

Introduction

- Cerebral palsy (CP): most common motor disability in children (~1.6/1000 births)¹¹
- Caused by abnormal brain development/damage → affects movement, posture, balance¹⁴
- Electrical stimulation: uses electrical currents to activate muscles¹²
- Goal: improve **gait, strength, and motor function**



Methods

- Database: Google Scholar
- Keywords: CP, electrical stimulation, gait, NMES, FES, TES
- Included: RCTs, meta-analyses (1990–2026)
- Excluded: adult-only studies

Therapeutic Electrical Stimulation (TES)

- *What it is*
 - ◆ Low-intensity, long-duration stimulation³
- *Key Findings*
 - ◆ ↑ **Passive range of motion**⁶
 - ◆ ↓ **Spasticity**⁶
 - ◆ High compliance³
 - ◆ Well tolerated³
- *Takeaway*
 - ◆ Best as a supporting therapy³



Image from: (Renue Physical Therapy, 2024)

⚡ Electricity to Motion ⚡

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Functional Electrical Stimulation (FES)

- *What it is*
 - ◆ Stimulation during tasks (walking, reaching)^{10, 15}
- *Key Findings*
 - ◆ ↑ **Gait symmetry & foot clearance**^{13, 15}
 - ◆ ↑ **Daily function (walking)**^{2, 15}
 - ◆ ↑ **Neuroplasticity**⁹
 - ◆ ↑ **Lasting effects post-treatment**⁹
- *Takeaway*
 - ◆ Most effective for real-life function^{10, 13, 15}



Image from: (FES for Cerebral Palsy, 2018)

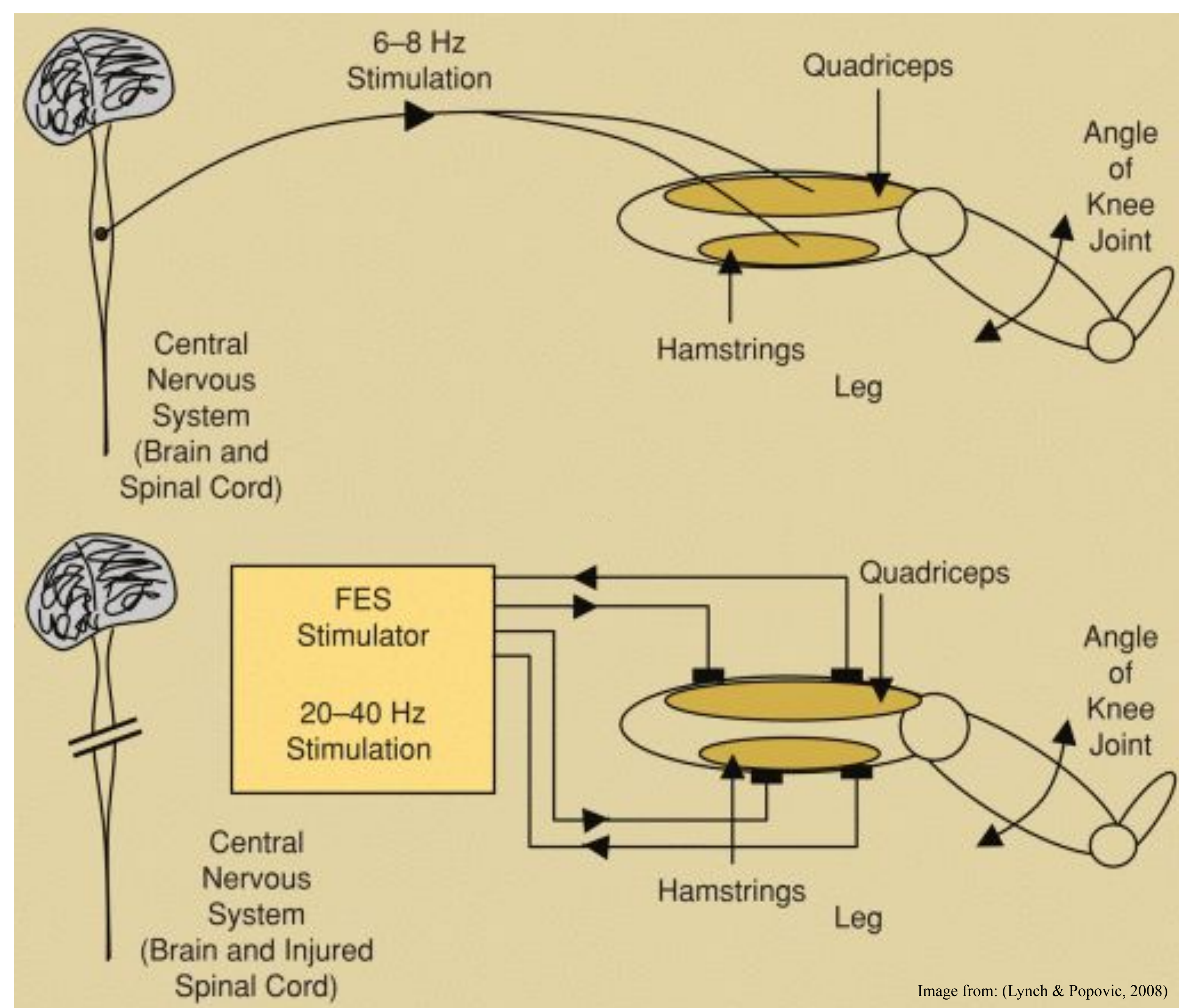


Image from: (Lynch & Popovic, 2008)

Limitations

- Small samples & inconsistent methods
- Limited long-term data & generalizability

References



Neuromuscular Electrical Stimulation (NMES)

- *What it is*
 - ◆ Stimulates muscles and nerves → causes contractions¹²
 - ◆ Used for strength + motor control
- *Key Findings*
 - ◆ ↑ **Walking speed**^{4, 16}
 - ◆ ↑ **Step length**^{1, 16}
 - ◆ ↑ **Muscle strength**^{4, 8}
 - ◆ ↓ **Spasticity**¹⁶
 - ◆ Works best with physical therapy^{4, 8}
- *Takeaway*
 - ◆ Strong evidence for improving active movement + walking^{4, 16}



Image from: (Wright et al., 2012)

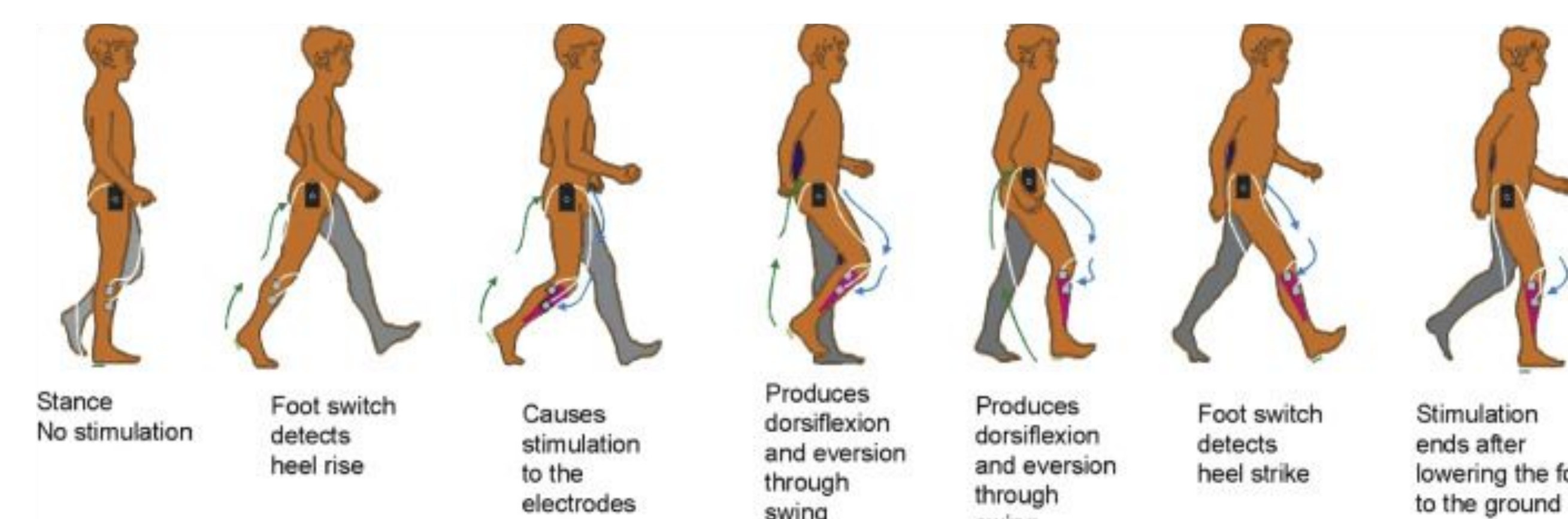


Image from: (Singleton et al., 2019)

Conclusion

- All effective but serve different roles
- Best outcomes from combined, continuous use
- *Clinical Insight*
 - ◆ TES → prepares muscles^{6, 7}
 - ◆ NMES → builds strength^{1, 4, 16}
 - ◆ FES → applies function^{9, 13, 15}
- *Future Research*
 - Larger studies needed
 - Standardized protocols
 - Focus on real-world outcomes & quality of life