Table A. Details of MW’s six weeks of vestibular rehabilitation.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Session and total duration | Gaze stability | | | | | | Static Stability | | | Dynamic stability |
| Type | Background/ Target\* | Frequency/ Duration | Head turn direction | Surface/ Stance | # | Surface/ Stance | # and Duration | EO/EC |  |
| 1 | VORx1 | simple, far | 140bpm/60s | HHT/VHT | firm, SWA | 2x | foam, SWA | 2x 60s | EC | Walking with L and R head turns 2x 25ft |
|  | VORx1 | simple, far | 140bpm/60s | HHT/VHT | firm, FT | 1x | firm, ST | 2x 30s | EO | Walking with ↑ and ↓ head turns 2x 25ft |
|  | VORx1 | simple, far | 140bpm/60s | HHT/VHT | foam, SWA | 1x | firm, ST | 2x 30s | EO | Cone pick up 2x 25ft |
|  | VORx1 | simple, far | 140bpm/30s | HHT | foam, FT | 2x | firm, ST | 2x 30s | EC | Weaving between cones 2x 25ft |
|  | VORx1 | simple, far | 140bpm/60s | VHT | foam, FT | 2x | firm, ST | 2x 45s | EC |  |
| 41min |  |  | 18min |  |  |  |  | 10min |  | 13min |
| 2 | VORx1 | simple, far | 150bpm/90s | HHT/VHT | firm, FT | 1x | foam, SWA | 2x 90s | EC | Walking with HHT in hallway 8x 50ft |
|  | VORx1 | simple, far | 150bpm/60s | HHT/VHT | foam, SWA | 1x | firm, FT | 2x 90s | EC |  |
|  | 2 Target GS | simple, far | self-select/60s | HHT/VHT | firm, SWA | 1x | firm, ST | 2x 60s B | EO/EC |  |
|  | 2 Target GS | simple, far | self-select/60s | HHT/VHT | foam, SWA | 1x | firm, T | 2x 60s | EO/EC |  |
|  | 2 Target GS | busy, far | self-select/60s | HHT/VHT | foam, SWA | 1x |  |  |  |  |
|  | VORx1 | busy, far | 140bpm/60s | HHT/VHT | foam, FT | 1x |  |  |  |  |
| 40min |  |  | 15min |  |  |  |  | 15min |  | 10min |
| 3 | VORx1 | simple, far | 150bpm/60s | HHT/VHT | firm, FT | 1x | foam, SWA | 1x 60s | EC | Walking with HHT in hallway 8x 50ft |
|  | VORx1 | simple, far | 160bpm/60s | HHT/VHT | firm, FT | 1x | foam, FT | 1x 60s | EC | Walking with HHT outside on grass 4x 50ft |
|  | VORx1 | simple, moving far-near | self-select/60s | HHT/VHT | firm, SWA | 2x | foam, T | 1x 60s B | EO |  |
|  | VORx1 | simple, moving far-near | self-select/60s | HHT/VHT | firm, FT | 2x | foam, ST | 1x 30s B | EC |  |
|  |  |  |  |  |  |  | firm, SLS | 1x 30s B | EO, HHT |  |
| 40min |  |  | 12min |  |  |  |  | 12min |  | 16min |
| 4 | VORx1 | simple, far | 160bpm/60s | HHT/VHT | firm, FT | 2x | foam, SWA | 1x 90s | EC | Walking with HHT/VHT in hallway 8x 50ft |
|  | VORx1 | simple, far | 170bpm/60s | HHT/VHT | firm, FT | 1x | foam, T | 2x 60s B | EO | Walking with HHT/VHT outside on grass 4x 50ft |
|  | VORx1 | simple, moving far-near | 140bpm/60s | HHT/VHT | firm, SWA | 2x | foam, ST | 1x 60s | EC |  |
|  | VORx1 | simple, moving far-near | 140bpm/90s | HHT/VHT | firm, SWA | 1x | firm, SLS | 1x 45s | EO, HHT |  |
| 34min |  |  | 14min |  |  |  |  | 8min |  | 12min |
| 5 | VORx1 | simple, far | 160bpm/120s | HHT/VHT | firm, FT | 1x | foam, SWA | 1x 30s | EC | Walking with HHT/VHT in hallway 8x 50ft |
|  | VORx1 | simple, far | 160bpm/120s | HHT/VHT | foam, SWA | 1x | foam, FT | 3x 60s | EC | Walking with HHT/VHT in hallway 8x 50ft- fast pace |
|  | 2 Target GS | simple, far | self-select/90s | HHT/VHT | firm, FT | 1x | foam, ST | 1x 60s B | EC |  |
|  | VORx1 | busy, moving far-near | self-select/90s | HHT/VHT | firm, SWA | 2x |  |  |  |  |
| 42min |  |  | 17min |  |  |  |  | 10min |  | 15min |
| 6 | VORx1 | simple, far | 170bpm/90s | HHT/VHT | firm, ST | 1x B | foam, FT | 4x 60s | EC | Walking with HHT/VHT in hallway 4x 50ft |
|  | VORx1 | simple, far | 170bpm/90s | HHT/VHT | foam, ST | 1x B | foam, ST | 2x 60s B | EC | Walking with HHT/VHT in hallway 4x 50ft- fast pace |
|  | VORx1 | simple, far | 150bpm/90s | HHT/VHT | firm, FT | 1x |  |  |  | Walking with HHT/VHT on grass 4x 50ft- fast pace |
|  | VORx1 | simple, moving far-near | 150bpm/90s | HHT/VHT | firm, FT | 1x |  |  |  |  |
|  | VORx1 | simple, moving far-near | 130bpm/90s | HHT/VHT | foam, SWA | 1x |  |  |  |  |
| 38min |  |  | 15min |  |  |  |  | 8min |  | 15min |
| 7 | VORx1 | simple, far | 170bpm/120s | HHT/VHT | firm, FT | 1x | foam, FT | 2x 60s | EC | Walking with HHT/VHT, changing walking direction on command, 2x 50ft |
|  | VORx1 | simple, far | 170bpm/120s | HHT/VHT | foam, ST | 1x | foam, SWA | 2x 120s | EC, HHT/ VHT | Walking with HHT/VHT with near target/busy background, changing walking direction on command 2x 50ft |
|  | VORx1 | simple, moving far-near | 140bpm/90s | HHT/VHT | firm, FT | 1x | foam, SLS | 1x 45s B | EO |  |
|  | VORx1 | simple, far | 140bpm/90s | HHT/VHT | foam, SWA | 1x |  |  |  |  |
| 36min |  |  | 14min |  |  |  |  | 12min |  | 10min |
| 8 | VORx1 | simple, far | 170bpm/120s | HHT/VHT | foam, FT | 1x | foam, FT | 2x 90s | EC | Tandem walking 25ft(3x laps- looking down, looking straight, HHT) |
|  | VORx1 | simple, far | 170bpm/120s | HHT/VHT | foam, ST | 1x | foam, SWA | 1x 90s | EC, HHT/ VHT | Walking with HHT/VHT on grass 3x 50ft continuous laps |
|  | VORx1 | simple, moving far-near | 140bpm/120s | HHT/VHT | firm, SWA | 1x | foam, SWA | 1x 90s | EC, HHT/ VHT | Walking with HHT/VHT on grass 50ft- fast and slow pace 2x each |
|  | VORx1 | simple, moving far-near | 140bpm/120s | HHT/VHT | firm, FT | 1x |  |  |  | Walking with L/R head turns on grass, holding head turn until directed 2x 50ft each |
| 41min |  |  | 16min |  |  |  |  | 10min |  | 15min |
| 9 | VORx1 | simple, far | 170bpm/120s | HHT/VHT | foam, FT | 1x | foam, FT | 2x 90s | EC | Tandem walking 25ft (2x laps each- looking straight, HHT, VHT, backwards) |
|  | VORx1 | simple, far | 170bpm/120s | HHT/VHT, switch when directed | foam, ST | 1x | foam, FT | 2x 90s | EC, directed head turns | Slow walking HHT/VHT with moving target 4x 50ft |
|  | VORx1 | simple, moving far-near | 140bpm/60s | HHT/VHT | foam, FT | 2x |  |  |  |  |
| 40min |  |  | 12min |  |  |  |  | 10min |  | 18min |
| 10 | VORx1 | simple, far | 170bpm/120s | HHT/VHT | foam, ST | 1x B | foam, FT | 1x 120s | EC, direct-ed HHT turns | Tandem walking 25ft(2x laps each- looking straight, HHT, VHT, backwards) |
|  | VORx1 | simple, far | 170bpm/120s | HHT/VHT | foam, ST | 1x B | foam, ST | 1x 90s B | EC, direct-ed HHT turns | Walking HHT/VHT @130bpm with moving target 4x 50ft |
|  | VORx1 | simple, far | 150bpm/60s | HHT/VHT | foam, FT | 1x B |  |  |  | Reaction to ball toss with 180d turn- 3x 30s |
|  | VORx1 | simple, far | 150bpm/120s | HHT/VHT | foam, FT | 1x B |  |  |  | Walking with L/R head turns on hills, holding head turn until directed, self-selected, slow and fast pace 2x 50ft each |
|  |  |  |  |  |  |  |  |  |  | Walking with HHT/VHT with moving target on hills, 2x 50ft each |
| 50min |  |  | 15min |  |  |  |  | 15min |  | 20min |
| 11 | VORx1 | simple, far | 170bpm/120s | HHT/VHT | foam, ST | 1x B | foam, FT | 1x 120s | EC, direct-ed HHT turns | Tandem walking 2x 25ft |
|  | VORx1 | simple, far | 170bpm/120s | HHT/VHT | foam, ST | 1x B | foam, SLS | 1x 30s B | EC | Walking ball toss 4x 25ft |
|  | VORx1 | simple, moving far-near | 150bpm/120s | HHT/VHT | foam, FT | 1x B | firm, SLS | 1x 30s B | EC | Reaction to ball toss with 180d turn- 4x 30s |
|  | VORx1 | simple, moving far-near | 150bpm/120s | HHT/VHT | foam, FT | 1x B | firm, T | 1x 45s B | EC |  |
| 45min |  |  | 13min |  |  |  |  | 14min |  | 18min |
| 12 | VORx1 | simple, far | 170bpm/120s | HHT/VHT | foam, ST | 1x B | foam, FT | 1x 90s | EC | Tandem walking, forward and backwards, 4x 25ft |
|  | VORx1 | simple, far | 170bpm/120s | HHT/VHT | foam, ST | 1x B | foam, ST | 1x 60s B | EC | Walking with L/R head turns in hallway, holding head turn until directed, slow pace and fast pace, 2x 50ft each |
|  | VORx1 | simple, far | 170bpm/180s | HHT/VHT | foam, ST | 1x B | firm, T | x1 60s B | EC | Reaction to ball toss with 180d turn- 4x 30s |
|  | VORx1 | simple, far | 170bpm/120s | HHT/VHT | foam, FT | 1x B |  |  |  |  |
|  | VORx1 | simple, far | 170bpm/120s | HHT/VHT | foam, ST | 2x B |  |  |  |  |
| 40min |  |  | 15min |  |  |  |  | 10min |  | 15min |

VOR, Vestibulo-ocular reflex; 2 Target GS, Two target gaze stabilization exercise; Bpm, beats per minute; s, seconds; min, minutes; HHT, horizontal head turns; VHT, vertical head turns; FT, feet together; SWA, shoulder width apart; ST, semi-tandem; T, tandem; SLS, single leg stance; EC, eyes closed; EO, eyes open; ft, feet.

\*far (Target)= target was placed at arm-length. Far-near (Target)= target is held by the participant and moved from arm extended position towards their nose back and forth for the duration of exercise.

Gaze stability exercises used with this patient included “VOR X1 viewing” and “2 Target GS”. These exercises were chosen to drive changes in both adaptation (improved VOR gain) and substitution (saccade recruitment). Additionally, by providing different error signals (velocity and position) as well as varied practice in which the gaze is centered (VOR x1) and gaze is directed laterally (2 Target GS) the goal was for the person’s nervous system to choose the most effective means of gaze stabilization.