

Retropulsion – A common finding in neurorehabilitation

J. Bergmann^{1,2}, L.-M. Huber², C. Krewer^{2,3}, F. Müller^{1,2}, K. Jahn^{1,2}

¹ German Center for Vertigo and Balance Disorders (DSGZ), Ludwig-Maximilians-Universität München, Munich, Germany

² Schoen Clinic Bad Aibling, Department of Neurology, Research Group, Bad Aibling, Germany

³ Chair of Human Movement Science, Department of Sports and Health Sciences, Technical University of Munich, Munich, Germany

Background: Patients with retropulsion show a posterior shift of their center of mass with a tendency to fall backwards. They have problems actively shifting their center of mass forward and show resistance to passive correction [1, 2]. Similar to lateropulsion (pusher behavior), patients with retropulsion seem to orient their body towards an impaired inner reference of verticality [3, 4]. Retropulsion can be caused by different neurological disorders such as vascular lesions, Parkinsonian syndromes, normal pressure hydrocephalus, and amyotrophic lateral sclerosis as well as geriatric conditions [2, 5–7]. Although retropulsion is common and appears to be important for neurorehabilitation, studies on retropulsion are very limited. One problem is that there was no validated clinical assessment available to quantify this postural behavior.

Development of the Scale for Retropulsion: We invited an international and multidisciplinary expert panel to participate in a Delphi study [3]. The objective of the study was to develop a clinical scale to diagnose and quantify retropulsion in neurological disorders. The study comprised three rounds of online questionnaires and resulted in high level of overall agreement among experts, with the newly developed Scale for Retropulsion (SRP). The scale includes four subtests: A) static postural control, B) reactive postural control, C) resistance, and D) dynamic postural control which are tested in a sitting and standing (initial) position. The score ranges from

0 (no signs of retropulsion) to 24 (very severe retropulsion). The SRP is a bedside test which can be easily implemented into the clinical routine (application time is 5–10 minutes).

Subsequently, the clinimetric properties of the SRP were determined in 70 patients with different neurological disorders [8]. The scale showed excellent internal consistency and good to excellent test-retest and interrater reliability. Content validity was established during the development of the scale, and the construct validity was approved by correlations with other measures of postural control.

Prevalence of retropulsion in neurorehabilitation: The next step was to incorporate the SRP into the electronic health record of the Schoen Clinic Bad Aibling. Physiotherapists assessed the SRP in all patients admitted to neurorehabilitation. Data from 05/2021 to 02/2022 revealed that retropulsion is very frequent in neurorehabilitation: 65,6% (122 of 186) patients showed signs of retropulsion (SRP score ≥ 1). The median SRP score in these patients was 12 (Q1,Q3 5,19) and covered the whole range of the scale (min–max 1–24). The prevalence of retropulsion in the different neurological disorders is shown in figure 1. Retropulsion occurred most frequently in patients with a brain or spinal tumor and patients with Parkinson's Disease.

In a group of 17 patients (14 stroke, 3 CIP/ CIM), the SRP was assessed on admission and on discharge from reha-

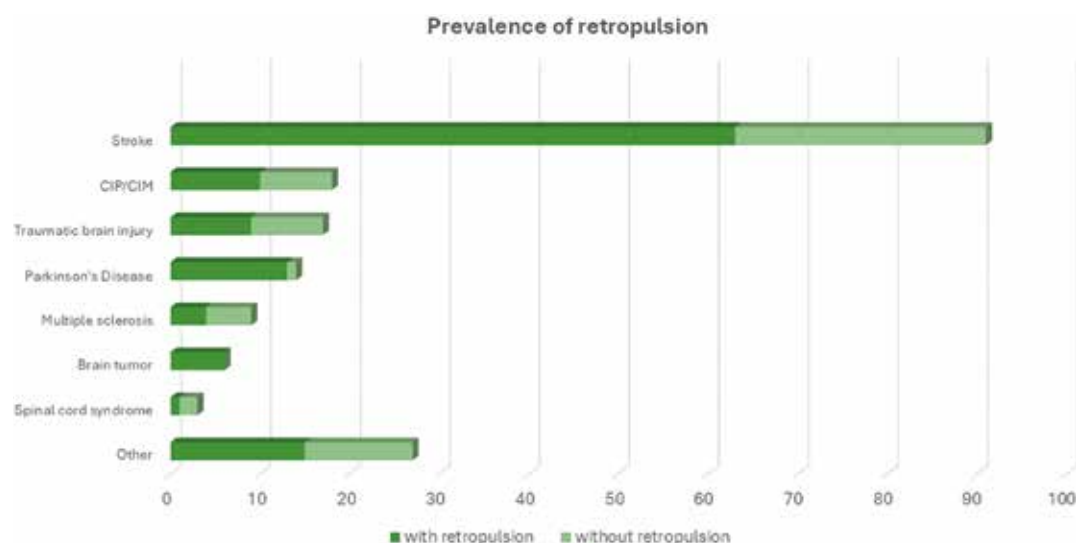


Figure 1. Number of patients with and without retropulsion in the different neurological disorders.

bilitation to investigate retropulsion during the course of rehabilitation. 77% (13/17) of patients showed signs of retropulsion at the beginning of rehabilitation (median SRP score 3 (1,10) and 60% (6/10, median 2 (0,3)) at discharge. The severity of retropulsion at admission moderately correlated with the time of rehabilitation ($r_{sp} = 0.665$): the more severe the retropulsion, the longer the rehabilitation time. Further, patients with retropulsion showed a higher fear of falling (Falls Efficacy Scale-International) compared to patients without retropulsion (Fig. 2) and there was a positive correlation between the severity of retropulsion and the level of concern about falling ($r_{sp} = 0.719$).

Retropulsion in Parkinsonian syndromes: In a recent study we aimed to investigate the different characteristics of retropulsion in Parkinsonian syndromes and its association with functional disability, postural control and fall risk. The SRP was assessed in 30 patients with Parkinsonian syndromes (24 Parkinson's Disease, 4 Progressive Supranuclear Palsy, 2 Vascular Parkinsonism). Overall, retropulsion was very frequent in patients with Parkinsonian syndromes (87%, 26/30). The SRP score correlated moderately to well with functional disability and disease severity ($r_{sp} > 0.58$), and strongly with the Berg Balance Scale ($r_{sp} = 0.823$). The severity of retropulsion was also associated with a posteriorly shifted perception of verticality ($r_{sp} = -0.499$). The SRP significantly differed between recurrent fallers and single or non-fallers and identified subjects at risk of falling.

Summary: Retropulsion is a frequent postural disorder in neurorehabilitation that occurs in various neurological diseases. The SRP is a valid and reliable clinical bedside test for the diagnosis of retropulsion. Our data give preliminary evidence that retropulsion is associated with a longer rehabilitation stay and an increased fear and risk of falling. Large systematic studies on predictors and the pathophysiology of retropulsion are needed to design targeted treatment approaches.

Acknowledgements:

The authors thank the physiotherapists of the Schoen Clinic Bad Aibling for their support in implementing and collecting the SRP. We also like to thank Alica Paschek, Bettina Riedl, and Florentine Strobel who collected and processed part of the presented data for their Bachelor theses.

Funding:

This work was supported by funds from the German Federal Ministry of Education and Research [BMBF IFB 01EO1401].

References:

1. Scheets PL, Sahrman SA, Norton BJ, Stith JS, Crowner BE. What is backward disequilibrium and how do i treat it? A complex patient case study. *J Neurol Phys Ther.* 2015; 39(2): 119–26
2. Manckoundia P, Mourey F, Perennou D, Pfitzenmeyer P. Backward disequilibrium in elderly subjects. *Clin Interv Aging.* 2008; 3(4): 667–72
3. Bergmann J, Krewer C, Koenig E, Müller F, Jahn K. Development of a clinical scale to assess retropulsion in neurological disorders. *Neurol Rehabil* 2019; 25: 7–17
4. Manckoundia P, Mourey F, Pfitzenmeyer P, Van Hoecke J, Perennou D. Is backward disequilibrium in the elderly caused by an abnormal percep-

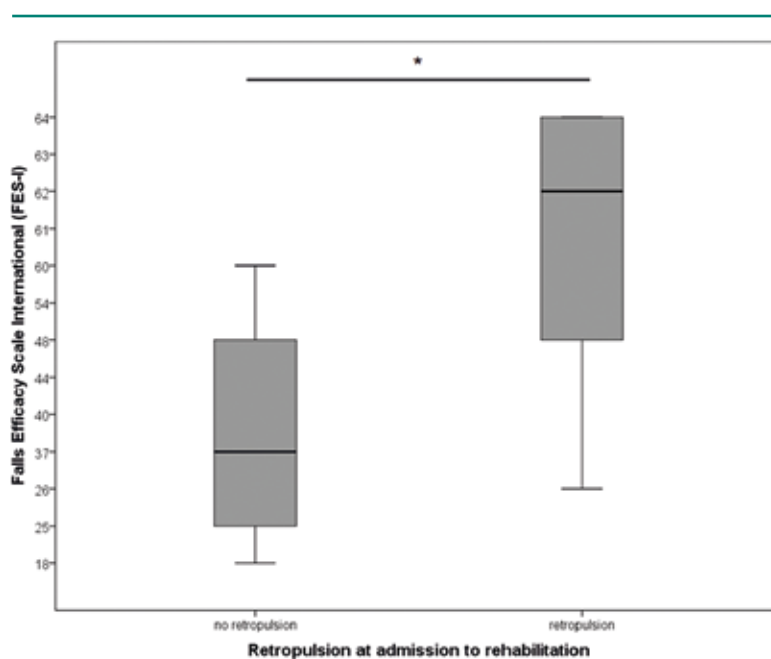


Figure 2. The fear of falling measured with the Falls Efficacy Scale International was significantly higher in patients with signs of retropulsion (SRP score ≥ 1) compared to patients without retropulsion ($U = 7.000$, $p = 0.030$)

5. Mourey F, Manckoundia P, Martin-Arveux I, Tavernier-Vidal B, Pfitzenmeyer P. Psychomotor Disadaptation Syndrome (PDS) – A new clinical entity in geriatric patients. *Geriatrics.* 2004; 59(5): 20–4
6. Menant JC, Latt MD, Menz HB, Fung VS, Lord SR. Postural sway approaches center of mass stability limits in Parkinson's disease. *Mov Disord.* 2011; 26(4): 637–43
7. Desai J, Swash M. Extrapyramidal involvement in amyotrophic lateral sclerosis: backward falls and retropulsion. *J Neurol Neurosurg Psychiatry.* 1999; 67(2): 214–6
8. Bergmann J, Krewer C, Müller F, Jahn K. The Scale for Retropulsion: Internal consistency, reliability and construct validity. *Ann Phys Rehabil Med* 2021: 101537