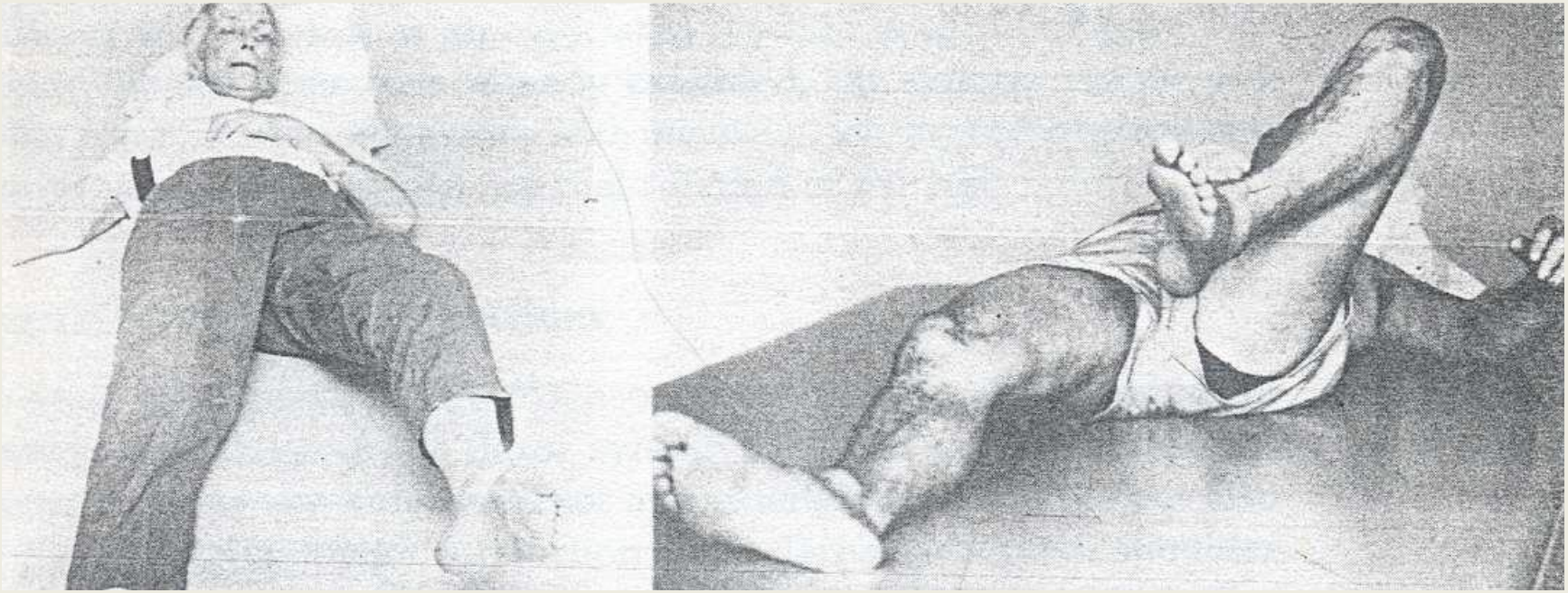
• Scapula	Protraction and/ depression
• Shoulder	Adduction & internal rotation
• Elbow	Extension
• Forearm	Pronation
• Wrist	Extension or flexion
• Fingers	Extension or flexion
• Dominant rotation	Shoulder adduction & internal
• Weakest	Elbow extension

Extensor synergy of upper limb

Flexor synergy of lower limb

Hip	Flexion, abduction & external rotation
Knee	Flexion
Ankle	Dorsiflexion and inversion
Toes	Extension
Dominant	Hip flexion
Weakest	Hip abduction and external rotation

Flexor synergy of upper limb



Extensor synergy of lower limb

Hip	Extension, adduction & internal rotation
Knee	Extension
Ankle	Plantar flexion and inversion
Toes	Flexion

Dominant: Hip adduction, knee extension & ankle plantar flexion

Weakest: Hip extension and internal rotation

Characteristic of synergistic movement

- The flexor synergy dominates in upper limb and extensor synergy in lower limb
- Performance of synergistic movements may be influenced by postural mechanisms
- The resting posture of the limb is represented by the dominant components of both flexor and extensor synergies

The Typical Hemiplegic Posture

HEAD	**Lateral y flexed toward the affected side**
UPPER LIMB	Scapula – depressed, retracted Shoulder – adducted, IR Elbow – flexed Forearm – pronated Wrist – flexed, ulnarly deviated Fingers - flexed
TRUNK	Lateraly flexed toward the affected side
LOWER LIMB	Pelvis – posteriorly elevated, retracted Hip – IR, adducted, extended Knee – extended Ankle – plantarflexed, inverted, supinated Toes - flexed

Developmental Reflexes

- Tonic Neck Reflexes
  - Symmetric TNR

stimulus	response
Neck flexion	Upper extremity flexion Lower extremity extension
Neck extension	Upper extremity extension Lower extremity flexion

  - Asymmetric TNR

stimulus	response
Neck lateral rotation	**Jaw side:** **upper extremity extension** **lower extremity flexion** **Skull side:** **upper extremity flexion** **lower extremity extension**

- Tonic Labyrinthine Reflexes

stimulus	response
supine	Limbs tend to move in extension
prone	Limbs tend to move in flexion

Tonic Lumbar Reflex

stimulus	response
Trunk rotation (R)	Increased flexor tone (R) UE and (L) LE Increased extensor tone (L) UE and (R) LE
Trunk rotation (L)	Increased flexor tone (L) UE and (R) LE Increased extensor tone (R) UE and (L) LE

Associated reaction

- In patients with hemiparesis reflex tensing of muscles and involuntary limb movement are frequently observed. These response are known as associated reactions.
- In most patients voluntary forcefull movements in other part of the body readily elicit such reactions in the affected limb.

Associated reactions

- Investigation by Walshe (1923)
  - Associated reactions are released postural reactions deprived of voluntary control
- Investigation by Simons (1923)
  - Position of the head has a marked influence on the outcome of the associated rections
  - Limb reactions evoked closely resemble tonic neck reflexes
- Observations by Brunnstrom (1951,1952)
  - UE: movements employed elicited the same reactions in the affected limb
  - LE: movements employed elicited opposite reactions in the affected limb

Associated reactions

- Observations by Brunnstrom (1951, 1952)

- May be evoked in a limb that is essentially flaccid, although latent spasticity may be present
- May occur in the affected limb under a variety of condition: in the presence of spasticity, when a degree of voluntary control has been achieved, and after spasticity has subsided
- May be present years after the onset of hemiplegia

Associated reactions

- Observations by Brunnstrom (1951,1952)
- ➢ repeated stimuli may be required to evoke a response
- ➢ tension in the muscles of the affected limb decrease rapidly after cessation of stimulus that evoked the associate directions
- ➢ attitudinal reflexes influence the outcome of associated reactions

Associated reactions

- HOMOLATERAL LIMB SYNKINESIS
  - The response of one extremity to stimulus will elicit the same response in its ipsilateral extremity

- RAIMISTE'S PHENOMENON
  - Resisted abduction or adduction of the sound limb evokes a similar response in the affected limb

- IMITATION SYNKINESIS

➢ Mirroring of movements occur in the affected side when movements are attempted or performed on the unaffected side

❑ E.g.

➢ Flexion of the unaffected side will evoke flexion of the affected side

➢ Used generally to facilitate movements on the affected side

- INSTINCTIVE GRASP REACTION
  - Closure of hand in response to contact of stationary object with palm of the hand
  - Seen in frontal lobe lesions
- INSTINCTIVE AVOIDING REACTION
  - Stroking over palmar surface of hand in distal direction causes hyperextension of fingers in a characteristic fashion
  - Seen in parietal lobe lesions

- SOUQUES PHENOMENON
- Elevation of the affected arm causes the paralyzed fingers to extend automatically
- Used to facilitate release of fingers
- PROPRIOCEPTIVE TRACTION RESPONSE
- Stretch of any of the flexor muscles in upper limb evokes or facilitates contraction of flexor muscles all other joints in upper limb

Associated reactions

- Yawning
- Flexor synergy is elicited during initiation of yawn

- Coughing and Sneezing
- Evoke sudden muscular contractions of short duration

Hand reactions

- Steps to restoration of hand function (Twitchell, 1951)

- Tendon reflexes return and become hyperactive
- Spasticity develops; resistance to passive motion is felt
- Voluntary finger flexion occurs, if facilitated by proprioceptive stimuli

Hand reactions

- Proprioceptive traction response can be elicited
- Aka proximal traction response
- Stretch of flexors of one of the joints of the upper limb facilitates a contraction of the flexor muscles of other joints of the same limb thus producing total limb shortening

- Control of hand without proprioceptive stimuli begins

Hand reactions

- Grasp is reinforced by tactile stimulus on the palm of the hand; spasticity declines
- True grasp reflex can be elicited; spasticity further declines
- Elicited by distally moving deep pressure over certain areas of the palm and digits
- Catching phase: weak contraction of flexors and adductors upon stimulus
- Holding phase: proceeds when traction is done on muscles activated in the catching phase

Recovery stage

STAGE	CHARACTERISTICS
Stage 1	•Period of flaccidity •Neither reflex nor voluntary movements are present
Stage 2	•Basic limb synergies may appear as associated reactions •Spasticity begins mostly evident in strong components (flexor synergy appear prior to extensor synergy) •Minimal voluntary movement responses may be present
Stage 3	•Patient starts to gain voluntary control over movement synergies •Spasticity reaches its peak •Semi-voluntary stage as individual is able to initiate movement but unable to control it

Recovery stage

STAGE	CHARACTERISTICS
Stage 4	•Some movement combinations outside the path of basic limb synergy patterns are mastered •Spasticity begins to decline
Stage 5	•More difficult combinations are mastered •Spasticity continues to decline
Stage 6	•Individual joint movement becomes possible •Coordination approaches normalcy •Spasticity disappears: individual is more capable of full movement patterns
Stage 7	Normal motor functions are restored

EVALUATION

MOTOR TEST- SHOULDER AND ELBOW

- Stage 1.
  - No voluntary movement
  - Limbs feel heavy
  - Flaccidity
- Stage 2.
  - Basic limb synergies appear
  - Flexor synergy appear before extensor synergy
  - Spasticity develops in elbow flexors

- Stage 3.

➢ Basic limb synergies become stronger

➢ Flexor synergy tested by asking the patient to scratch behind the ear

➢ Extensor synergy tested by asking the patient to touch between the knees held together

➢ Usually synergies does not combine in stage 3

- Stage 4.
  - 4A: Placing the hand behind the body
  - 4B: Elevation of the arm to a forward-horizontal position
  - 4C: Pronation- supination with elbow at 90.

- Stage 5.
  - 5A: Arm raising to a side-horizontal position
  - 5B: Arm raising forward and overhead
  - 5C: Pronation- supination with elbow extended
- Stage 6.
  - Isolated joint movements

MOTOR TEST- HAND

- Stage 1: Flaccidity
- Stage 2: Little or no active finger flexion
- Stage 3:

➢ Mass grasp

➢ Hook grasp but no release

➢ No voluntary finger extension

➢ Possible reflex extension of digits

- Stage 4:
  - Lateral prehension
  - Release by thumb movement
  - Semi voluntary finger extension, small range
- Stage 5:
  - Palmar prehension
  - Possibly cylindrical & spherical grasp
  - Awkwardly performed with limited use
  - Voluntary mass extension of digits

- Stage 6:
- Individual finger movements
- Voluntary extension of digits
- Less accurate than opposite side

SPEED TEST

1. Hand is moved from lap to chin, requiring complete ROM of elbow flexion

2. Hand is moved from lap to opposite knee, requiring full ROM of elbow extension

- Stop watch is used
- No of full strokes completed in 5 seconds

MOTOR TEST- TRUNK AND LOWER LIMB

- Stage 1. Flaccidity
- Stage 2. Minimal voluntary movement of lower limb
- Stage 3. Hip knee ankle flexion in lying & standing
- Stage 4.

➢ Sitting, knee flexion beyond 90^{o} with the foot sliding backward on the floor,

➢ Voluntary dorsiflexion of the ankle without lifting the foot of the floor

- Stage 5.
- Standing, isolated non weight bearing knee flexion with hip in extension or nearly extended
- Standing, isolated dorsiflexion of the ankle with knee in extension.
- Stage 6.
- Standing, hip abduction beyond range obtained from elevation of the pelvis
- Sitting, reciprocal action of the inner & outer hams muscles, combined with inversion & eversion

SENSORY STATUS

- Position sense
- Passive motion sense of upper and lower limb
- Finger tip recognition
- Sole sensation

PRINCIPAL OF TREATMENT

- Treatment must progresses developmentally
  (Reflex, Voluntary , Functional)
- Movement is facilitated using

➢ Reflexes

➢ Associated reactions

➢ Proprioceptive and exteroceptive stimuli

➢ Resistance

References

- Bandong, A. (2008). Approaches to therapeutic exercise: Concepts, principles, and strategies. Power point lecture presentation in PT 154.
- Bobath B (1990). Adult hemiplegia: Evaluation and treatment (3rd ed). Oxford, Heinemann Medical Books.
- Levitt S (2004). Treatment of cerebral palsy and motor delay (4th ed). Singapore, McGraw-Hill Inc.
- Sawner K & LaVigne J (1992). Brunnstrom's Movement Therapy in hemiplegia: A Neurophysiological Approach (2nd ed). Philadelphia, J.B. Lippincott Company.