



Movement Disorders After Brain Injury

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Objectives

1. Review the evidence behind linking brain injury to movement disorders
2. Identify movement disorders that are commonly seen in persons with brain injury
3. Discuss management options for movement disorders in persons with brain injury





Brain Injury and Movement Disorders: Why They Happen

History

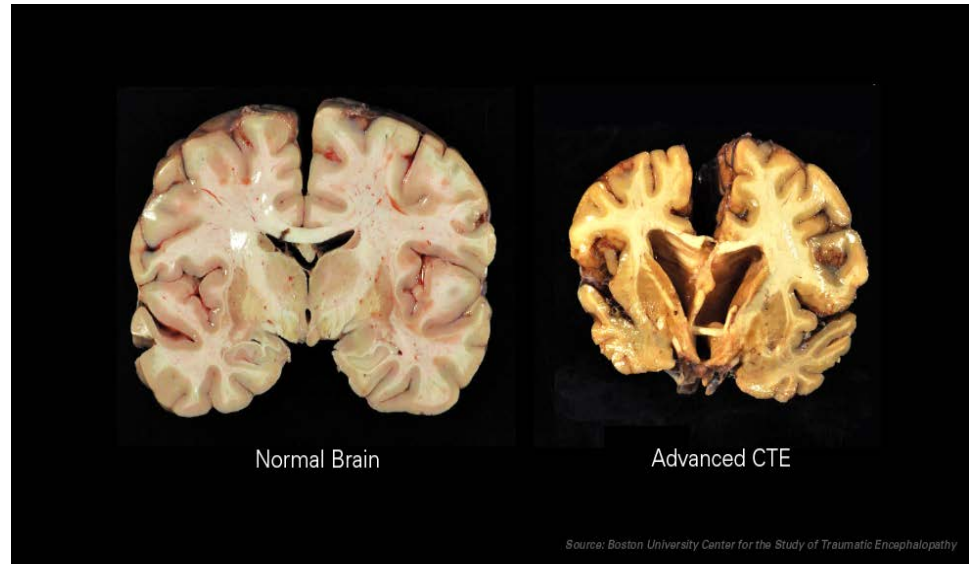
- James Parkinson's *Essay on the Shaking Palsy*
 - Stated that PD patients had no h/o trauma
- "*Punch Drunk Syndrome*" in boxers (Martland, 1928)
- Parkinsonian features after midbrain injury (Kremer 1947)
 - 7 pts, Varying etiology of injury
- Many more reports have emerged over time



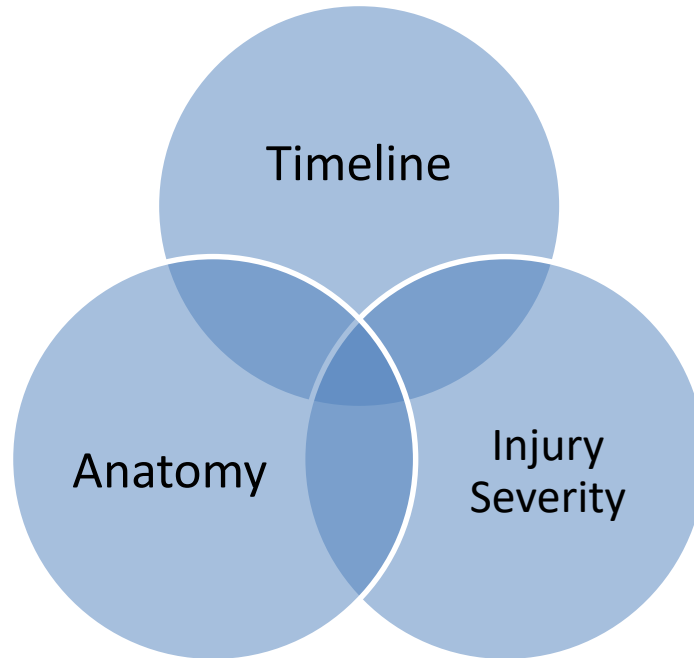
History

Chronic Traumatic Encephalopathy (CTE)

- *Dementia pugilistica* (1920s)
- **Chronic, repeated** head injury (30%)
 - Football players
 - Mike Webster, 2005
 - Boxers
 - Other “combat” sports
 - Domestic violence
 - Military background
- Many neurological sx
- Dx on autopsy
 - Taupoathy



Linking Brain Injury to Movement Disorders



Brain Injury and Movement Disorders

Typically **severe** injury

- Rare after mild-moderate injury

Pre-existing movement disorders *may* be linked

- Parkinson's Disease (PD)
- Caveats:
 - Incidence is overall low
 - Environmental factors also at play
 - Not all data supports it

• *Neurology* (2018)

- 325,870 veterans
- Half with TBI (all severities)
- 12-year follow-up
 - 1,462 dx with PD
 - 949 had TBI
- **Mild TBI = 56%** increased risk of PD
- **Mod-Severe TBI = 83%** increased risk of PD



Timeline: Brain Injury and Movement Disorders

Variable and Etiology-Dependent

- Tremor
 - Two weeks to 1 year following injury
- Dystonia
 - 2 months to 2 years
- Parkinsonism
 - Delay of years
- Ataxia depends on cause
 - Stroke - acute
 - Toxic exposure and TBI – months to years
- Chorea / ballism
 - Usually acute (ABI)



Severity of Brain Injury and Movement Disorders

Typically severe injury

- Definition
 - Amnesia > 7 d PTA
 - GCS < 8 after 30 min
 - LOC > 7 d
- 1996 study of 221 patients (Krauss)
 - 22.6% with MDs
 - Tremor (19%)
 - Dystonia (4.1%)
- 13-66% (Krauss & Jankovic 2002)
- 45% of kids developed tremor (Johnson & Hall 1992)



Severity of Brain Injury and Movement Disorders

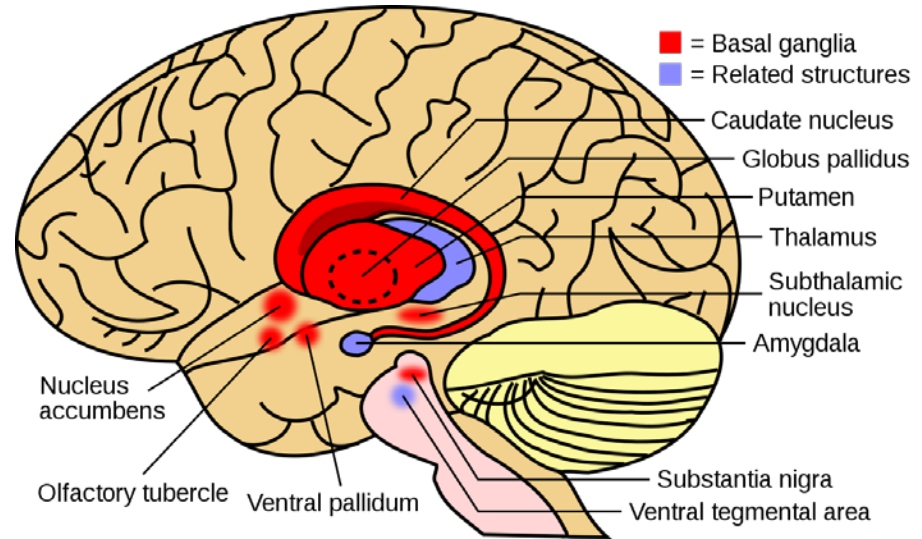
Rare after *mild-moderate* injury

- “Concussion”
 - Amnesia <24 hr PTA
 - GCS 13-15 after 30. min
 - LOC <30 min
- Sx Transient
- Often no Rx needed
- 1996 study of 158 patients (Krauss)
 - 10% with MDs
 - 7.6% transient
 - 2.6% persistent
 - 50% in severe (Krauss et al 1997)



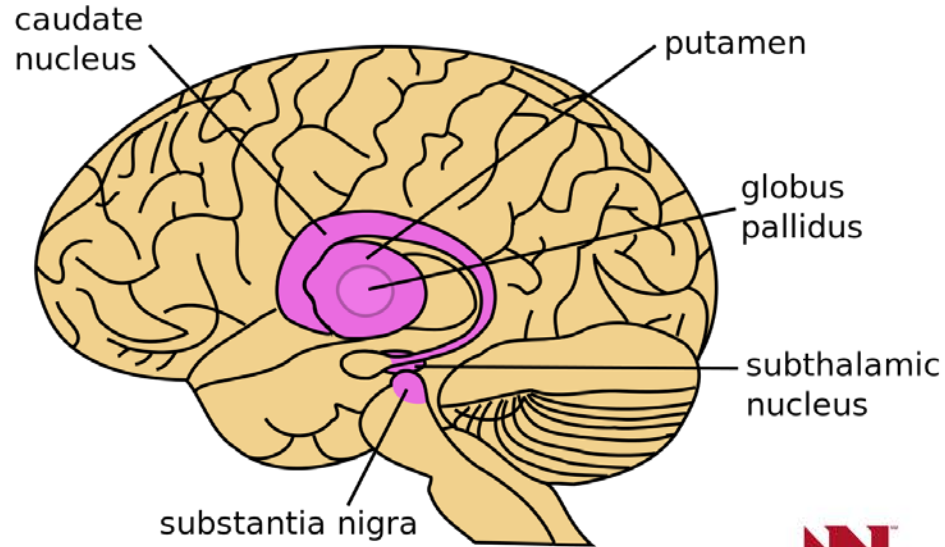
Anatomy of Movement Disorders

- Damage to:
 - Basal ganglia
 - Thalamus
 - Cerebellum
 - Cortex (indirectly BG)

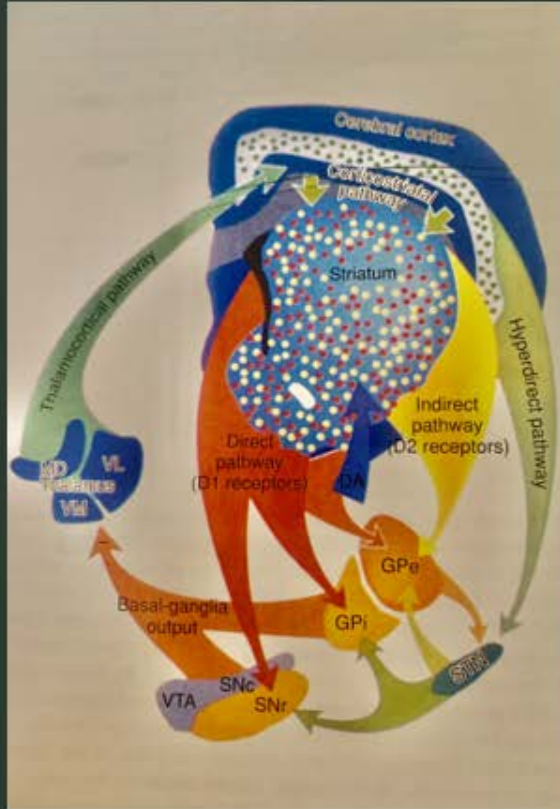


The Basal Ganglia

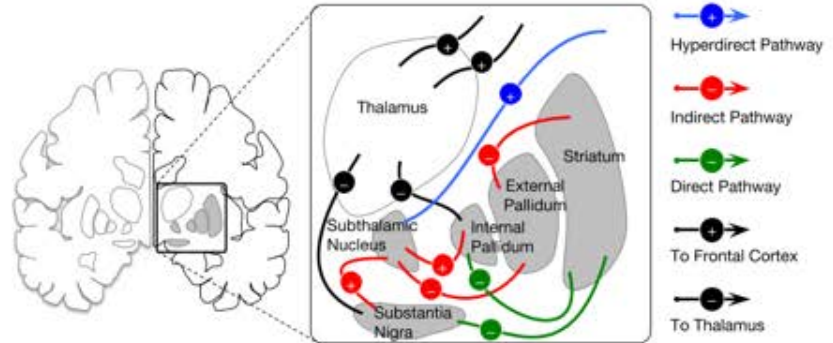
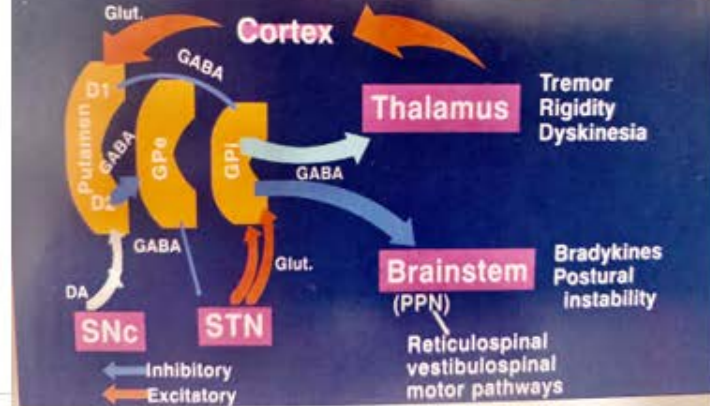
- Where movement disorders happen!
 - Key role = *initiation* and *integration* of movement



ORGANIZATION – THE PATHWAYS

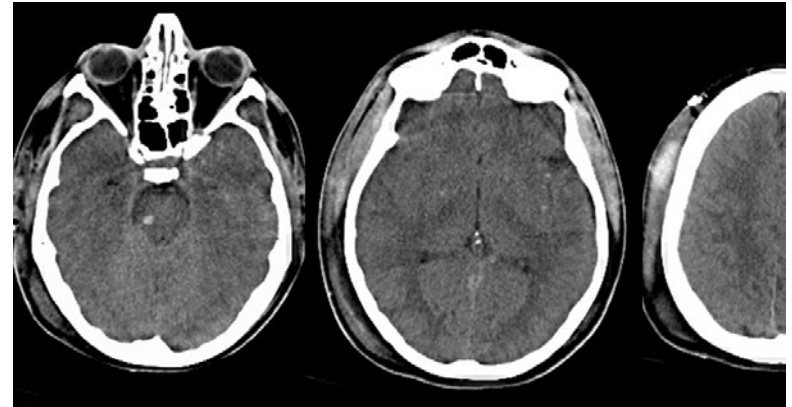


Functional Anatomy of Basal Ganglia



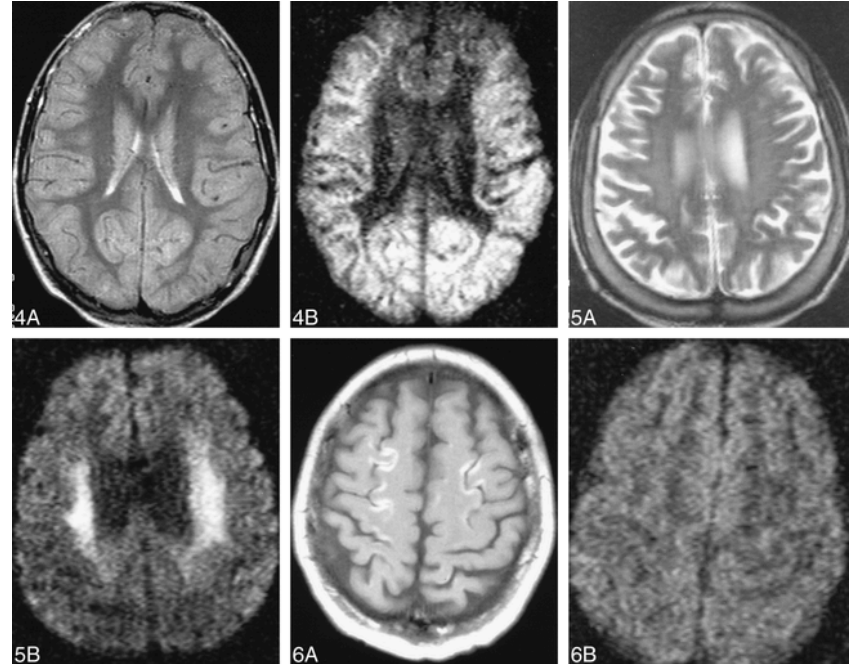
Mechanisms of Brain Injury and Movement Disorders

- Common injuries:
 - Contusions
 - Diffuse axonal injury (DAI)
 - Stroke
 - Ischemia
 - Hemorrhage



Mechanisms of Brain Injury and Movement Disorders

- Secondary injuries:
 - Hypoxia
 - Hypotension
 - Elevated intracranial pressure (ICP)



Anatomy of Movement Disorders

What happens when these areas gets damaged?

- Tremors**
 - Action/Kinetic
 - Postural
 - Resting
- Dystonia**
- Muscle spasticity
- Myoclonus
- Ataxia & coordination issues
- Parkinsonism
- Chorea & athetosis
- Clonus
- ...and more!





Common Movement Disorders After Brain Injury

Tremor

- Damage to:
 - Substantia nigra
 - Thalamus
 - Cerebellum
- Associated with *deceleration* trauma
 - eg, impact from a car accident



Tremor

- Most common MD
- Multiple types:
 - Kinetic - action
 - Resting
 - Postural
 - Ataxic / Cerebellar
 - Proximal
 - Rubral or “Holmes”
 - Dystonic
 - Myoclonic
- Upper extremities
- Two weeks to 1 year following injury



Tremor



Tremor



Parkinsonism

- Resting tremor
- Stiffness / rigidity
- Slowing of movements (bradykinesia)
- Balance difficulties
- “Shuffling gait”



Parkinsonism

- Very rarely a single head injury
 - Would have to penetrate the brainstem or be very severe (eg, coma)
 - Muscle rigidity and slowness > tremor
 - May take weeks to years to emerge after injury
- Repeated head injury
 - *Pugilistic PD*
 - 20-50% of boxers
 - Correlates to length and # of injuries
 - Onset delay of years
 - Tremor more common



Parkinsonism

- Different pathological findings than idiopathic PD
- Genetic predisposition
 - Apolipoprotein E4 allele
- Link to Idiopathic PD?
 - More head injuries in PD patients (Factor & Weiner)
 - 20-30 years before onset
 - Higher risk with # of injuries and (+) LOC



Parkinsonism

PILL ROLLING TREMOR - PARKINSONS DISEASE

By Dr O'Donovan MBBS,
MRes



Parkinsonism



Dystonia

- Damage to:
 - Caudate
 - Putamen
 - STN
 - Thalamus
- Involuntary muscle contraction
- Abnormal postures



Types of Dystonia

Focal

Segmental

Generalized



Dystonia

- Patterned, twisting
- Worsened by movement
- May look like tremor or myoclonus
 - Jerky quality
 - Certain positions make it better or worse



Dystonia



Dystonia



Spasticity

- Hypertonia
- Velocity-dependent resistance to stretch
 - “Clasped knife”
- Increased tendon jerks



Spasticity

- Spasms
- Abnormal postures
- Weakness
- Fatigue
- Increased stiffness
 - Can be valuable

Identifying gait abnormalities

SPASTIC GAIT



SCISSORS GAIT

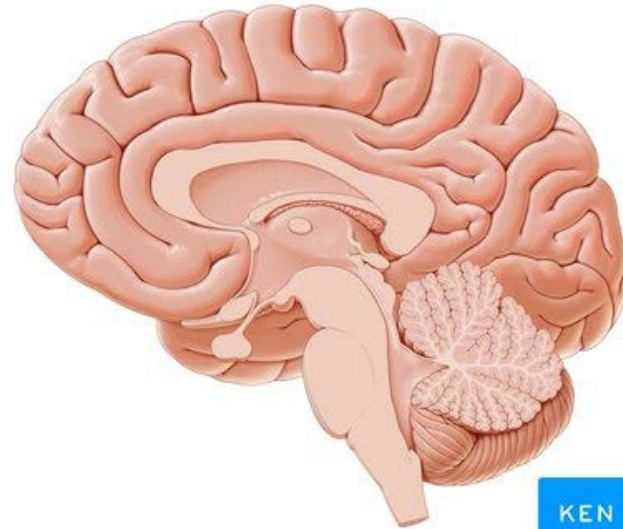


Spastic Gait



Ataxia & Discooordination

- Damage to the cerebellum
- Stroke, TBI, toxic exposures
- Coordination issues:
 - Ataxia
 - Dysmetria
 - Speech apraxia
 - Nystagmus



Ataxia & Discooordination



Ataxia & Discooordination



Nystagmus & Eye Movements



Chorea, Ballism & Athetosis

- Basal ganglia injury
- Chorea
 - Large amplitude
 - Involuntary “dance-like” movement
- Athetosis
 - Slower
 - Distal (hands, feet)



Chorea, Ballism & Athetosis

- Ballism / Hemiballismus
 - Usually unilateral
 - “Wild flailing”
 - STN Stroke



Chorea, Ballism & Athetosis

Chorea & Athetosis



Chorea, Ballism & Athetosis

Hemiballismus



Myoclonus

- Unpredictable jerking movements
- Not rhythmic
- Small amplitude
- Severe with brain injury
- Often follows diffuse insult
 - eg, hypoxic event



Clonus



- Hyperactive stretch reflex
- Looks like tremor
- Arms and legs
- Triggered by stretching



Rare Post-Traumatic Movement Disorders

Ballism

Paroxysmal
Dyskinesias

Tics &
Tourettism





Treatment of Movement Disorders After Brain Injury

Prognosis

- Rare spontaneous recovery
- Mild-moderate injury
 - Transient, non-disabling
- Severe head injury
 - Very disabling
- Rx is multidisciplinary
 - PT, OT
 - Psychotherapy
- Pharmacological Rx similar for non-traumatic MDs



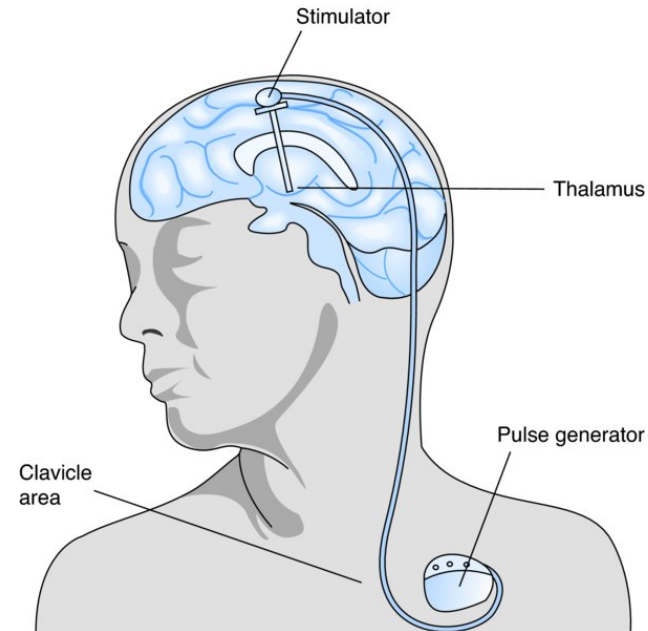
Tremor Treatment

- No Rx for mild-mod injury
- Hard to treat after severe injury
- Kinetic tremor
 - Propranolol, Primidone, Topiramate
- Rest tremor
 - Carbidopa/Levodopa (Sinemet), anticholinergics
- Postural tremor
 - Botox may be helpful



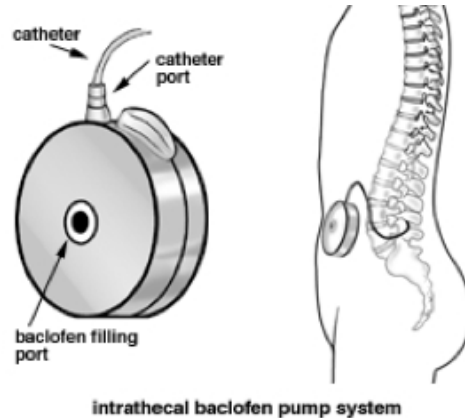
Tremor Treatment

- Overall, medications do not work as well
- Surgery for severe tremor cases
 - Deep brain stimulation (DBS) targeting the thalamus



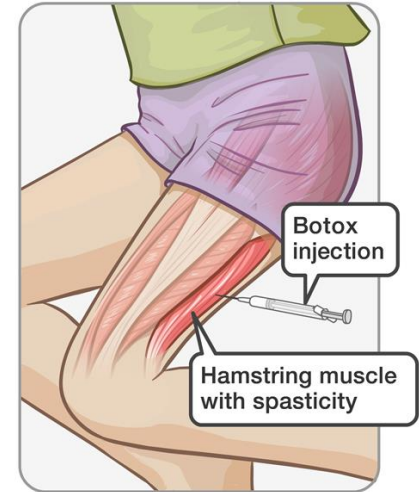
Dystonia Treatment

- Typically will stabilize over time
- **Botox** is the treatment of choice
- Medications less effective
 - Anticholinergics
 - Benzodiazepines
 - Baclofen
- Surgery is also an option
 - DBS to the thalamus or GPi
 - Baclofen pump therapy



Spasticity Treatment

- PT/OT
- Orthotics
- Oral drugs
 - Baclofen
 - Benzodiazepines
 - Muscle relaxers
- Botox
- Baclofen Pump
- Tendon Release Surgery



Parkinsonism Treatment

- Similar to regular PD
 - Carbidopa/Levodopa (Sinemet)
- DBS to the subthalamic nucleus or globus pallidus



Chorea, Ballism & Athetosis Treatment

- More persistent
- Less likely to spontaneously resolve
 - Better prognosis in ballism from STN stroke
- Tetrabenazine
- Benzodiazepines
- Surgery
 - Baclofen pump
 - DBS?



Treatment at UNMC

- Botox Injections
- Intrathecal Baclofen Pumps (ITB)
- Deep Brain Stimulation (DBS)
- Other post-brain injury treatment
 - Memory care
 - PT, OT, Speech
 - Headache
 - Chronic pain





Questions?

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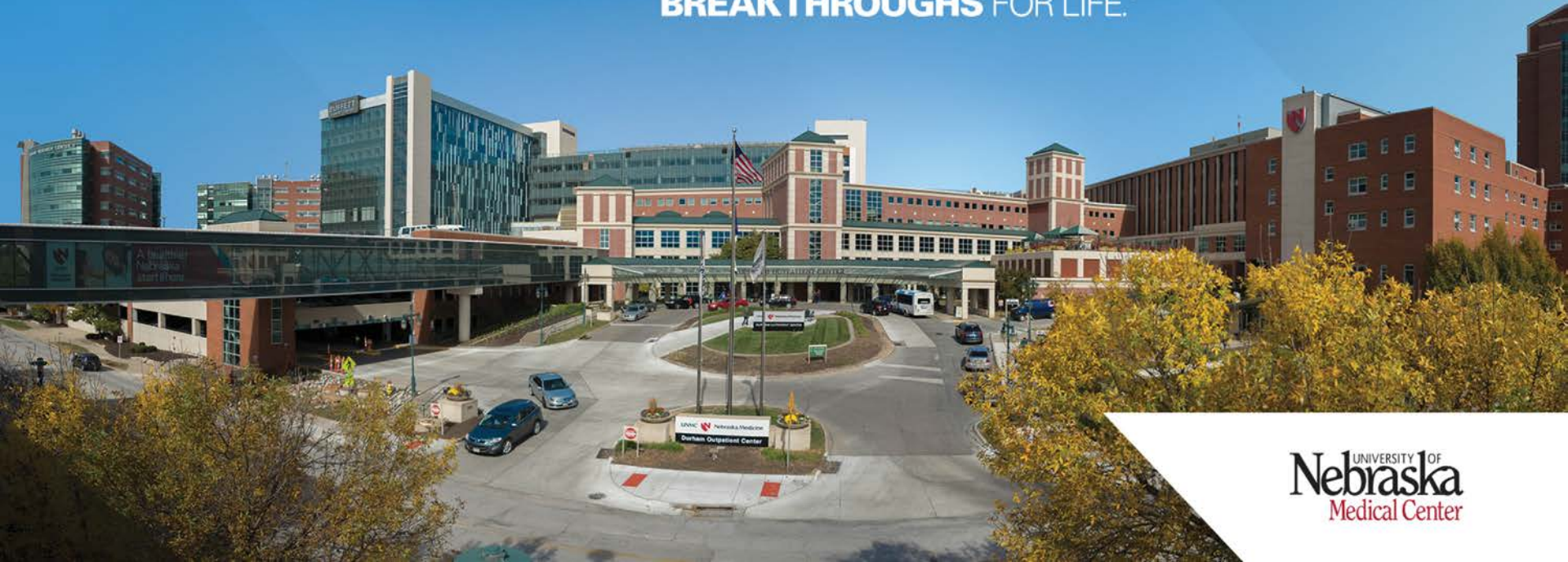


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