

# Case Report on Vestibular and Oculomotor Rehab for Concussion

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*Carolina Panthers*

# Sideline Evaluation

## Immediate Symptoms

Headache

Dizziness

Fogginess

## Memory Assessment

Correct  
Maddocks

No Amnesia

## Neuro

No Focal  
Neurologic  
Findings

No LOC

## Gross Motor

No Ataxia

No instability

# Evaluation

Symptom	Baseline	Post-Inj
Headache	0	4
'Pressure in head'	0	3
Feeling slowed down	0	3
'Don't feel right'	0	3
Sensitivity to light	0	0
Feeling like 'in a fog'	0	2
Neck Pain	0	3
Irritability	0	3
Drowsiness	0	0
Balance Problems	0	2
Dizziness	0	2
Nausea or vomiting	0	0
Difficulty concentrating	0	0
Blurred vision	0	0
Fatigue or low energy	0	0
Confusion	0	0
Sensitivity to noise	0	0
Difficulty remembering	0	0
Trouble falling asleep	0	0
More emotional	0	0
Sadness	0	0
Nervous or anxious	0	0
<b>Symptom Severity</b>	<b>0</b>	<b>25</b>
<b>Symptoms Reported</b>	<b>0</b>	<b>9</b>

	Baseline	Post-Inj
<b>Symptom Severity</b>	<b>0</b>	<b>25</b>
<b>SAC</b>	<b>45/50</b>	<b>39/50</b>
<b>Tandem Gait</b>	<b>10.94</b>	<b>15.05</b>
<b>BESS (Firm only)</b>	<b>6</b>	<b>7</b>

# Evaluation - VOMS

Smooth Pursuits	NPC	Saccades	VOR / Gaze Stability	Visual Motion Sensitivity
No Increase in symptoms	Worse than Baseline 12cm vs 6cm	Dizzy and Foggy	Dizzy and Foggy	Dizzy, Foggy, and Nausea

# Post-Injury Day 1

- **Symptoms**
  - Slightly decreased symptom severity
  - New: Sensitivity to light and nausea
- **Acute Management**
  - No driving
  - Relative Rest – avoid activities that worsen symptoms
  - No Meetings
  - Continue to Monitor Symptoms

Days Post Injury	0	1
Headache	4	3
'Pressure in head'	3	2
Feeling slowed down	3	3
'Don't feel right'	3	3
Sensitivity to light	0	2
Feeling like 'in a fog'	2	2
Neck Pain	3	2
Irritability	3	2
Drowsiness	0	0
Balance Problems	2	1
Dizziness	2	0
Nausea or vomiting	0	1
Difficulty concentrating	0	0
Blurred vision	0	0
Fatigue or low energy	0	0
Confusion	0	0
Sensitivity to noise	0	0
Difficulty remembering	0	0
Trouble falling asleep	0	0
More emotional	0	0
Sadness	0	0
Nervous or anxious	0	0
<b>Symptom Severity</b>	<b>25</b>	<b>21</b>
<b>Symptoms Reported</b>	<b>9</b>	<b>10</b>

# Symptom Profile



## Vestibular

- Dizziness
- Nausea
- Fogginess
- Increased symptoms with VOR and Visual Motion Sensitivity Test



## Ocular

- Headache triggered by visual activity
- Abnormal NPC
- Increased symptoms with saccades



## Risk Factors

for prolonged recovery

- History of Headache
- Baseline motion sensitivity in car
- Concussion History x3

<b>Phase 1</b>	<b>Phase 2</b>	<b>Phase 3</b>	<b>Phase 4</b>	<b>Phase 5</b>
<b>Symptom Limited Activity</b>	<b>Aerobic Exercise</b>	<b>Football Specific Exercise</b>	<b>Club-based Non-contact Training Drills</b>	<b>Full Football Clearance</b>

Phase 1	Phase 2	Phase 3	Phase 4	Phase 5
<b>Symptom Limited Activity</b>	Aerobic Exercise	Football Specific Exercise	Club-based Non-contact Training Drills	Full Football Clearance



# Phase I: Symptom Limited

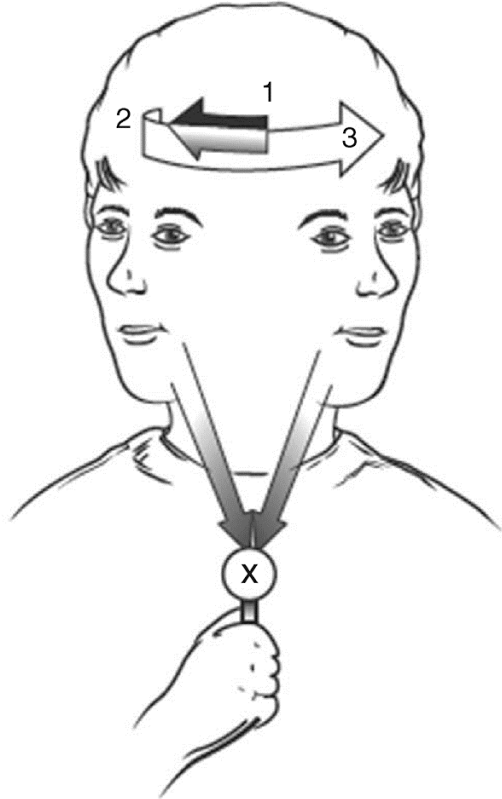
- **Goals:**
  - Decrease symptoms
  - Return to light aerobic activity
  - Return to driving
  - Return to meetings
- **Rehab and Treatment Plan**
  - Gentle Cervical Manual Therapy
  - Light Aerobic Activity
  - Balance
  - **Habituation Exercises**



# Habituation Exercises

	Exercises Included			Progressions
VOR	VOR x 1	VOR x 2		Increase BPM Dual-Task
Motion Sensitivity	VOR Cancellation	Virtual Environment Navigation	Virtual Environment Interaction	Dual-Task
Saccades	Horizontal	Vertical	Reactive	Incorporate with Head Turns
Convergence	Sequential Brock String	Reactive Brock String	Pencil Pushups	Decrease Distances

# Habituation Exercises – VOR x1

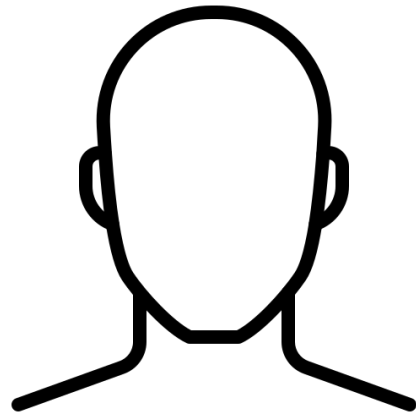


- Only head is moving
- Can complete horizontal and vertical
- **Started with slow BPM (~60bpm) and progressed based on symptoms.**
  - Increased by ~10bpm per day
- Too symptomatic in phase 1 to start VOR x2

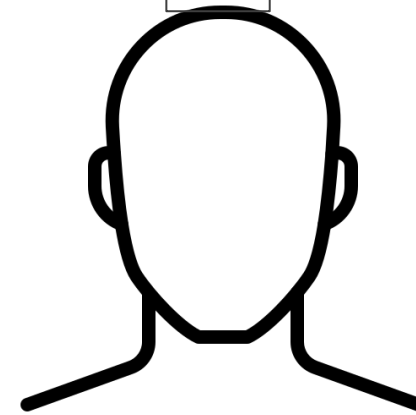


“Pro Metronome “ App

# Habituation Exercises - Saccades

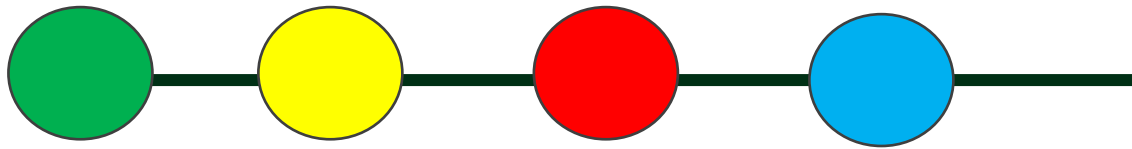


**Horizontal Saccades**



**Vertical Saccades**

# Habituation Exercises – Brock String



## Progressions:

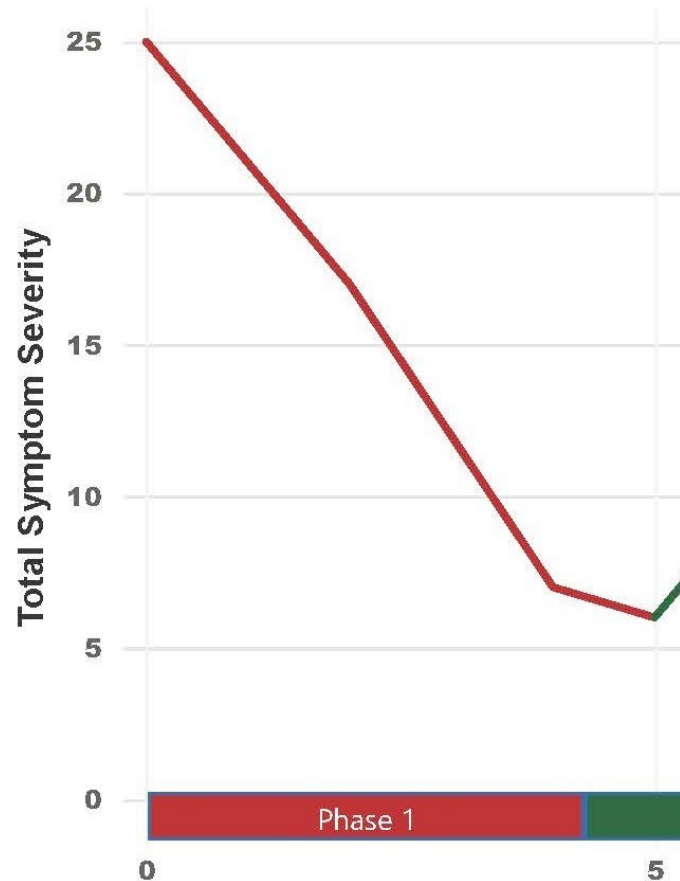
- Balance
- Reactive
- Adjust distances
- Bring near beads closer to challenge near point converge

# Phase I: Symptom Summary (Days 1- 4 PI)

	Day of Injury	Post Injury			
Days Post Injury	0	1	2	3	4
Headache	4	3	2	2	2
'Pressure in head'	3	2	2	0	1
Feeling slowed down	3	3	2	1	1
'Don't feel right'	3	3	2	1	0
Sensitivity to light	0	2	1	1	1
Feeling like 'in a fog'	2	2	2	1	0
Neck Pain	3	2	1	1	0
Irritability	3	2	1	1	0
Drowsiness	0	0	0	0	0
Balance Problems	2	1	1	1	0
dizziness	2	0	1	0	1
Nausea or vomiting	0	1	1	0	1
Difficulty concentrating	0	0	1	1	0
Blurred vision	0	0	0	1	0
Fatigue or low energy	0	0	0	0	0
Confusion	0	0	0	1	0
<b>Symptom Severity</b>	<b>25</b>	<b>21</b>	<b>17</b>	<b>12</b>	<b>7</b>
<b>Symptoms Reported</b>	<b>9</b>	<b>10</b>	<b>12</b>	<b>11</b>	<b>6</b>

- Decreasing in severity
- New sensitivity to light, nausea, and blurred vision, confusion.

# Phase I: Summary (Days 1- 4 PI)



- **Symptoms Improving Overall**
- **Response to treatment:**
  - Introduced to habituation activity – **increasing tolerance**
  - Light Aerobic Activity – **tolerating increased intensity**. Monitoring RPE and HR
- **Returned to Driving**
  - Cleared to drive after driving under the supervision of ATC. (3 Days PI)
- **Returned to Meetings**

<b>Phase 1</b>	<b>Phase 2</b>	<b>Phase 3</b>	<b>Phase 4</b>	<b>Phase 5</b>
Symptom Limited Activity	<b>Aerobic Exercise</b>	Football Specific Exercise	Club-based Non-contact Training Drills	Full Football Clearance

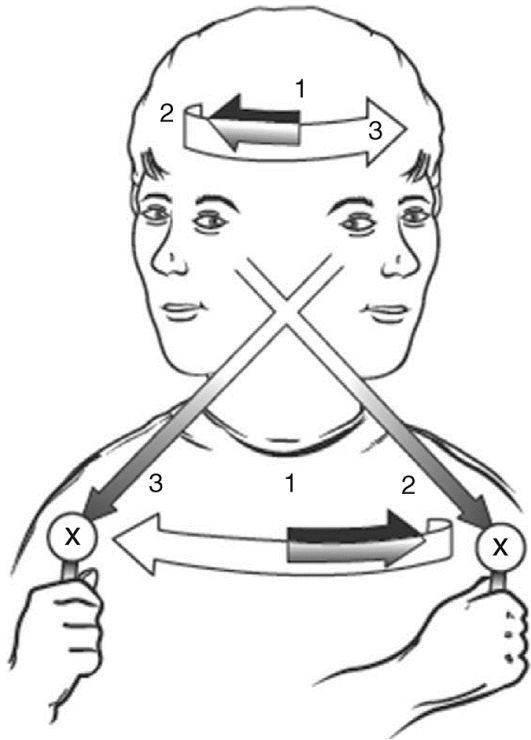


## Phase 2: Aerobic Exercise

- **Goals:**
  - Continue to decrease symptoms
  - Progress Habituation
  - Re-integrate into weight room
  - Maintain conditioning
- **Rehab and Treatment Plan**
  - Cervical Manual Therapy
  - Aerobic Activity
  - Progressed Habituation Exercises
  - Progress Balance
  - Incorporate dual-tasking



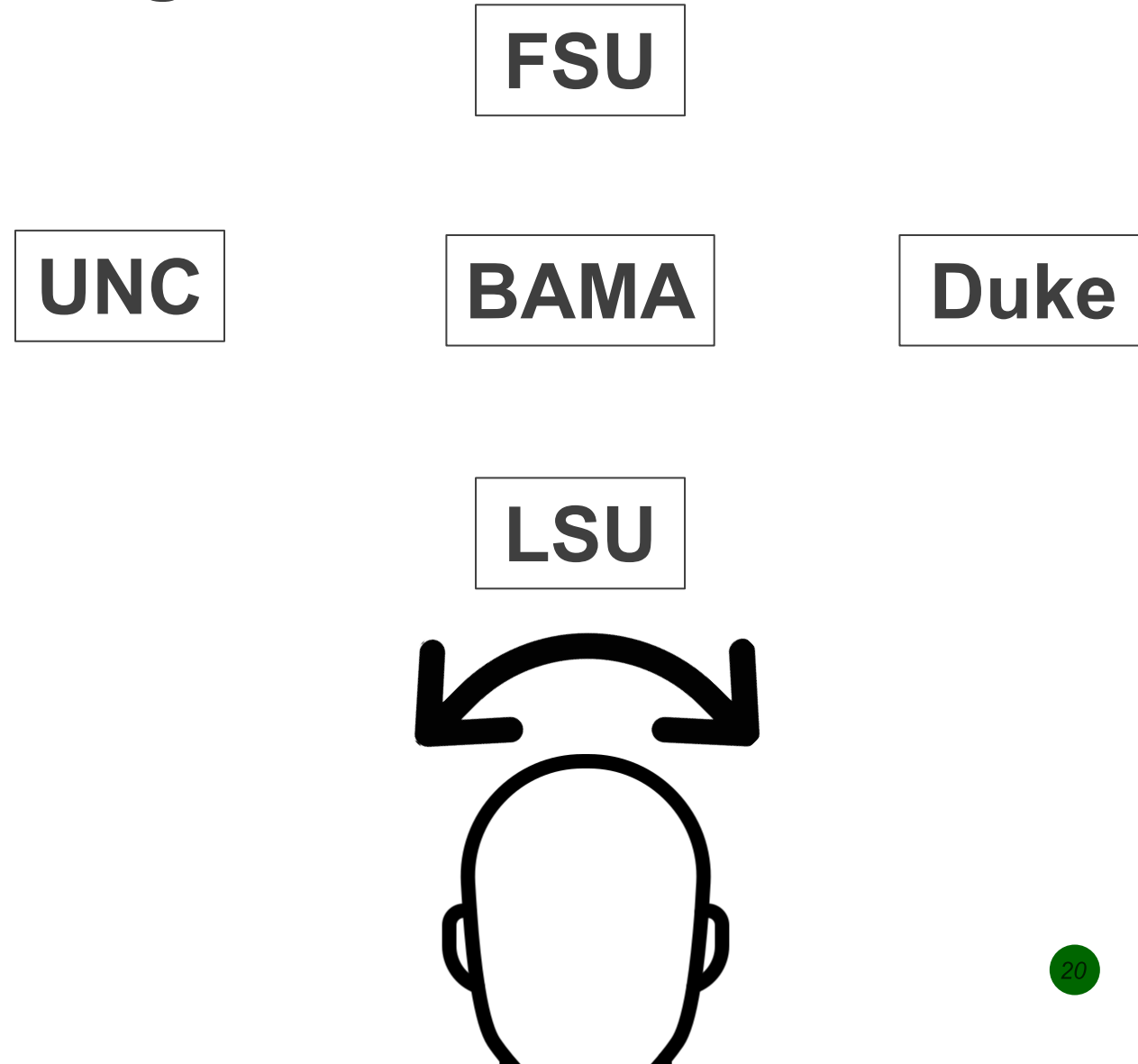
# Habituation Exercises – VOR x2



- Head and hand move in opposite directions
- Started once no to minimal symptom exacerbation with VOR x1
- Implemented later in rehab process
- **Progressions:**
  - Increase tempo (use metronome)
  - Add Dual-Tasking

# Progressing VOR – Dual Tasking

- Start with VOR x1 head turns
- Upon command, **switch gaze from target to target**
  - Switch based on college names: “UNC, FSU, DUKE, UNC, LSU”
  - Switch based on criteria: “Roy Williams, Nick Saban, Coach K,…”
- **Maintain head turns** the whole time.
- Switch between vertical and horizontal VOR.
- **Progressions:**
  - Pair with balance
  - Place targets on window vs solid background
  - Use metronome to increase tempo



## Phase 2: Symptom Summary (Days 5-9PI)

	Day of Injury	Post Injury								
Days Post Injury	0	1	2	3	4	5	6	7	8	9
Headache	4	3	2	2	2	2	2	1	1	1
'Pressure in head'	3	2	2	0	1	0	1	1	1	1
Feeling slowed down	3	3	2	1	1	1	0	1	0	0
'Don't feel right'	3	3	2	1	0	1	1	1	0	0
Sensitivity to light	0	2	1	1	1	1	2	1	0	0
Feeling like 'in a fog'	2	2	2	1	0	1	1	0	0	0
Neck Pain	3	2	1	1	0	0	0	0	0	0
Irritability	3	2	1	1	0	0	0	0	0	0
Drowsiness	0	0	0	0	0	0	2	1	1	1
Balance Problems	2	1	1	1	0	0	0	0	0	0
Dizziness	2	0	1	0	1	0	0	0	0	0
Nausea or vomiting	0	1	1	0	1	0	0	0	0	0
Difficulty concentrating	0	0	1	1	0	0	0	0	0	0
Blurred vision	0	0	0	1	0	0	0	0	0	0
Fatigue or low energy	0	0	0	0	0	0	1	0	0	0
<b>Symptom Severity</b>	<b>25</b>	<b>21</b>	<b>17</b>	<b>12</b>	<b>7</b>	<b>6</b>	<b>10</b>	<b>6</b>	<b>3</b>	<b>3</b>
<b>Symptoms Reported</b>	<b>9</b>	<b>10</b>	<b>12</b>	<b>11</b>	<b>6</b>	<b>5</b>	<b>7</b>	<b>6</b>	<b>3</b>	<b>3</b>

- Continued improvement in symptoms
- Lingering headache, pressure in head, drowsiness
- Note increase in symptoms on day 6 PI

## Phase 2: Summary (Days 5-9PI)



- 1. 5 Days PI:** Athlete went to watch a high-school football game at night on day 5.
  - Difficulty maintaining focus during game and difficulty looking upwards due to bright stadium lights
  - Reported feeling drowsy and low energy in the days following
- 2. 9 Days PI:** Due to lingering symptoms, evaluation with neuro PT for re-evaluation:
  - No BBPV
  - No Red Flags
  - Improved Saccades
  - Normal Dynamic Visual Acuity Test
  - Normal Visual Motion Sensitivity
  - **Continued abnormal VOR but tolerated improved tempo of head turns**

<b>Phase 1</b>	<b>Phase 2</b>	<b>Phase 3</b>	<b>Phase 4</b>	<b>Phase 5</b>
Symptom Limited Activity	Aerobic Exercise	<b>Football Specific Exercise</b>	Club-based Non-contact Training Drills	Full Football Clearance

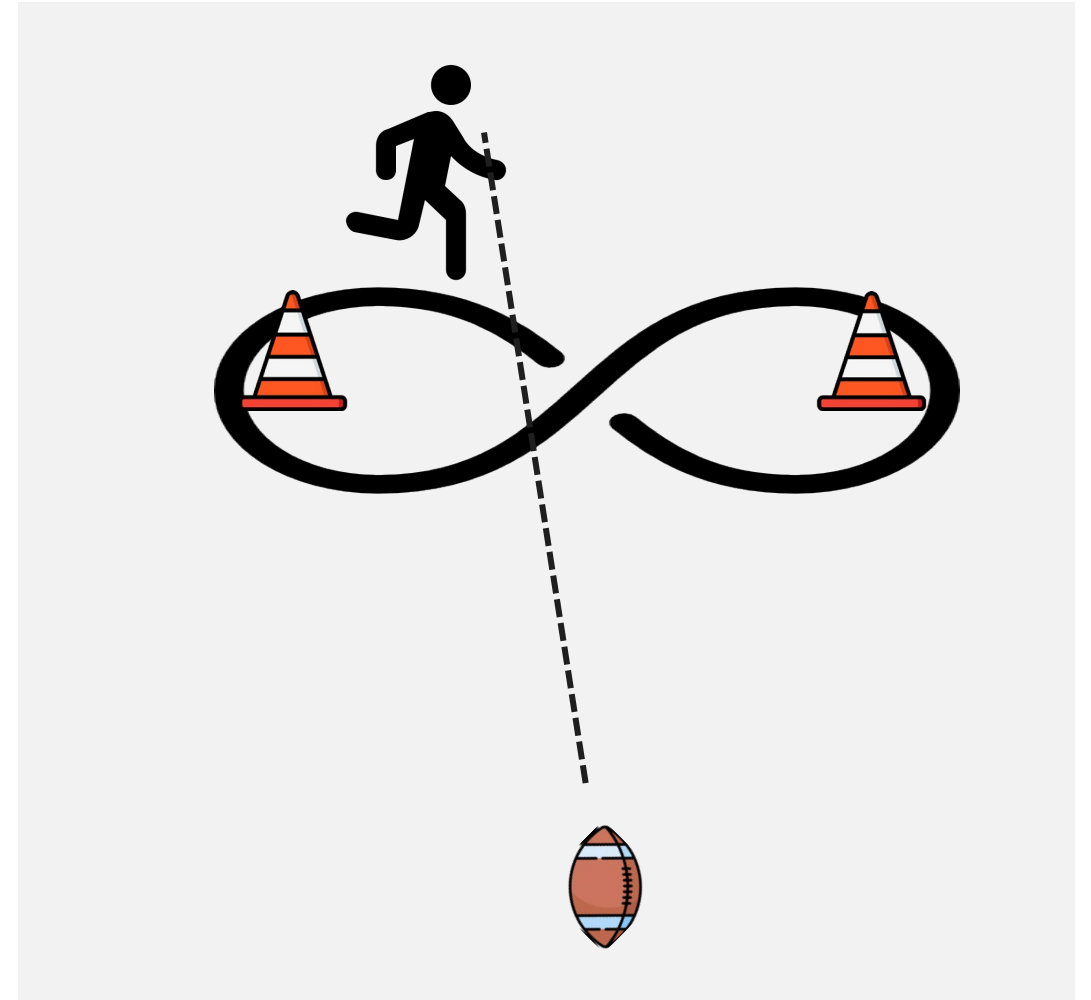
# Phase 3: Football Specific Exercise (Day 10-23)



- Return to on-field activity followed same progressive framework:
  - **Linear → Curvilinear → COD → Position Drills**
- **Football Skill Habituation**
  - Ball Tracking Drills
  - Infinity Runs
  - Position Drills

# Infinity Runs

- Eyes on Ball the whole time
- Start by running a half loop – only run around 1 cone.
- Ball Thrown when in middle
- Progress to running around both cones or run multiple loops before ball is thrown
- Can add in dual-tasking while running





# Infinity Runs





# Overhead Ball Tracking

- As position drills progressed, **headache and dizziness increase only with overhead ball tracking**. Exacerbated by bright light in path of eyes during catching (i.e. overhead lights in indoor facility).
- Focus on position drills to habituate head turns with ball tracking.
- Progressions:
  - **Stationary** → walk/jog thru → **full speed**
  - **Over-the-shoulder** catches – Head looks one way only
  - **Overhead catches** – head tracks from one side to the other while looking overhead





# Overhead Ball Tracking – Over the Shoulder



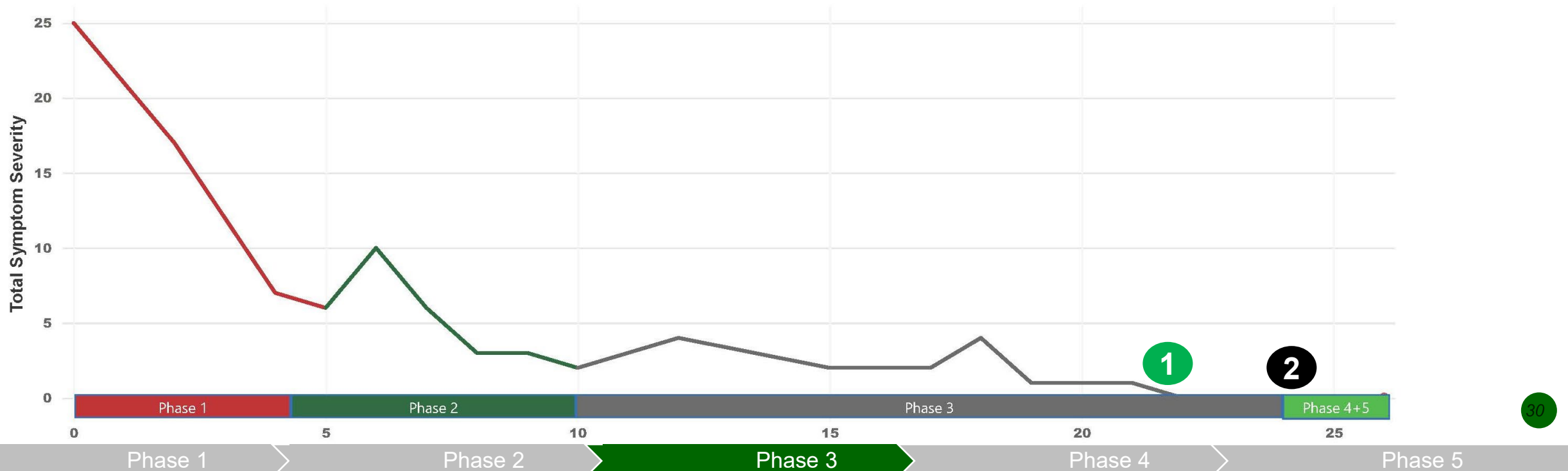


# Overhead Ball Tracking – Overhead



# Symptom Progression

1. 22 Days PI: First Day with No Symptoms
2. 24 Days PI: Non-contact Practice



Phase 1	Phase 2	Phase 3	Phase 4	Phase 5
Symptom Limited Activity	Aerobic Exercise	Football Specific Exercise	Club-based Non-contact Training Drills	Full Football Clearance

No Symptoms –  
Full Return 26 Days Post-Injury



# Conclusion

- The athlete returned to play for remainder of the season with no subsequent issues
- **Take Homes:**
  - Every concussion is different
  - Identify risk factors for a prolonged recovery and communicate to expectations to stakeholders
  - Be creative with designing dual tasking and habituation tasks – match the demands of their sport
  - Incorporate multi-disciplinary team



# Thank you!

## Corey Rodrigo

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