Pusher Syndrome: Neuroscience, Evidence, Assessment and Treatment

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Learning Objectives

• At the completion of this course, you will be able to:
  • Identify structures within the CNS that are impaired in their function in patients with Pusher Syndrome
  • Understand the clinical presentation seen in patients with Pusher Syndrome
  • Relate your knowledge of Pusher Syndrome to current evidence
  • Apply new knowledge about assessment and treatment of Pusher Syndrome
What Is Pusher Syndrome?

• A.K.A.
  • Contraversive pushing
  • Ipsilateral pushing
  • Unilateral neglect syndrome
  • Lateropulsion
What Is Pusher Syndrome? (Cont’d)

• A patient with hemiplegia exhibiting:
  • Pushing towards the involved side
  • Decreased awareness of midline
  • Strong extension with the uninvolved arm and leg that pushes them to the weak side
  • Resistance to attempts to correct their posture towards midline
What Is Pusher Syndrome? (Cont’d)

• Other characteristics commonly seen with Pusher Syndrome:
  • Neglect of the involved side
  • Decreased sensation on the involved side
Neuroscience of Pusher Syndrome
Schematic section through thalamus
(at level of broken line shown in figure at right)

Thalamic nuclei

CM = Centromedian
LD = Lateral dorsal
LP = Lateral posterior
M = Medial group
MD = Medial dorsal
VA = Ventral anterior
VI = Ventral intermedial
VL = Ventral lateral
VP = Ventral posterior (ventrodorsal)
VPL = Ventral posterolateral
VPM = Ventral posteromedial

Schematic representation of thalamus
(external medullary lamina and reticular nuclei removed)

- Lateral cell mass
- Medial cell mass
- Anterior cell mass

Unl. Fig. 3-19.
Posterolateral Thalamus

Sends somatic sensation from body to somatosensory cortex

**Vision** - Provides information about movement and cues for judging upright posture

**Vestibular** - Informs a person about head position relative to gravity and about head movement

**Somatosensation** - provides information about weight bearing and the relative position of body parts
Somatosensation

• Lee et al (2013):
  • Somatosensory input plays a relatively minor role in PS
  • 2 groups (12 PS, 12 no PS)
  • Assessed SCP, SEPs and CSII at weeks 1 and 14
  • No significant differences between groups
Processing Visual Information
Central Vestibular System
Graviception

Perception of the body position, equilibrium, and direction of gravitational forces.\textsuperscript{1}

Pusher Syndrome: Distortion of subjective postural vertical.\textsuperscript{2}
Perception of vertical

A mismatch exists between visual and vestibular inputs, and one’s perception of tilted body relative to vertical.$^3$

Conflict between two reference systems
Left vs Right sided stroke

- Right hemispheric lesion: posterior part of the insula, the superior temporal gyrus, the operculum

- Left hemispheric lesion: anterior insular cortex, the operculum, the internal capsule and slightly the lateral thalamus
Left vs Right sided stroke

Pusher syndrome: its cortical correlate (Baier et al)
Summary

• Severe misperception of the body orientation in relation to gravity.

• Problems integrating visual and vestibular information.

• Somatosensation is not associated with Pusher Syndrome
Evidence
Incidence of Pusher Syndrome

• Pedersen (1996): incidence of 5.3% of all patients with CVA
• Baccini et al (2008): incidence of 16.2%
• Danells et al (2004): incidence of 63%
• Abe et al (2012): incidence of 9.4%
• Clark et al (2012): incidence of 26.9%
• Lee et al (2013): incidence of 9.2%
• For my study, 5 patients with Pusher Syndrome were admitted in a 6 month span (this represents 4.2% of all patients with CVA)
Differential Diagnosis

- Margaret Roller, JNPT 2004

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Pusher Syndrome</th>
<th>Thalamic Astasia</th>
<th>Wallenberg’s Syndrome</th>
<th>Vestibular Cortex Stroke</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direction of pushing or loss of balance</td>
<td>Push sideways toward the paretic side</td>
<td>Fall backward or to the paretic side without pushing</td>
<td>Fall sideways toward the non-paretic side without pushing</td>
<td>Lean and lose balance toward the paretic side without pushing</td>
</tr>
<tr>
<td>Location of lesion</td>
<td>Posterolateral thalamus</td>
<td>Posterolateral thalamus</td>
<td>Medulla of brainstem</td>
<td>Posterior insula, AKA vestibular cortex</td>
</tr>
<tr>
<td>Severity of hemiparesis</td>
<td>Severe</td>
<td>Mild to none</td>
<td>Mild</td>
<td>Mild</td>
</tr>
<tr>
<td>Subjective visual vertical</td>
<td>Intact</td>
<td>Intact</td>
<td>Impaired</td>
<td>Impaired</td>
</tr>
<tr>
<td>Subjective postural vertical</td>
<td>Impaired</td>
<td>Not stated</td>
<td>Not stated</td>
<td>Intact</td>
</tr>
</tbody>
</table>
“Current” Literature

• Patricia Davies “Steps to Follow” (1985)
  • Comprehensive description of the typical signs of Pusher Syndrome
  • First to coin the term “pusher syndrome”
  • Useful treatment ideas
  • An intuitive approach to the treatment of Pusher Syndrome (no formal research to validate her treatment interventions)
Current Literature

• Pedersen et al (1996)
  • Description of the incidence and the associated neuropsychological symptoms of ipsilateral pushing
  • Conclusion: The presence of a “Pusher Syndrome” (ipsilateral pushing and hemineglect) was not confirmed by this study
    • Hemineglect is a symptom of Pusher Syndrome with some, but not all, of the patients in the study
Current Literature

• Pedersen et al (Cont’d)
  • Conclusions:
    • Ipsilateral pushing does not affect functional outcome, but slows the process of recovery considerably
    • They need 3.6 weeks (63%) longer to reach the same functional outcome as hemiparetic patients without pusher syndrome
Current Literature

• Punt and Riddoch (2002)
  • More appropriate to consider *motor* rather than *visual* neglect
  • Explore the concept of motor extinction and its role in pusher syndrome
  • Pushing behavior may be the severe end of a “right-hemisphere syndrome”
Current Literature

• Santos-Pontelli et al (2005)
  • Dysfunction of the semicircular canals does not seem to be relevant for the clinical manifestation of PS

• Perennou et al (2002)
  • Pushing behavior does NOT have a vestibular origin
    • Some of the symptoms of pusher syndrome can mimic vestibular dysfunction
  • While sitting on a rocking platform, patients with Pusher Syndrome tilted their pelvis towards the involved side, but were able to keep their head aligned to vertical
Current Literature

• Perennou et al (Cont’d)
  • It is a high-order disruption in the processing of somesthetic information from the left side of the body (could be due to graviceptive neglect)
    • Graviceptive neglect: extinction of the somatosensory information from the hemiplegic side of the trunk
  • This disruption causes pushers to actively adjust their body to a subjective vertical that is biased to the side opposite to the cerebral lesion
Current Literature

  - While sitting in a motorized padded chair, patients reported their subjective vertical
  - Patients with Pusher Syndrome perceived their body as upright when tilted 18 degrees to the uninvolved side (but visual perception of vertical was normal)
  - Subjective visual vertical intact
Current Literature

• Karnath et al (Cont’d)
  • There is a mismatch between the visual and the postural vertical, and the pushing behavior is an effort to compensate
  • The patients feel that their center of mass is too far to the uninvolved side, so they actively push the body towards the involved side
Current Literature

• Karnath et al (Cont’d)
  • The posterolateral thalamus seems to be fundamentally involved in the human control of upright body posture
  • Though there is a strong correlation between Pusher Syndrome and spatial neglect, the results showed that spatial neglect does not cause Pusher Syndrome (20% of patients did not have neglect)

• Santos-Pontelli et al (2011)
  • Lesions in the thalamus and parietal region
  • Midline shift and hemorrhagic stroke volume NOT correlated with pusher syndrome
Current Literature

- Lafosse et al (2005)
  - N=114 patients with ischemic CVA
  - Pusher syndrome:
    - At start of rehab: 40% of L CVA and 52% of R CVA
    - 12 wks after rehab started: 20% of L CVA and 50% of R CVA
  - Incidence of pusher syndrome significantly higher in right CVA (Left hemiplegic) patients
Contraversive Pushing in non-stroke patients

<table>
<thead>
<tr>
<th>Patients</th>
<th>Age (years)</th>
<th>Sex</th>
<th>Interval (in days) between lesion onset and first evaluation</th>
<th>Pain Sensibility</th>
<th>Hemineglect</th>
<th>SCP* (Post/Ext/Resis)</th>
<th>Lesion side</th>
<th>Side of pushing behavior</th>
<th>Clinical outcome (Barthel Index)</th>
<th>Resolution of pushing behavior</th>
<th>Etiology</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>74</td>
<td>M</td>
<td>55</td>
<td>Hypesthesia</td>
<td>YES</td>
<td>2/2/2</td>
<td>R</td>
<td>L</td>
<td>Death</td>
<td>Not evaluated</td>
<td>Infarct</td>
</tr>
<tr>
<td>2</td>
<td>75</td>
<td>F</td>
<td>60</td>
<td>Hypesthesia</td>
<td>YES</td>
<td>2/2/2</td>
<td>R</td>
<td>L</td>
<td>(50)</td>
<td>24–28 weeks</td>
<td>Infarct</td>
</tr>
<tr>
<td>3</td>
<td>48</td>
<td>M</td>
<td>33</td>
<td>Normal</td>
<td>NO</td>
<td>2/2/2</td>
<td>R</td>
<td>L</td>
<td>(85)</td>
<td>12 weeks</td>
<td>Infarct</td>
</tr>
<tr>
<td>4</td>
<td>76</td>
<td>M</td>
<td>35</td>
<td>Normal</td>
<td>NO</td>
<td>1.75/2/2</td>
<td>L</td>
<td>R</td>
<td>(25)</td>
<td>8 weeks</td>
<td>Hem</td>
</tr>
<tr>
<td>5</td>
<td>62</td>
<td>M</td>
<td>16</td>
<td>Normal</td>
<td>YES</td>
<td>2/2/2</td>
<td>R</td>
<td>L</td>
<td>(00)</td>
<td>Not evaluated</td>
<td>Traumatic</td>
</tr>
<tr>
<td>6</td>
<td>80</td>
<td>F</td>
<td>27</td>
<td>Hypesthesia</td>
<td>YES</td>
<td>1.5/2/2</td>
<td>R</td>
<td>L</td>
<td>(80)</td>
<td>7 weeks</td>
<td>Traumatic</td>
</tr>
<tr>
<td>7</td>
<td>50</td>
<td>M</td>
<td>13</td>
<td>Normal</td>
<td>YES</td>
<td>1.5/1.5/2</td>
<td>R</td>
<td>L</td>
<td>(100)</td>
<td>Not evaluated</td>
<td>Traumatic</td>
</tr>
<tr>
<td>8</td>
<td>58</td>
<td>F</td>
<td>15</td>
<td>Hypesthesia</td>
<td>YES</td>
<td>2/2/2</td>
<td>B&lt;sup&gt;a&lt;/sup&gt;</td>
<td>L</td>
<td>Death</td>
<td>Not evaluated</td>
<td>Tumor</td>
</tr>
</tbody>
</table>

* Scale for Contraversive Pushing (SCP) assesses 1) symmetry of spontaneous posture (Post) while sitting and standing (max, 2), 2) the use of the arm or the leg to extend (Ext) the area of physical contact to the ground while sitting and standing (max, 2), and 3) resistance (Resis) to passive correction of posture while sitting and standing (max, 2). Hem: intraparenchymatous hemorrhage; A right; L left; B Bilateral

* Although patient 8 had a small lesion over the left parieto-occipital transition, the lesions in the right hemisphere were larger, had a mass effect and were related to the clinical motor deficits. * Patient 5 was not evaluated owing to clinical deterioration and occurrence of seizures after transference to a secondary hospital.
Current Literature (Prognosis)

• Karnath et al (2002)
  • Prognosis of contraversive pushing
    • 6 months post-stroke, the pusher symptoms of 12 patients had nearly completely recovered
    • No significant change in arm strength (at 6 month follow up) but significant changes in leg strength
    • Aim of PT: to shorten the period of necessary treatment and to enable earlier discharge
Current Literature (Prognosis)

  • N=65
  • At 1 week post-stroke 63% of subjects demonstrated features of pushing (5-10% incidence reported in most other studies)
  • 62% of pushers: symptoms resolved by 6 weeks
  • 21% of pushers: symptoms persisted at 3 months
  • Motor recovery and function significantly lower in pushers (compared to non-pushers) at 3 months
  • Pushers: significantly longer LOS (89 vs 57 days)
Current Literature (Prognosis)

• Danells et al (cont’d)

  • “identification of stroke patients with pushing symptoms has prognostic implications for recovery”
  
  • “rehabilitation specialists need to refine treatment approaches for the pushers to further improve functional outcome”
Current Literature (Prognosis)

• Babyar et al (2008)
  • Case-matched controlled study (36 pairs of pts with CVA, one with PS and one without)
  • FIM efficiency (FIM change/LOS) and d/c FIM scores worse in PS group
  • Similar mean LOS for both groups
  • Pts with PS and R CVA were significantly worse
  • Pts with PS required more dependent living situations at d/c (especially with R CVA)
Current Literature (Prognosis)

• Babyar SR et al (2015)
  • N=169 subjects (BLS score of 2 or greater)
  • 3 groups:
    • Motor deficits only
    • Motor and visual-spatial OR motor and proprio deficits
    • Motor, proprio and visual-spatial deficits
  • Achieved target of BLS score 0 or 1 at d/c (27 day LOS)
    • Motor only (90.5%), 2 deficits (59%), all 3 deficits (37%)
  • 47% with L CVA did not achieve the target (c.f. 52% with R CVA)…slightly worse outcome for L hemis
Current Literature (Prognosis)

• Abe H et al (2012)
  • N=1660 pts with stroke
  • 9.4% of total sample had pushing behaviour (PB)
  • Prevalence of PB significantly higher in RBD (17.4%) than LBD (9.5%)
  • Of the 156 subjects with PB, pts with RBD exhibited a significantly slower recovery than pts with LBD (p=0.027)
  • Important information when considering goal setting and d/c disposition

• Santos-Pontelli (2012) response
  • Slower recovery for RBD could be due to post-stroke depression being associated with R hemisphere strokes
Prognostic indicators

• Babyar et al (2016):
  • To distinguish pts who will/will not recover from PS
  • Indicators of delayed recovery:
    • Left CVA: older age, worse admission motor status (RLE Motricity Index score)
    • Right CVA: older age, greater admissions limb placement error, lower cognitive FIM scores
    • Visuospatial neglect did not influence recovery from PS
Assessment
Table 2  Clinical Assessment Scale for Contraversive Pushing (SCP). (Translated from ref. [6])

<table>
<thead>
<tr>
<th>Examination Form</th>
<th>Clinical Scale for Contraversive Pushing (SCP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>Date of birth</td>
</tr>
<tr>
<td>Ward</td>
<td></td>
</tr>
<tr>
<td>Examination date</td>
<td>Diagnosis</td>
</tr>
<tr>
<td>Physician in charge</td>
<td>Physical therapist in charge</td>
</tr>
</tbody>
</table>

(A) Spontaneous body posture
- Value 1 = severe contraversive tilt with falling to that side
- Value 0.75 = severe contraversive tilt without falling
- Value 0.25 = mild contraversive tilt without falling
- Value 0 = inconspicuous

Sum total (max. = 2):
- Sitting
- Standing

(B) Use of the non-paretic extremities (abduction & extension)
- Value 1 = performed spontaneously, already when at rest
- Value 0.5 = performed only on changing the position (e.g. on transferring from bed to wheelchair)
- Value 0 = inconspicuous

Sum total (max. = 2):
- Sitting
- Standing

(C) Resistance to passive correction of tilted posture*
- Value 1 = resistance occurs
- Value 0 = resistance does not occur

Sum total (max. = 2):
- Sitting
- Standing

* Touch the patient at the sternum and the back. Instruction: “I will move your body sideways. Please permit this movement”.
Standardized Scale of Contraversive Pushing (Cont’d)

• Scored in sitting and standing for each of the categories (posture, extension and resistance)
  • Maximum score of 2 (1 for sitting and 1 for standing) for the three categories
  • A score of 6/6 implies severe pushing behavior
Reliability and Validity of SCP

• Baccini et al (2006)
  • Compared clinical diagnosis and Dx with the SCP
  • Low agreement with original cut-off to diagnose Pusher Syndrome (≥ 1 in each subscale)
  • Near perfect agreement with modified cut-off criterion (>0 in each subscale)
  • Interrater reliability good to excellent
Burke Lateropulsion Scale

• 17 point ordinal scale
  • Grades postural alignment and degree of resistance when moving patient passively in functional positions:
    • Supine
    • Sitting
    • Standing
    • Transfers
    • Walking
Validation of a lateropulsion scale for patients recovering from stroke

Michael A D’Aquila Mercy College School of Allied Health, Dobbs Ferry, New York, Teresa Smith The Burke Rehabilitation Hospital, White Plains, New York, Debbie Organ, Steven Lichtman Mercy College School of Allied Health, Dobbs Ferry, New York and Michael Reding The Burke Rehabilitation Hospital, White Plains, New York, USA

Received 18th October 2002; returned for revisions 15th January 2003; revised manuscript accepted 14th February 2003.

Objective: To determine the validity and reliability of a clinical scale for assessing lateropulsion following stroke.

Design: Serial observational study of Lateropulsion Scale scores.

Setting: Inpatient stroke rehabilitation unit.

Subjects: A convenience sample of 85 patients examined 19 ± 2 SEM days post stroke.

Main outcome measures: An empirically derived 17-point Lateropulsion Scale was used to assess and follow postural responses to rolling, sitting, standing, transferring and walking. Intraclass correlation coefficients were calculated by having patients evaluated twice by their primary physical therapist (days 1 and 3), and once by an alternate physical therapist (day 2). Concurrent validity was estimated by computing Spearman’s rank order correlations between the lateropulsion score and other markers for motor control dysfunction: Fugl-Meyer balance subscore, the Functional Independence Measure (FIM) mobility subscore, and length of rehabilitation hospital stay.

Results: Inter-rater and intra-rater reliability were $r = 0.93$ ($p < 0.001$) and $r = 0.94$ ($p < 0.05$), respectively. Concurrent validity estimates showed the initial lateropulsion score to be correlated with the Fugl-Meyer balance subscore ($r = -0.57, p < 0.001$), with the admission and discharge FIM mobility subscores ($r = -0.56, p < 0.0001$ and $r = -0.58, p < 0.0001$), respectively, and with length of rehabilitation hospital stay ($r = 0.6, p < 0.0001$).

Conclusions: The Lateropulsion Scale is both a reliable and a valid assessment of lateropulsion following stroke.
Burke Lateropulsion Scale-Supine

• Use ‘log roll’ technique to test patient’s response. Roll first towards the affected side then towards the unaffected side. Circle the side to which the resistance is most prominent. Score below the maximum resistance felt and add one point if resistance is noted in both directions. (Patients with marked lateropulsion may resist rolling to either side, hence an extra point is added if resistance is noted with rolling both towards and away from the affected side)
  • 0 = No resistance to **passive** rolling
  • 1 = Mild resistance
  • 2 = Moderate resistance
  • 3 = Strong resistance
  • 1 = Add one point if resistance noted in both directions
Burke Lateropulsion Scale-Sitting

- Score with the patient seated, feet off floor, both hands in lap. The expected hemiplegic response is for patient to carry his weight towards the unaffected side. Some patients will passively fall towards their paretic side when placed in true vertical position by the examiner. This will not be scored as ‘lateropulsion’.

- Position the patient with their trunk 30 degrees off true vertical towards their affected side, then score the patient’s response to your attempts to bring them back to vertical. The ‘lateropulsion’ phenomenon is an active attempt by the patient to keep their centre of gravity towards their impaired side as they are brought to true vertical
Burke Lateropulsion Scale-Sitting

- 0 = No resistance to passive return to true vertical sitting position
- 1 = Voluntary or reflex resistive movements in trunk, arms or legs noted only in the last 5 degrees approaching vertical
- 2 = Resistive movements noted but beginning within 5 to 10 degrees of vertical
- 3 = Resistive movements noted more than 10 degrees off vertical
Burke Lateropulsion Scale-Standing

• Score with the patient standing with whatever support is needed. The expected hemiplegic response is for the patient to carry their weight toward the unaffected side or to passively fall towards their paretic side when placed in true vertical position by the examiner. This will not be scored as ‘lateropulsion.’

• Position the patient with their trunk 15 to 20 degrees off true vertical towards their affected side then score the patient’s response to your attempts to bring them back to vertical, then 5 to 10 degrees past vertical toward the intact side. The ‘lateropulsion’ phenomenon is a voluntary or reflexive response in the trunk or limbs to keep the centre of gravity towards the impaired side e.g., forced trunk curvature towards the paretic side, flexion of affected hip or knee, shifting weight to the lateral aspect of the unaffected foot.
Burke Lateropulsion Scale-Standing

• 0 = Patient prefers to place his centre of gravity over the unaffected leg.
• 1 = Resistance is noted when attempting to bring the patient 5 to 10 degrees past midline.
• 2 = Resistive voluntary or reflex equilibrium responses noted, but only within 5 degrees of approaching vertical.
• 3 = Resistive reflex equilibrium responses noted, beginning 5 to 10 degrees off vertical.
• 4 = Resistive voluntary or reflex equilibrium responses noted, more than 10 degrees off vertical.
Burke Lateropulsion Scale-Transfers

• Score this function by transferring the patient from the seated position first to the unaffected side, then if possible, to the affected side. The expected hemiplegic response would be for the patient to require more assistance to transfer towards the affected side (use a sit pivot, modified stand pivot, or stand pivot transfer, depending on the patient’s functional level).
Burke Lateropulsion Scale-Transfers

• 0 = No resistance to transferring to the unaffected side is noted.
• 1 = Mild resistance to transferring to the unaffected side.
• 2 = Moderate resistance to transferring is noted. Only one person is required to perform the transfer.
• 3 = Significant resistance is noted with transferring to the unaffected side. Two or more people are required to transfer the patient due to the severity of lateropulsion.
Burke Lateropulsion Scale-Walking

• Score lateropulsion by noting active resistance by the patient to efforts by the therapist to support the patient in true vertical position. Do not score passive falling or leaning to the paretic side. Score lateropulsion as follows:
  • 0 = No lateropulsion noted.
  • 1 = Mild lateropulsion noted.
  • 2 = Moderate lateropulsion noted with walking.
  • 3 = Strong lateropulsion noted, takes two individuals to walk with the patient, or unable to walk because of severity of lateropulsion.
Burke Lateropulsion Scale

• Circle most prominent direction of lateropulsion: left, right, posterior-left, posterior-right.

• Note: Some patients may show such marked lateropulsion that they cannot be assessed while standing or walking. In such cases they are scored as having a maximum deficit for those tasks not testable due to the severity of their lateropulsion.

• TOTAL SCORE = SUM OF THE ABOVE ______

                (Max = 17)
Inconsistent classification of pusher behaviour in stroke patients: a direct comparison of the Scale for Contraversive Pushing and the Burke Lateropulsion Scale

Jeannine Bergmann¹,², Carmen Krewer¹,², Katrin Rieß¹,², Friedemann Müller¹,², Eberhard Koenig¹,² and Klaus Jahn²,³

Abstract
Objective: To compare the classification of two clinical scales for assessing pusher behaviour in a cohort of stroke patients.
Design: Observational case-control study.
Setting: Inpatient stroke rehabilitation unit.
Subjects: A sample of 23 patients with hemiparesis due to a unilateral stroke (1.6 ± 0.7 months post stroke).
Methods: Immediately before and after three different interventions, the Scale for Contraversive Pushing and the Burke Lateropulsion Scale were applied in a standardized procedure.
Results: The diagnosis of pusher behaviour on the basis of the Scale for Contraversive Pushing and the Burke Lateropulsion Scale differed significantly ($\chi^2 = 54.260$, $p < 0.001$) resulting in inconsistent classifications in 31 of 138 cases. Changes immediately after the interventions were more often detected by the Burke Lateropulsion Scale than by the Scale for Contraversive Pushing ($\chi^2 = 19.148$, $p < 0.001$). All cases with inconsistent classifications showed no pusher behaviour on the Scale for Contraversive Pushing, but pusher behaviour on the Burke Lateropulsion Scale. 64.5% (20 of 31) of them scored on the Burke Lateropulsion Scale on the standing and walking items only.
Conclusions: The Burke Lateropulsion Scale is an appropriate alternative to the widely used Scale for Contraversive Pushing to follow-up patients with pusher behaviour (PB); it might be more sensitive to detect mild pusher behaviour in standing and walking.

Keywords
Stroke, pusher syndrome, Scale for Contraversive Pushing, Burke Lateropulsion Scale
Burke Lateropulsion Scale

- Bergmann et al (2014)
  - BLS more responsive to small changes than the SCP
- Clark et al (2012)
  - BLS is a responsive scale to monitor progress/recovery
  - SCP and BLS are reliable and valid measures with good clinical applicability
Treatment Interventions
Intervention

- Krewer et al (2013)
  - Compared Lokomat training, galvanic vestibular stimulation and PT with visual feedback
  - GVS: no significant effects
  - Lokomat: significant effect on BLS score (not on SCP) when compared to visual feedback
  - BLS more useful than SCP to detect small changes for clinical trials and routine treatment
  - Lokomat: forced control of upright position, decreased fear of falling, recalibrates sense of verticality (via somatic graviception)
Intervention

• Yang et al (2014)
• Compared computer-generated interactive visual feedback training program and mirror visual feedback training
• Both groups improved, with the computer-generated group having significantly better results in decreasing SCP score and improving BBS score
Intervention

• Bohannon (1998)
  • Case report using a motor relearning approach:
    • Allow pt to repeatedly experience the consequences (LOB)
    • Have the pt recognize that his perception of upright is NOT correct
    • Use tactile and verbal feedback to orient pt to true vertical
  • Claims the pt can stand within 15 minutes of this Rx (admits this doesn’t work for pts with aphasia, cognitive issues, or anxiety)

  • Does not find visual cues helpful (letter to the editor about Karnath’s work)
Intervention

  • Case report (n=1)
  • Somatosensory inputs (weight bearing) had no immediate effect on pusher behavior
  • Treatment using visual or auditory feedback had positive immediate effects (but results were not maintained)
Intervention

• Chen et al (2014)
  • Case report (n=1), pt with PS and unilateral neglect
  • Interventions used:
    • Visual feedback technology
    • Sit and stand balance (focus on midline and weight shifting)
    • Gait with “lower limb robot” 20 minutes daily
    • 40 min/day, 5 days/wk, 3 weeks total
    • For unilateral spatial neglect, used visual scanning, reading training and acupuncture
Intervention


• 8 patients with severe contraversive pushing
  • 6 RBD, 2 LBD
  • 50% of LBD had aphasia (0% of RBD)
  • 83% of RBD had spatial neglect

• Used Scale of Contraversive Pushing

• 3 aspects were repeatedly addressed in each Rx session
Intervention (Broetz cont’d)

1. Allow pt to realize that their perception of vertical is disturbed.
   - Let them tip over, assist with a controlled fall if needed, until they are lying sideways on the bed
   - Ask them to find a way to get upright again
   - If they can’t the PT can assist
2. Instruct pt to actively explore visual surroundings
   • Tell pt to reach upright posture by visually aligning their own body with the vertical objects in the environment
   • Use visual aids (PT’s arm or body) and mirrors to give feedback about their body orientation
   • The experience of not falling after they attain the corrected position (and seeing that they are upright) increases confidence and lowers the pushing with the arm and leg
Intervention (Broetz cont’d)

3. Ask the pt to reach for an object placed on their non-paretic side (weight shift to that side)… this stops them from the pathological pushing temporarily
   • Used demonstration by PT and acoustic signals to gain the pt’s attention to that object

4. Once the first 3 goals are mastered, a 4th training aspect was added:
   • Distracting the pt by involving them in conversation or asking them to do a coordinated arm or head movement
   • Looking to make postural control more automatic
Intervention

• Broetz et al (2005)
  • Follow up paper
  • Transfers
    • Recommend transferring to the uninvolved side first
    • Practice leaning forward and do a “low transfer”
    • Therapist in front of pt, guides pt’s legs from the outside, hands grasp pt from above at outer scapular borders
    • Practice both ways once pushing has lessened
  • Positioning in w/c
    • Pt sits at very back and middle of w/c, feet on ground
    • To correct pushing, have pt lean forward and slide butt back
Intervention

• Shepherd R and Carr J (2005)
  • Response to Broetz’ paper
  • Agree with using vertically-oriented visual cues
  • Disagreed with reaching to the uninvolved side
    • Recommend reaching to the hemi side and encouraging hemi leg to help support the pt
  • Recommend sit to stand training vs. transfer training
  • Recommend trying BWSTT
Treatment Interventions for Pusher Syndrome: A Case Series

• **Purpose:**
  - To describe a series of treatment interventions that aim to reduce pushing behavior and improve functional outcomes in patients with PS.

• **Case Description:**
  - Five individuals with PS due to stroke
  - Ages=42 to 76, admitted to inpatient rehabilitation 5 to 16 days post-stroke.

• **Intervention:**
  - 90 minutes of PT (5 days/week) with an average LOS of 27 days.
  - Treatment focused on regaining their sense of midline (balance and transfers), mobility retraining, and neuro re-education activities.
  - Outcome measures examined pushing behavior, transfer ability, and sitting balance.

Currently under review, submitted to JNPT
### Demographic and Clinical Data

<table>
<thead>
<tr>
<th></th>
<th>Participant 1</th>
<th>Participant 2</th>
<th>Participant 3</th>
<th>Participant 4</th>
<th>Participant 5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td>76</td>
<td>61</td>
<td>50</td>
<td>47</td>
<td>42</td>
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<tr>
<td><strong>Sex</strong></td>
<td>Female</td>
<td>Male</td>
<td>Male</td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td><strong>LOS</strong></td>
<td>28</td>
<td>29</td>
<td>27</td>
<td>24</td>
<td>26</td>
</tr>
<tr>
<td><strong>Site of lesion</strong></td>
<td>Right fronto-parietal artery</td>
<td>Right anterior cerebral artery</td>
<td>Right anterior cerebral artery</td>
<td>Right middle cerebral artery</td>
<td>Left middle cerebral artery</td>
</tr>
<tr>
<td><strong>Time from stroke to admission</strong></td>
<td>5 days</td>
<td>8 days</td>
<td>6 days</td>
<td>15 days</td>
<td>16 days</td>
</tr>
<tr>
<td><strong>Other neurological deficits</strong></td>
<td>Left Neglect, dysarthria, dysphagia</td>
<td>Left Neglect, dysarthria</td>
<td>Left Neglect, dysphagia, lethargy</td>
<td>Left Neglect, dysphagia</td>
<td>Right Neglect, global aphasia, dysphagia</td>
</tr>
<tr>
<td><strong>Sensory deficit</strong></td>
<td>Severely impaired LT and propio</td>
<td>Impaired LT and proprio</td>
<td>Severely impaired LT and proprio</td>
<td>Severely impaired LT and proprio</td>
<td>Impaired LT and propio (difficult to assess d/t aphasia)</td>
</tr>
<tr>
<td><strong>CMSA score</strong></td>
<td>Arm=2, Hand=2, Leg=3, Foot=2</td>
<td>Arm=3, Hand=2, Leg=1, Foot=1</td>
<td>Arm=2, Hand=2, Leg=1, Foot=1</td>
<td>Arm=1, Hand=1, Leg=2, Foot=1</td>
<td>Arm=1, Hand=1, Leg=1, Foot=1</td>
</tr>
</tbody>
</table>

LOS: length of stay; CMSA: Chedoke McMaster Stroke Assessment; LT: light touch

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Treatment Interventions

• Developed over the past 20+ years
• Synthesis of the most effective strategies for extinguishing or decreasing the pushing behavior seen in patients with PS
• Primary goal: helping the patient relearn their awareness of midline
• Based on work by Karnath et al and Broetz et al:
  • Use visual cues as a compensatory strategy when the patient with PS has a distorted sense of postural vertical
  • Using feedback (visual, tactile, auditory) during therapy can help to compensate for the sensory mismatch experienced by patients with PS

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Key Factors to Increase Success

• Transfer training
  • Look towards hemi side, PT prevents right leg from sliding out into extension (block foot), have pt hold hemi hand with right hand (to prevent grabbing w/c and not letting go)
  • For lower level pts: lateral scoot transfer (even modified standing can increase pushing behavior due to fear of falling)

• (examples are for left hemiparesis on the next 14 slides)
Key Factors to Increase Success

- **Wheelchair mobility:**
  - Proper W/C seating is crucial:
    - Pelvic seat belt and rear anti-tippers to prevent falls
    - Contoured cushion/backrest (help maintain midline)
    - Brightly colored brake extensions and footrest releases to improve scanning to neglected side (colored tape or balloons are an easy modification)
  - VG to encourage active scanning to neglected side during W/C prop
    - Allow errors (e.g. running into objects) when safe, to improve learning

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Key Factors to Increase Success

- Sitting balance:
  - Patient seated at EOM with feet supported, use a mirror to increase visual feedback (they have a poor sense of postural vertical, mirror allows them to access their intact sense of visual vertical)
  - Goal: have patient achieve, maintain, and regain midline in sitting
  - Achieve midline with PA/VG from PT (visual, verbal, tactile cueing) and taper support from PT as soon as possible
Key Factors to Increase Success (sit balance)

- Quiet sitting with prevention of active pushing:
  - Place right hand on PTs shoulder or leg (PT can monitor pressure)
  - Forearm on Swiss ball
  - Pushing hand placed palm up on patient’s thigh (discourages pushing)
  - Watch for height of right shoulder. If it’s elevated due to pushing on the right, remind them to relax their shoulder (either verbally or just a gentle tap on the right shoulder works). Visual feedback from mirror helps
  - Right leg in good alignment (PT’s leg and/or VG to maintain position and not allow pushing)

Examples are for left hemiparesis
Key Factors to Increase Success (sit balance)

• Reach towards right side (they are very reluctant, strong fear of falling to the non-hemiparetic side)
  • Start with sliding right hand along mat towards an object placed to the right of the hip, focus on visual scan prior to reach. Progress to objects higher/farther away on right side
  • Can upgrade to reaching in middle/upper visual fields
  • Make sure they regain midline by using trunk muscles (not pushing with the non-hemiparetic arm/leg)
Key Factors to Increase Success (sit balance)

• Reach towards left side (incorporate visual scanning exercises if neglect is present).
  • Keep left UE in a proper WBing position during reaching
  • Trunk needs to be upright and active (PT facilitates controlled movement in/out of midline)
• “Reverse sit –ups”: sits at EOM with an active trunk in midline, no upper extremity support, leans back to the point of feeling off balance, then returns to midline (promotes trunk control and midline awareness)
Key Factors to Increase Success (Sit to Stand)

• Start with elevated mat for lower level patients (task is easier, decreases amount of pushing)

• Sit to stand from W/C with elevated mat on patient’s right side.
  • Promotes weight shift to the right side (visual and tactile cue), have patient weight shift so right hip touches/bumps elevated mat
  • Avoid excessive leaning and weight bearing on the mat... it should only provide light balance support and a target for weight shifting

examples are for left hemiparesis
Key Factors to Increase Success (stand balance)

• Stand with non-hemiparetic (right) side beside an elevated mat.
  • Patient can practice WS activities using mat as a target for right hip (using a visual/tactile target circumvents the patient’s impaired sense of postural vertical)
  • Encourages proper WS onto right leg without pushing behavior

• Add functional tasks to the WS to the right: reach across mat (or up and to the right) for objects

examples are for left hemiparesis
Key Factors to Increase Success (stand balance)

• Stand patient with non-hemiparetic side beside a wall: patient can practice quiet stand and WS.
  • The wall is a reference of vertical (visual/tactile) and decreases fear of falling, so pushing lessens

• Stand patient in a corner (difficult transfer, but most of the pushing stops).
  • The wall/corner positions provide a target for correct posture and a sense of security to decrease fear of falling
  • Once quiet standing is achieved, work on scanning activities, WS and pregait/stepping activities

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Treatment Goals

• Sit unsupported in midline for 1 minute
• Transfer from wheelchair to bed with minimal physical assistance
• Decrease their score on the Scale of Contraversive Pushing to 3/6
Outcome Measures

• Main
  • Scale of Contraversive Pushing (SCP)
  • Functional Independence Measure (FIM) transfer score
  • Unsupported sitting balance

• Secondary
  • Chedoke McMaster Stroke Assessment (CMSA)
## Effects of Treatment Interventions on Primary Outcome Measures

<table>
<thead>
<tr>
<th>Participant #</th>
<th>SCP: Admit</th>
<th>D/C</th>
<th>FIM Transfer Score: Admit</th>
<th>D/C</th>
<th>Sit Unsupported for 1 minute</th>
<th>CMSA scores: Admit</th>
<th>D/C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>NO</td>
<td>YES</td>
<td>9</td>
</tr>
<tr>
<td>2</td>
<td>6</td>
<td>3</td>
<td>1</td>
<td>4</td>
<td>NO</td>
<td>YES</td>
<td>7</td>
</tr>
<tr>
<td>3</td>
<td>6</td>
<td>3</td>
<td>1</td>
<td>4</td>
<td>NO</td>
<td>NO</td>
<td>6</td>
</tr>
<tr>
<td>4</td>
<td>6</td>
<td>3</td>
<td>1</td>
<td>4</td>
<td>NO</td>
<td>YES</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>4.75</td>
<td>0</td>
<td>3</td>
<td>5</td>
<td>NO</td>
<td>YES</td>
<td>4</td>
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<tr>
<td><strong>Mean</strong></td>
<td><strong>5.75</strong></td>
<td><strong>2.2</strong></td>
<td><strong>1.4</strong></td>
<td><strong>3.8</strong></td>
<td><strong>100% NO</strong></td>
<td><strong>20% NO</strong></td>
<td><strong>6.2</strong></td>
</tr>
</tbody>
</table>

SCP: Scale of Contraversive Pushing; FIM: Functional Independence Measure; CMSA: Chedoke McMaster Stroke Assessment
Results

• All of the patients made significant gains in their SCP and FIM Transfer scores
• Most (80%) of the patients were able to sit unsupported for 1 minute at discharge
• There was little or no change in CMSA scores for the majority of the patients
  • It is likely that the improvements noted in the participants were due to changes in balance and mobility, rather than due to improved upper and lower limb motor recovery
• Video clip of assessment and treatment of one of the patients in the study
References


• Baccini M, Paci M, Rinaldi L. The scale for contraversive pushing: a reliability and validity study. Neurorehabil Neural Repair. 2006;20:468-472
References


References


References

References


References

References


Panel Discussion