Stroke rehabilitation:

Orthotic and prosthetics

Presented by:
Fateme Pol, *Assistant Professor of Orthotics and Prosthetics*
Department of Orthotics and Prosthetics, School of Rehabilitation Sciences
Isfahan University of Medical Sciences

Background

Globally, stroke is the second major cause of death and disability, with an incidence of 203 per 100 000 people and a worldwide average of 13 million new cases yearly.

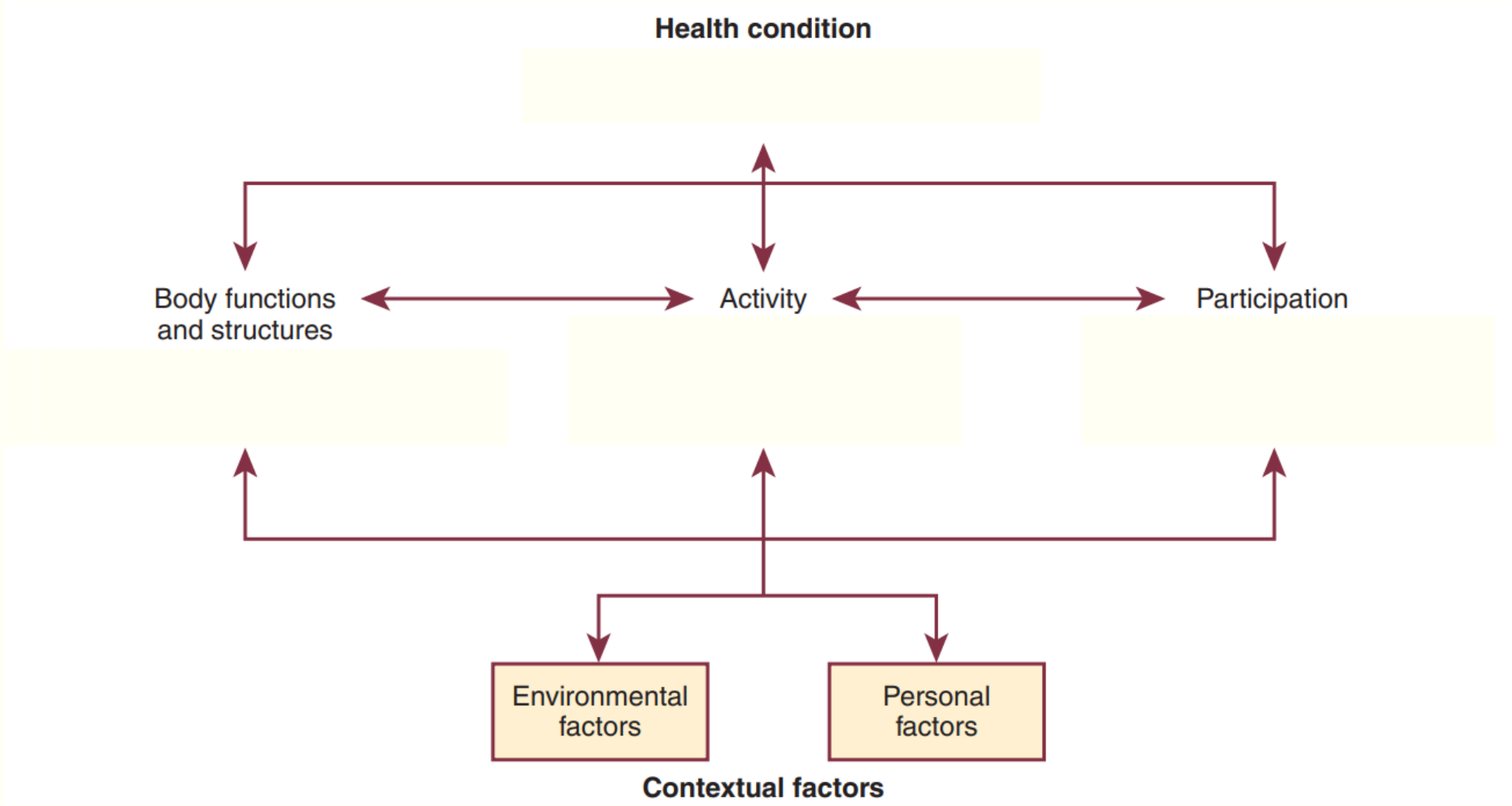
Loss or difficulty with ambulation has been described as one of the most devastating results of a stroke and, gait restoration is often a primary goal of rehabilitation.

Within the orthotics field, recovery assessment following a stroke often focuses on measurements of functional status, with an emphasis on gait, transfers, and balance

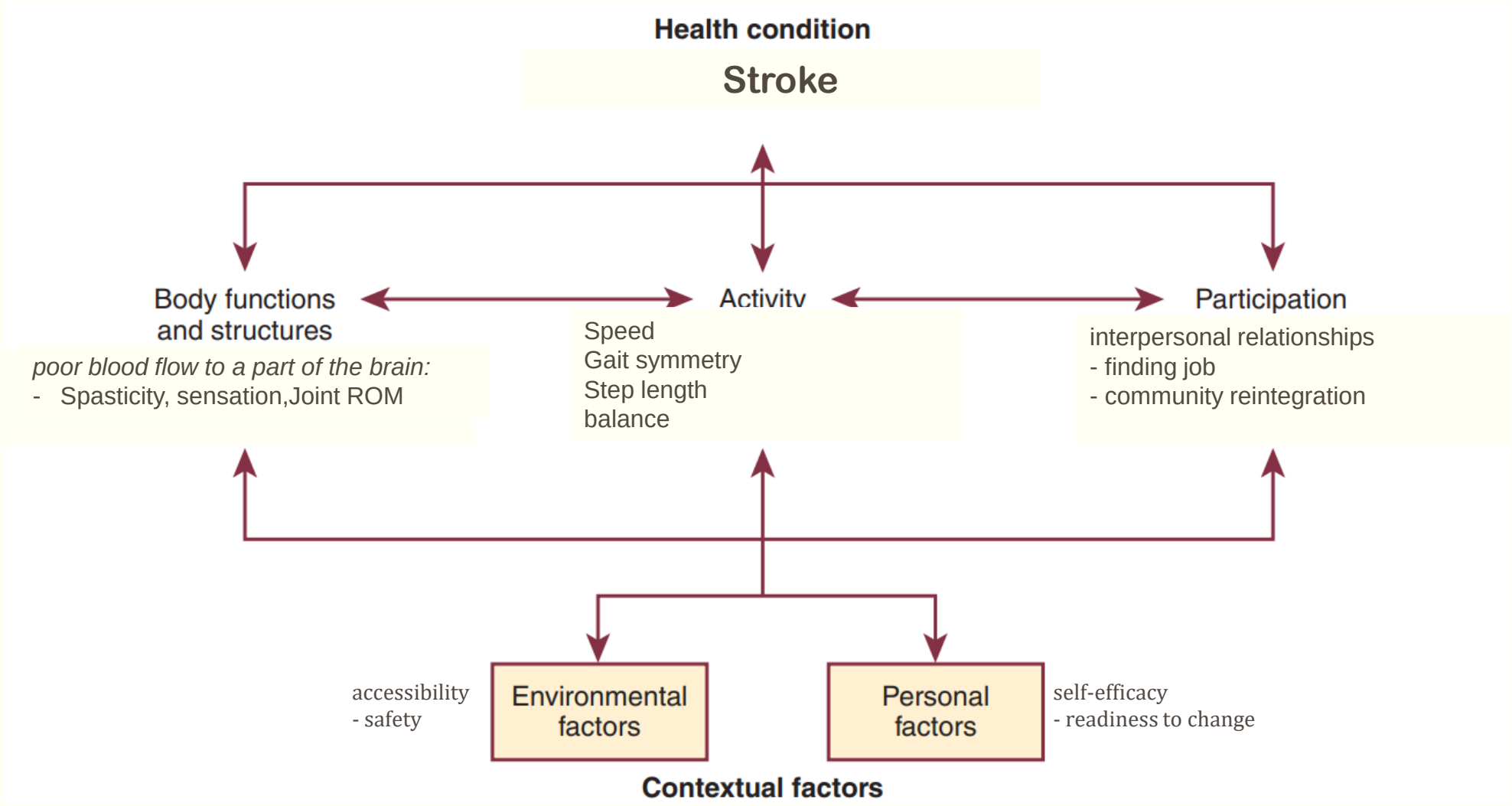
Background

- **Acute phase** :patients typically develop hypotonicity (flaccidity)
- **Chronic phase**: the hypotonicity reduces and is replaced by hypertonicity
- Orthoses for individuals with stroke is considered an integral part of the neurorehabilitation process
- Orthotic interventions differ across each stage of stroke recovery, with **distinct objectives** at each phase.
- Orthotic treatment in stroke patients is inherently individualized, tailored to the specific needs and progress of each patient.
- The neuroplastic changes occurring in stroke patients necessitate the re-assessment of orthotic devices at each stage of functional evaluation, prompting clinicians to continually reassess neuroplasticity in their clinical decision-making process.

ICF Model


Health condition
Body functions and structures
Activity
Participation
Environmental factors
Personal factors
Contextual factors

ICF Model: stroke

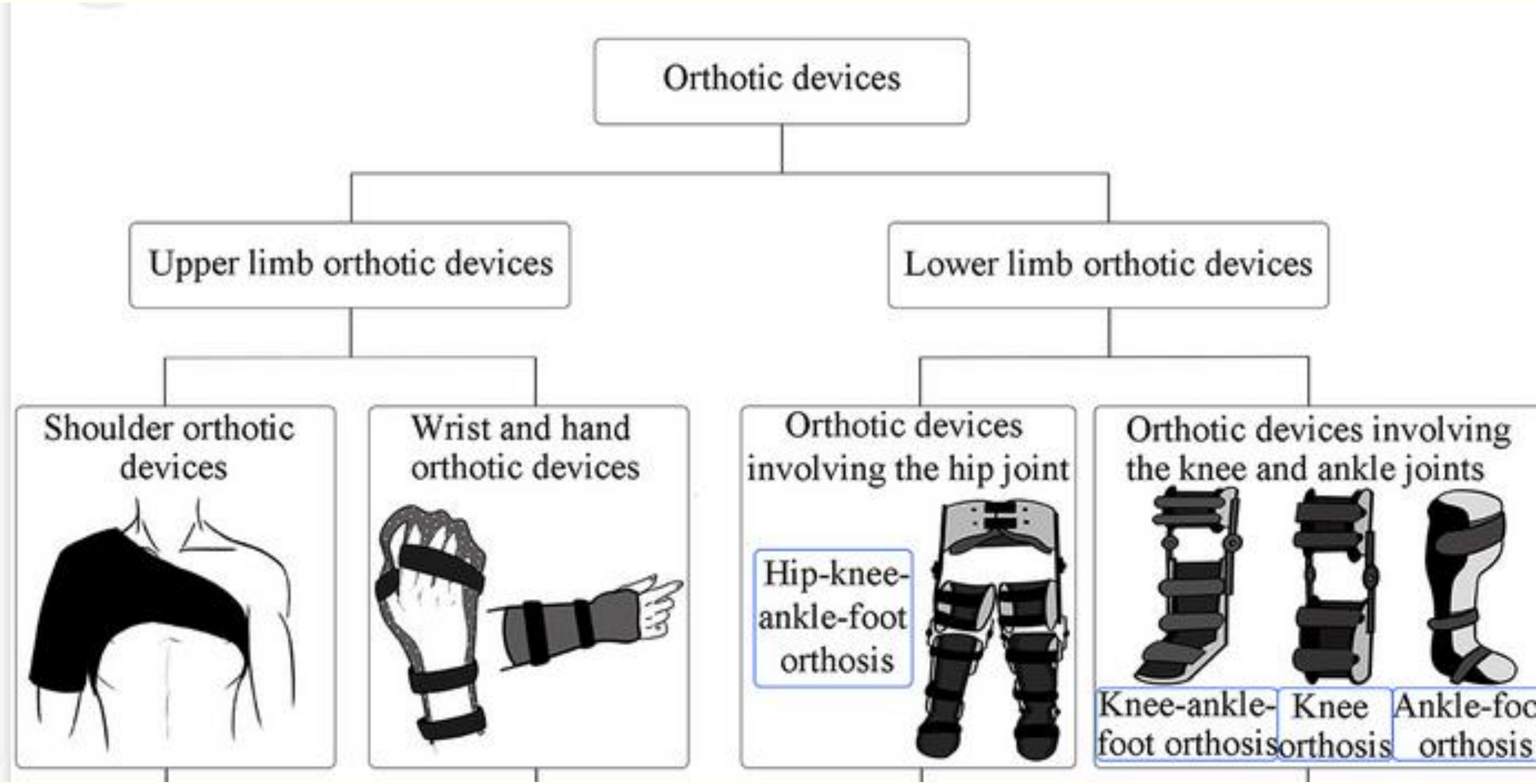


Objective of Orthotic Use in Neurological Impairments :

- An *orthosis* by *definition*, is "an *externally applied device* used to modify the structural and functional characteristics of the neuromusculoskeletal system.

- Preserve ROM and prevent contracture
- Spasticity control
- maintain alignment
- Promote function

- **"The application of orthoses in stroke patients differs significantly between hypertonicity and hypotonicity; in the hypertonic phase, orthoses are primarily used to manage spasticity, prevent contractures, and maintain joint alignment and range of motion, while in the hypotonic phase, orthoses provide support to weak or flaccid muscles, prevent joint collapse, and maintain proper anatomical positioning to facilitate early movement and mobilization.**


Orthotic devices
Upper limb orthotic devices
Lower limb orthotic devices
Shoulder orthotic devices
Wrist and hand orthotic devices
Orthotic devices involving the hip joint
Orthotic devices involving the knee and ankle joints
Hip-knee-ankle-foot orthosis
Knee-ankle-foot orthosis
Knee orthosis
Ankle-foo orthosis

Gait pattern

- The most common pattern of walking impairment poststroke is hemiparetic gait, which is characterized by **asymmetry associated with an extensor synergy pattern in L.E and flexor in U.E**

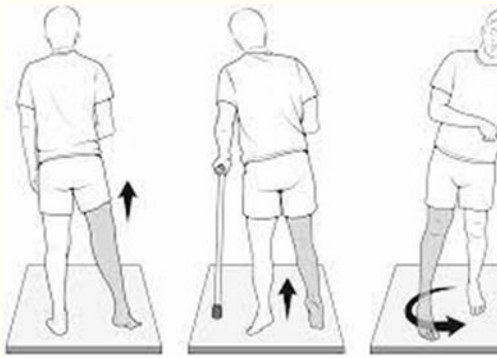
Lower limb orthosis:
Control of the Foot and Ankle
Equinus Associated With Low Tone

Flaccid paralysis of the dorsiflexors, in the absence of any significant increase in plantarflexor tone, results in a dropfoot that is a problem principally in swing phase on stairs and inclines or when navigating over obstacles. This leads to difficulty clearing the ground with the affected leg, with adoption of compensatory strategies such as

- **vaulting**(a compensatory gait which defined by a plantar flexion of the contralateral ankle during the single-limb support phase.)
- **circumduction**(each step is rotated away from the body, then towards it, forming a saemicircle.)

Or

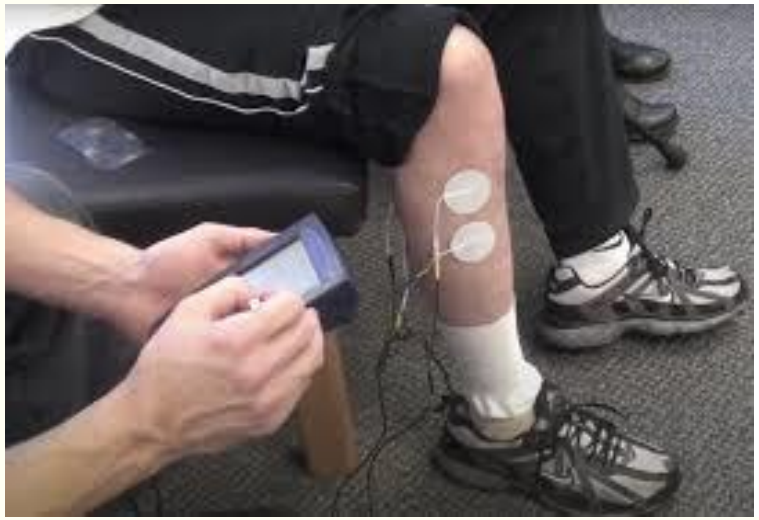
- **steppage gait**(A manner of *walking* in which the advancing foot is lifted high so that the toes clear the ground)



Lower limb orthosis:
Control of the Foot and Ankle
Equinus Associated With Low Tone

Orthotically, this situation can often be managed with

1-a PLS AFO
3-functional electrical stimulation (FES)



Lower limb orthosis:
Control of the Foot and Ankle
Equinus Associated With High Tone

More common than the flaccid dropped foot is the development of an equinus posture due to the increase in plantarflexion tone.

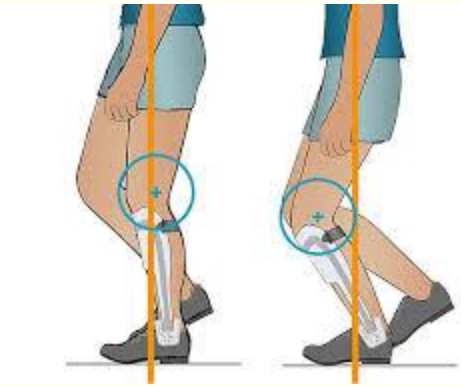
Once again, initial contact is made with the forefoot, but in this case, rather than the foot dorsiflexing under body weight to achieve full plantar surface contact with the ground, the foot remains plantarflexed and is able to make full contact only at the expense of persistent knee extension, hyperextension, or midfoot collapse .

Lower limb orthosis:
Control of the Knee
Knee Hyperextension Control

Knee hyperextension after stroke is common and should not be ignored.

DIRECT:
A KAFO may be a better option in the population of individuals who have had a stroke because it can address simultaneously the problems of the knee and the ankle-foot complex.

INDIRECT:
Even significant knee hyperextension can be satisfactorily controlled using an AfO that prevents plantarflexion in stance .



If the AfO must be made in plantarflexion because of a contracture or to avoid triggering spasticity, the appropriate angle of tibial inclination still can be achieved by varying the heel height of the footwear or by using heel wedges, a process known as APO tuning

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Upper limb orthoses for the stroke

Objectives of Upper Extremity Orthoses in Stroke Rehabilitation

- **Prevent Deformities:** Maintain anatomical positioning to prevent contractures and deformities, especially in the wrist, hand, and shoulder.
- **Enhance Functional Capacity:** Improve the functional use of the upper extremity by stabilizing joints and enabling the patient to perform essential tasks.
- **Support Weak Muscles:** Provide external support to weak or paralyzed muscles to promote mobility and functional independence.
- **Stabilize Joints:** Prevent excessive joint movements, such as subluxation or hyperextension, and assist in maintaining proper alignment for joint stability and function.

SLING

Purpose: These orthoses are particularly important for stroke patients with hemiplegia, where shoulder subluxation or dislocation may occur due to muscle weakness. The orthosis helps stabilize the shoulder joint and prevents it from moving into an unstable position.

Treatment Objective: To prevent shoulder subluxation, maintain joint alignment, and reduce pain or discomfort caused by muscle imbalance or weakness. It also facilitates smoother arm movements by providing external support.

WRIST AND HAND ORTHOSIS

Purpose: These are used primarily in the acute and chronic phase of stroke to maintain the hand in a antispastic or functional position, preventing contractures and deformities such as claw hand or fist formation. They help in preventing the development of pressure sores by supporting the wrist, hand, and fingers in a neutral or slightly extended position.

Treatment Objective: To prevent joint deformities, maintain anatomical alignment, and support the natural position of the hand during the early phase of rehabilitation.