The Prone Position as a Therapeutic Measure for the Treatment of Retropulsion in Patients with Parkinson's Disease

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Summary

Parkinson syndrome is one of the most common movement-related disorders. Therapeutic interventions for frequent balance disorders in their various forms are particularly challenging to treat as drug therapy often does not bring about sufficient improvement (1). Due to the fact that patients with a Parkinson syndrome, in comparison to an able-bodied population, are at a considerably higher risk for falling and injuring themselves (2), the evaluation of the balance disorders and the appropriate therapeutic measures chosen by the physical therapist are of significance.

The treatment of the retropulsion, often in connection with insufficient or missing counter reactions in the Pull-Test, is an especially difficult challenge. Based on the author's own personal observations, a change in posture can be visible in the patient after approximately 6 minutes in the prone position. This positive change can be seen as an improved posture regulation when standing, an easier transition from sitting to standing and a steadier gait.

The question therefore is why prone positioning is effective, and what the practical applications for the above - mentioned observations could be.

The following provides neurophysiological hypotheses, a clinical case and the therapeutic approach.

Introduction

Parkinson syndromes are characterized by hypokinesia or akinesia, and one of the following cardinal signs of the disease: Rigor, Tremor, Postural instability

However, which of the various Parkinson syndromes one is confronted with cannot certainly be determined so far.

All Parkinson syndromes are classified into three groups: (3)

1. Parkinson's disease (idiopathic Parkinson Syndrome (IPS) or genetically determined
2. Secondary or symptomatic Parkinson-syndromes
3. Parkinson-syndromes in the context of neurodegenerative diseases

Parkinson's disease is the most common type of all PS since 75%–80% fall under this category (3).

Parkinson's disease

Parkinson's disease is caused by a lack of dopamine due to a loss of dopamine producing cells in the substantia nigra pars compacta. This leads to damage of the nigrostriatal system accompanied by impaired movements in the form of bradykinesia and hypokinesia, rigor, low-frequency tremor and disturbed postural reflexes. Other transmitter system changes can also appear, such as in the noradrenergic system in the locus coeruleus or in the limbic system with changes of the amygdalae. The postural instability occurs in Parkinson's disease (IPS) in later stages (4). Patients are at higher risk of falling due to the increased flexor tonus and the frequently occurring forward or lateral pulsion. However, a retropulsion is also possible.

Symptomatic, secondary Parkinson-syndromes

The subcortical vascular encephalopathy (SVE) and the normal pressure hydrocephalus (NPH)

Within the category of symptomatic secondary Parkinson-syndrome, the subcortical vascular encephalopathy (SVE) as well as the normal pressure hydrocephalus (NPH) should be emphasized due to the early postural instability.

Typically seen in the above-mentioned diseases is a gait disorder that appears as a wide stance walk using little steps, an occurring dementia process and bladder dysfunctions. The mobility of the upper body is, in general, normal (Lower Body Parkinson). As the patient begins to walk and when changing direction, blockades (»magnet walk«) set in (5).

In contrast to Parkinson's disease, where a propulsion is more commonly observed, a retropulsion as an early balance disorder can be seen in the a.m. cases.

In the case of SVE demyelination of the white layer is caused by vascular changes, in comparison an increased pressure in the ventricles of the brain due to abnormal accumulation of cerebrospinal fluid occurs in NPH. This happens especially at night and thereby damages the brain.

Parkinson syndromes in the context of neurodegenerative diseases

The multiple system atrophy (MSA) and the progressive supranuclear palsy (PSP)

MSA refers to a disease that is clinically similar to Parkinson's disease as MSA-P (approx. 80%), but occurs as well as MSA-C (approx. 20%), comprising of mostly cerebellar ataxia symptoms (6). This can lead to degeneration in the basal ganglia, substantia nigra, the cerebellum and pons.

In the case of PSP, the atrophy occurs especially in the mesencephalon with axial pronounced Parkinson's syndrome, increased extensor muscle tonus, distinct neck rigor, an early gait disorder with a tendency to fall backwards and vertical gaze palsy.

These clinical pictures are of significance for the physical therapists as well as both of them have a postural instability in common. The retropulsion is found in an especially pronounced form in PSP, often without any compensatory steps for the Pull Test.

Fig. 1_Patients suffering from a pronounced retropulsion tend to loose their balance spontaneously and possibly need the assistance of a physical therapist to get up from a chair

Fig. 2_Patients with Parkinson's disease and retropulsion show a considerable counter reaction while shifting the pelvis anteriorly

Fig. 3_The above shown patient showed no compensatory steps when conducting the pull-test. He fells backwards »en bloc«

Clinical Signs

The retropulsion is characterized by a tendency to fall backwards. The axial position of the body in the sagittal plane has changed.

This affects the daily life activities of the patient. When standing up from a chair the body does not shift its center of gravity forwards sufficiently. The act of getting up is slow and often requires assistance with the arms. Sometimes the patient falls back into the chair or can only stand up with the assistance of another person (Fig.1). Walking is an instable act and can even be impossible. The results of the »Timed-Up-and-Go« (7) test become more distinct in accordance to the severity of the symptoms as well. The mobility is limited.

When trying to shift the patient's pelvis in the standing position forward over the feet he/she will often raise the heels off the floor and, frightened, will reach out for the therapist's shoulders in an attempt to keep the balance (Fig. 2). This reaction is sometimes just as strong when correcting a patient with a Pusher-symptom.

The Pull-Test (reaction to a sudden backwards motion following a pull on the shoulders) is positive. Depending on the degree of the disorder, either several uncertain counter-reactions can be observed or, in the worst case, no reaction at all will occur. The patient falls back »en bloc« without any compensatory step (Fig. 3).

Possible Causes of Retropulsion

The damaged brain areas of the various Parkinson-syndromes indeed overlap, however they do exhibit special characteristics that make singling out one cause not feasible. On the other hand, >>>

all of the above mentioned Parkinson-syndromes share the effectiveness of applying the prone position and therefore at least indicate the same mechanism of action. The author's observation that there is no apparent prone position effect for patients with a damaged cerebellum and a retropulsion seems to be significant.

Otolith functions

The retropulsion represents a false adjustment of the body axes in the sagittal plane of the ocular vestibular reflex that in turn could be traced back to a central otolith dysfunction (of the vestibular organ in the inner ear (the author)) (8).

Pathological Tonus Changes

Dr. Eugen Rasev sees a so-called synergetic hyperactivity of the extensor muscles, especially in the trunk and pelvic regions, as a possible cause of the retropulsion. This in turn leads to a new calculation of the adjustment of the body centre vestibular-cerebellarly and in the basal ganglia, as primarily the flexors of the trunk have a higher tonus than the extensors (9).

Furthermore, the patients with Parkinson-syndromes often exhibit a very visible neck rigor extension of the upper cervical spine.

Damaged modulation of the spinal reflexes

Posturographic tests performed on a platform that allows sudden tipping or shifting have revealed a pathological reaction pattern for patients with PD. They displayed, in contrast to healthy people, a simultaneous activation of antagonistic muscle groups of the lower extremities that make an appropriate balance reaction impossible. It is presumed this stems from a disorder of the central control of vestibular spinal reflexes (10).

This deficient adaption of agonists and antagonists of the lower extremities to changing body positions further aggravates the stabilization in the sagittal plane.

Promotive factors

The bradykinesia contributes to the inability to perform quick corrective movements appropriately. The fear of falling especially decreases the ability to maintain adequate balance reactions, as many patients have a history of falling and tend to feel insecure in an upright position and as a consequence tense up.

Case observation

Ms. Sch., born January 9th, 1930, was in the lung clinic of a hospital being treated for pneumonia. An additional diagnosis of secondary vascular Parkinson's syndrome was made. Her treatment included physical therapy along with respiration therapy because a mobilization of the patient was supposed to take place as she was only able to move about with help. This was due to a pronounced retropulsion and a high risk of falling. Hence the mobility was limited.

Ms. Sch. was unable to get up from a chair on her own. When standing she displayed a spontaneous tendency to fall backwards and had to be held by a therapist. The pull test therefore could not be conducted.

The patient was put into the prone position for approx. 6 minutes which she tolerated without any problems (Fig. 4). Subsequently she was placed again in a chair and asked to stand up without assistance. Her first attempt to transfer from sitting to standing was successful; the retropulsion was markedly reduced. The defined walking distance with a »timed up and go« (TUG) test was completed in 22 seconds,

Fig. 4_The patient in prone position in her room on the ward

which was a substantial mobility improvement.

It was now possible to conduct a pull test which showed however that in regard to the compensatory steps there was no stabilizing reaction. The patient would have fallen if she had not been held even though standing and walking were more stable.

The a.m. patient is a prime example of other patients who suffer from a Parkinson-syndrome (mainly secondary and atypical type) related retropulsion and were prepared similarly for further therapeutic measures. Although the effect of placing a patient in the prone position differs, it well warrants trying out.

The prone position as a therapeutic measure

This measure originally came from the idea that a normal reaction could be achieved through overcompensation.

Fig. 5_The 45°-position on the tilt-table as a variation

Fig. 6_Playful balance training in a slight forward position with contact of the pelvis treatment couch

A common position encountered for Parkinson patients is either sitting or in a supine position. Both have a reinforcing influence upon the retropulsion, which in turn can be attributed to the effect of the prone position. The length of time this was carried out (approx. 6-7 minutes) was chosen arbitrarily at first in order to promote the patient's acceptance for this position.

Normally the compliance is good but sometimes the patient requires assistance from the therapist to get into the prone position. It is beneficial to use a plinth with a face hole in order to not strain the cervical spine. However, during the a.m. time patients tolerate a turning of the head to the side which can also be varied. The upper cervical spine should be in a slight flexion, as this contributes to a reduction of the muscle tonus (11).

One variation is the 45° - position on the tilting table (Fig. 5). Mignolet (12) utilizes this in his work with Parkinson patients both as a therapeutic as well as a prophylactic measure for up to 30 minutes. A study regarding the effects does not exist to this time.

Following the a.m. positioning variations the actual therapy can begin. The practical applicability of the preceding prone positioning lies in the improved feasibility of conducting walk and balance training. The correct transfer from sitting to standing can be carried out easier now as well.

This is subject to the condition that the therapist can make the patient feel confident enough to participate without the commonly pronounced fear of falling. As part of the therapy it is quite possible to integrate ball games, whereby the body is slightly leaned forward and has contact with the pelvis on the treatment couch (Fig. 6).

Standing up from a chair is best accomplished in a walking stance; walking itself can be accompanied by a tactile stimulus on the pelvis from a Thera-Band and thereby, again, a forward thrusting impulse is provided (Fig. 7). The sequential activation of front and back calf muscles through balance training on the balancing board, utilizing sudden rocking motions forwards and backwards, trains the desired countermeasures for a tendency to fall forwards or backwards (Fig. 8).

Because of the importance of the transfer within his / her home, the patient can, asfar as possible, assume the prone position independently or with the assistance of a partner, and thereby improve his gait at least temporarily for specific activities.

The reflex counter-reactions in the sense of compensatory steps are often lacking. Therefore the evidence based push-training of Jöbes (13) is recommended. In this case the patient's shoulders are >>>

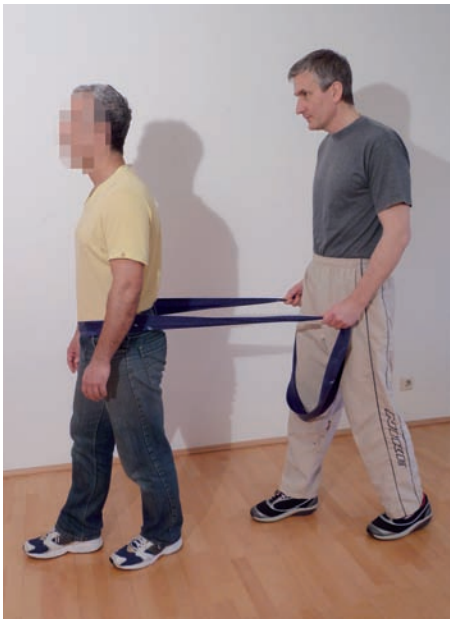

Fig. 7_Walking with a tactile stimulus on the pelvis. The Thera-Band gives a ventral Impulse

Fig. 8_Sequential activation of the calf muscles on the balancing board trains the counter reactions to prevent falling forwards or backwards

(analog of the pull test) repeatedly pulled back

It has been proved that this leads to a quicker initiated protective step that is also more extended. When walking, cadence and stride length increase. The effect lasts for two months without any further training.

Explanation model on the effect of the prone position

1. Due to overcompensation of the postural situation when getting into prone position, changed afferents from the otolith organs of the labyrinth in the inner ear may temporarily occur. This could be the reason for a centrally induced correction of the shifted middle of the body.
   This correlation may also be an explanation for the effectiveness of the prone position as described in Freivogel's publication about midbrain syndromes after cranio-cerebral trauma. Here she describes a tonus distribution in the sense of the tonic labyrinth reflexes with extension of both the lower extremities and spine that decreases in the prone position (14).
2. Due to the ventral tactile stimuli, additional information about the posture and position of the body is applied. The reduced tonus of the dorsal trunk muscles stemming from the application of the prone position also leads to the adjustment of the tonus levels, and thereby, possibly, to a normalization of the calculation of the body posture.
3. A potential influence of the possible ventral shifting of internal organs, stemming from the application of the prone position, could in turn feasibly ease the vertical positioning of the patient in the sagittal plane.

Conclusion

Because the effectiveness of the prone position is not permanent, it can be repeated before each physical therapy session. Based upon the author's own observations, the effect lasts for approximately the time of one therapy session. However, more extensive studies are warranted, in order to determine the optimum length of time for of the measure, the prolonged effectiveness and the posturographic influence. Thereby this paper serves as a base for discussion on one hand, and as a practical impulse for the work with Parkinson patients on the other. ▪

REFERENCES

1. Ceballos-Baumann A, Ebersbach G. 2008. Preface. In: *Aktivierende Therapien bei Parkinson-Syndromen.* Stuttgart: Thieme Verlag
2. Melton LJ, Leibson CL, Achenbach SJ et al. 2006. Fracture risk after the diagnosis of Parkinson's disease, influence of concomitant dementia. *Movement Disorders* 21: 1321-7
3. Jörg J. 2004. *Morbus Parkinson und Parkinson-Syndrome: Diagnose – Differentialdiagnose –Therapie*. Frankfurt: Hormosan
4. Csoti I, Eggert K, Vaitiekunas R. 2010. *Physiotherapie beim Parkinson-Syndrom.* München: Pflaum Verlag
5. Ceballos-Baumann A. 2008. Parkinson-Syndrome: Klinik, Medikamente und neurochirurgische Therapien. In *Aktivierende Therapien bei Parkinson-Syndromen.* Stuttgart: Thieme Verlag
6. Gilman S, Low PA, Quinn N, Albanese A, Ben-Schlomo Y, Fowler CJ. et al. 1999. Consensus statement on the diagnosis of multiple system atrophy. *Neurol Science* 163: 94-8
7. Schädler S, Kool J, Lüthi H, Marks D, Oesch P, Pfeffer A, Wirz. 2009. *Assessments in der Rehabilitation Band 1: Neurologie*. Bern: Huber
8. Dieterich M, Prof. Dr. med. Director of the Clinic for Neurology, Ludwig-Maximilians-Universität Munich, Hospital Großhadern (pers. correspondency 1/2013)
9. Rasev E, MU Dr. Univ. Prag Ph.D. Physician for neuroorthopedic rehabilitation and paintreatment of the musculoskeletal system – sensomotor-postural Therapy (pers. correspondency 11/2012)
10. Fries W, Liebenstundt I. 1998. *Physiotherapie beim Parkinson-Syndrom. Ein Leitfaden zur Bewegungstherapie.* München: Pflaum Verlag.
11. Freivogel S. 1997. *Motorische Rehabilitation nach Schädelhirntrauma. Klinik – Grundlagen – Therapie.* München: Pflaum Verlag
12. Bleton J-P. 2011. Maladie de Parkinson: reeducation de la symptomatologie axiale. *Kinésithér Scient* 524: 13-22
13. Jöbges M, Heuschkel G, Pretzel C et al. 2004. Repetitive training of compensatory steps: a therapeutic approach for postural instability in Parkinson's disease. *Neurol Neurosurg Psychiatry* 75: 1682-7
14. Freivogel S. 1997. *Motorische Rehabilitation nach Schädelhirntrauma. Klinik – Grundlagen – Therapie.* München: Pflaum Verlag

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