“Negative” Contribution of automatic postural control following stroke.

By

Rajul Vasa

Applied Movement Scientist

Mumbai [India].

Natural recovery

- Following brain stroke, brain begins to heal naturally with reduction in swelling, reduction in the pressure on the surviving neurons, improved circulation and connectivity between distant neurons, instant plastic changes, dendritic sprouting in chronic stage etc. BUT……. Yet….. most of the stroke patients of today struggle to recover function of their paretic body like a fellow stroke patient who suffered stroke in the last century.

Lesion

- Primarily Brain Lesion is considered to be responsible for loss of function, weakness, spasticity and abnormal movements.

COM

- In my experience, brain lesion is only a catalyst. Prime player behind chain of complications and poor recovery is

‘Negative contribution’

of

automatic postural control

i.e.

control of our body Centre of Mass (COM)

- COM is an invisible entity and not an anatomical structure in our body.
- We can take COM safety for granted because safety is highly automatic and it is a priority for all living beings.

Impact of stroke

- First impact of stroke is general paresis of muscles of one side of the body. (some strokes have effect on both sides of the body.) Paretic flail weak muscles are unable to generate spatiotemporally effective force to control and restore COM to safety.

Instant plasticity

- Instant plasticity and adaptability of self-organizing brain automatically triggers switching control of Centre of Mass (COM) to muscles of good side of the body to prioritize safety from falling.

[Instant plasticity is positive plasticity for safety in acute state]

Getting adapted to use good side.

- Switching control to good side from instant plastic changes can be detrimental to recovery of paretic muscles on a longer run because stroke patients get adapted to depend on his good side for safety from falling during all postural movements like sitting down, getting up, standing, walking. etc.

Negative plasticity

- Positive plasticity of acute state helps in short term to be able to use good body to sit, get up, stand and walk but adaptability of the system turns this advantage into disadvantage with

Negative plasticity

in chronic state

with

- Inability to reload paretic side.
- Inability to control and restore COM to safety with paretic body.

Unloading of paretic limb.

- Paretic lower limb muscles cannot sustain the weight of the Head, Arms, Trunk [HAT] mass. This makes self-organizing brain to automatically

'Switch Off'

the control of COM from paretic side. This results into automatic shift of head arms and trunk [HAT] mass onto the good leg resulting into Poor loading of paretic leg despite verbal feedback, mirror feedback, EMG feedback.

Switching off

- Switching off the control on COM from paretic side and transferring it to good side happens without the knowledge of the stroke subject.
- This results in automatic dependence of the patient exclusively on his good side of the body.
- He sits, gets up, and walks, using his good hand whenever he attempts it.

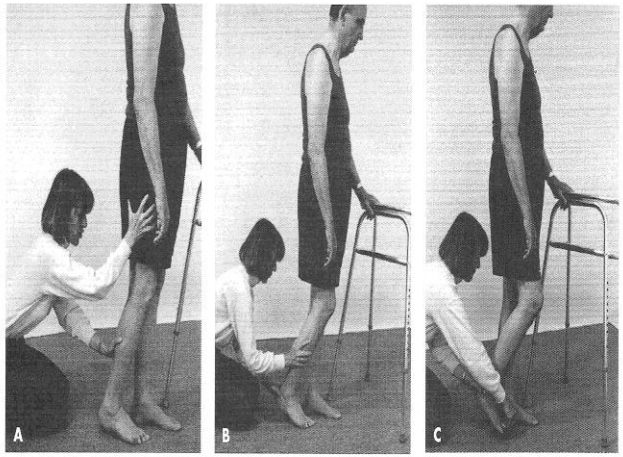
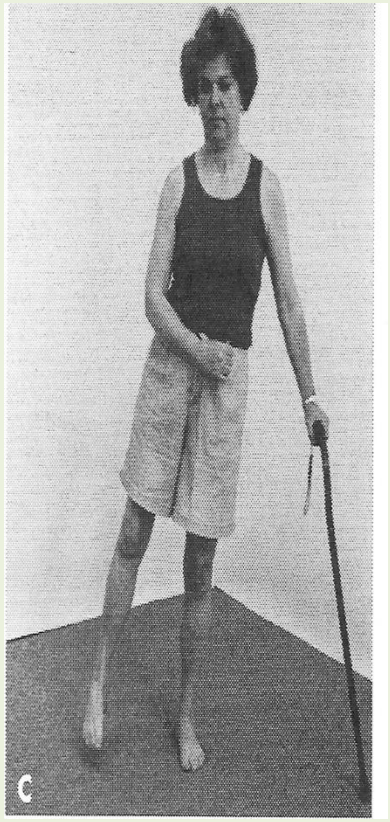


FIGURE 15-29 (*A*) Patient with a right hemiplegia standing with the support of a walker in left step/stance. Therapist places her right hand on his femur and her left hand on the tibia and externally rotates both leg segments to neutral as she asks him to shift forward onto his left leg. (*B*) She moves both hands more distally and her left hand now controls the rearfoot. Her control of the rearfoot helps prevent toe clawing. She uses both hands to help him learn how to move his heel gradually off the floor without losing control of depression so that he can shift forward onto the ball of the right foot. (*C*) As he shifts further forward and begins to swing his leg, she has him practice lifting his toes and ankle into dorsiflexion while the leg moves. Note the small size of the step/stance position. This decreases the demands on the hip and lower trunk so she can focus on ankle and foot reeducation.



Snowball effect

- Using good side to control, restore COM to safety and using good limbs to sit, get up and walk puts the stroke subject on a reverse escalator with negative recovery in terms of abnormal spastic movements that takes snow ball effect with passage of time with paretic limbs getting towed by good limbs.

Vicious Circle

- Despite initial natural healing in and around lesioned area poor loading on paretic leg triggers vicious circle of pathological abnormal movements from Spino- spinal connectivity between good limb and paretic limbs. These abnormal movements are ‘Here to Stay’ unless therapy focuses on making paretic body capable of controlling and restoring COM to safety.

Leading and Following

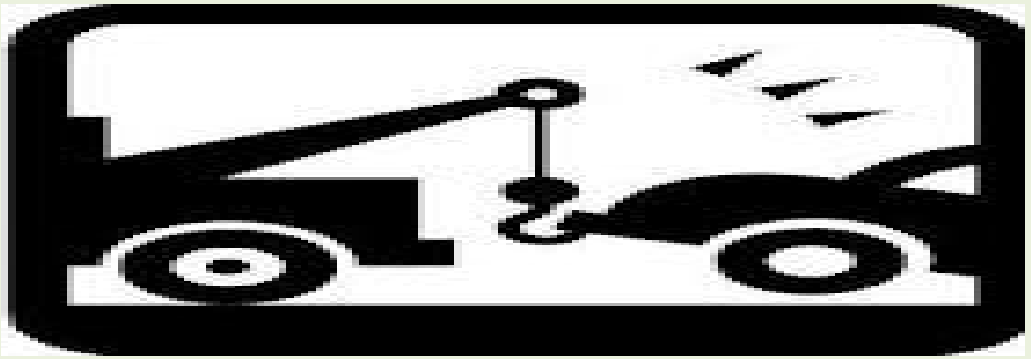
- Ability of good side to control and restore COM to safety makes good side turn into a LEADER leading and controlling posture uninterruptedly.
- This makes paretic side TO FOLLOW the good side uninterruptedly as safety of COM is automatic and is always a priority.

Towing

- In order that paretic side with huge inertial mass can be towed by good side easily optimally and economically, self-organizing brain begins to take several steps.

Car is hooked to towing van

- Contracture in deep short muscles and connective tissue at the central axis in the body hooks and binds paretic body to the good body for easy towing.



Log

- Brain with lesion triggers Contracture in connective tissue, in Thoraco-lumbar Fascia that connects cervical spine to pelvis and sacrum.
- Brain with lesion also induces stiffness and contracture in those large muscles which are attached to Thoraco-lumbar Fascia and travels all the way to upper limb like Lattissimus dorsi thus binding both girdles together like a log to enable easy towing by good side.

Anticipatory Postural control.

- Slightest instability, disequilibrium and threat to the safety of COM triggers anticipatory control to safeguard COM.
- Self-organizing brain restricts medio-lateral COM movement on paretic side in anticipation of threat in case if COM moved into paretic territory with weak flail muscles which are unable to restore COM to safety.

Solution by self-organizing brain

- With restrictions of medio-lateral movement of COM on paretic side, paretic lower limb is unable to bear weight of torso and upper limb thus reducing load on LL thereby reducing threat giving indirect safety to COM
- Also when self-organizing brain switches postural control for safety of COM to good side, no external verbal visual auditory feedback can change the solution arrived by self-organizing brain; not to shift weight medio-laterally on paretic lower limb.

Spino-Spinal connectivity

Brain exploits Spino-Spinal neuronal connectivity and limb to limb knowledge, inter limb knowledge to activate many muscles of paretic weak side together in a chain reaction in a synergic pattern to decrease ‘Increased degrees of freedom’ from paresis that could otherwise pose threat to the safety of COM. Safety being a priority for all living being.

Arm in abnormal flexion posture.

Brain triggers anticipatory control with slightest movement of COM and exploits Spino-Spinal connectivity and limb to limb knowledge, inter limb knowledge to bring the linked segments of paretic upper limb in flexion posture so as to bring the arm closer to the central axis so that segmental COM of paretic upper limb does not pose added threat to global COM by running out of the support surface.

Snow ball effect

Poor loading on paretic leg, abnormal flexion posture in upper limb, tight wrist and fingers continue to get worst with passage of time from negative contribution of automatic postural control that makes good limbs to dominate for safety from falling and paretic remain off loaded unless brain is re-reorganized with Vasa Concept to steer the paretic side to recover as desired.