Causes

- CVA--brain ischemia due to thrombosis, embolism, or systemic hypoperfusion
- Intracerebral hemorrhage--bleeding directly into the brain parenchyma
- Subarachnoid hemorrhage--bleeding into the cerebrospinal fluid within the subarachnoid space that surrounds the brain
- Spinal cord injury--injury which affects one half of the spinal cord
- Traumatic brain injury--injury to the brain which affects one half of the motor homunculus
- Cerebral palsy--can cause spastic hemiplegia

Hemiplegia leaves the patient with paralysis of one vertical half of the body
Prevalence

- The leading cause of hemiplegia is stroke\textsuperscript{6}
- Each year about 500,000 people experience a first stroke and 200,000 people experience a recurrent stroke, and these numbers are rising\textsuperscript{5}
- Hemiplegia is seen in 50\% of stroke survivors\textsuperscript{3}, 30\% are unable to walk without an assistive device and 26\% are dependent in activities of daily living 6 months after the stroke\textsuperscript{5}
42 y/o male; 11 months post stroke
  ○ R sided hemiplegia following a L MCA stroke

**toeOFF AFO (dynamic AFO)**
  ○ Lightweight carbon fiber
  ○ Carried on the anterior of the tibia, extending over lateral ankle and beneath the entire sole of foot

**Affected and unaffected limb observed, with and without AFO**
  ○ Temporal spatial and kinematic variables
Case Report - Results

- Temporal Spatial Variables
  - With use of AFO
    - Increase in cadence, bilateral stride length, and step length = increased walking speed
    - Bilateral decrease in DLS and step width

- Kinematic Variables
  - With use of AFO
    - Increase in ankle dorsiflexion at foot strike
    - Unchanged knee joint angle
    - Increase in hip flexion

<table>
<thead>
<tr>
<th>Condition</th>
<th>Gait velocity (m/sec)</th>
<th>Cadence (steps/min)</th>
<th>Step length (mm)</th>
<th>Stride length (mm)</th>
<th>Step width (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Affected Limb (-)AFO</td>
<td>0.51 ± 0.03a</td>
<td>85.45 ± 2.38</td>
<td>416.45 ± 20.41a</td>
<td>762.11 ± 22.92a</td>
<td>213.39 ± 8.82a</td>
</tr>
<tr>
<td>Affected Limb (+)AFO</td>
<td>0.58 ± 0.03a</td>
<td>87.05 ± 1.23</td>
<td>445.30 ± 14.15a</td>
<td>818.60 ± 28.95a</td>
<td>186.33 ± 20.14a</td>
</tr>
<tr>
<td>Unaffected Limb (-)AFO</td>
<td>0.51 ± 0.03b</td>
<td>85.45 ± 2.38</td>
<td>345.66 ± 14.11b</td>
<td>733.90 ± 34.39b</td>
<td>219.43 ± 13.36b</td>
</tr>
<tr>
<td>Unaffected Limb (+)AFO</td>
<td>0.58 ± 0.03b</td>
<td>87.05 ± 1.23</td>
<td>379.33 ± 24.70b</td>
<td>824.35 ± 27.15b</td>
<td>187.95 ± 15.62b</td>
</tr>
</tbody>
</table>

* $p \leq 0.05$ with vs. without AFO for the affected limb;
* $p \leq 0.05$ with vs. without AFO for the unaffected limb.
Clinical Ramifications

- Common Complications
  - Contractures
  - Inferior subluxation of GH joint
    - Bobath shoulder roll or Henderson shoulder ring
  - Gait dysfunction
    - asymmetrical gait with less time spent on affected limb than unaffected limb, hip hiking of the affected leg, reduction in knee flexion from toe-off to mid-swing, foot flat initial contact or drop foot

![Diagram of GH joint subluxation stages](image-url)
Hemiplegic Gait Pattern

Pt with R Hemiplegia walking with a 4-point cane and no orthotic

Pt with L Hemiplegia walking with a cane and orthotic
PT implications and treatment

- Gait Training
- Assistive device training
  - Cane may be more functional than a walker
- Transfer training
  - Transfer towards hemiplegic side
- Balance training
- Contracture treatment
  - Stretching
  - Casting

Newman (1972)
Orthotic Options

• Ankle Foot Orthoses
  ○ Posterior spring leaf AFO: used for patients who have instability of the knee along with drop foot
  ○ Solid AFO: Stops plantarflexion, as well as stopping or limiting dorsiflexion. Also good for patients with an unstable knee as it gives a tremendous amount of support.

• Shoulder Orthoses
  ○ Bobath shoulder sling, Henderson shoulder sling, Hemi-arm sling etc.
  ○ Functional Shoulder Orthoses: A stainless steel ball and socket joint is externally placed between the chest and arm and is attached to the torso. The orthotic is also attached via cuffs to the humerus and forearm. The cuffs are connected to
Treatment of glenohumeral subluxation

Functional Shoulder Orthosis

Hemi-arm sling

Bobath Clavicular sling

California Tri-pull taping method
References

3. Evaluation of a dynamic ankle foot orthosis in hemiplegic gait: A case report
5. The use of Ankle Foot Orthoses in the Management of Stroke