

# Rehabilitation strategies for mobility impairment in Parkinson's disease- Where are we now?

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## What is Parkinson's disease?

Parkinson's disease (PD)<sup>a</sup>, a degenerative neurological disease, was first described in 1817 by Dr James Parkinson in the publication 'Essay on the Shaking Palsy'. The disease, mainly<sup>b</sup> concerned with old-age, affects 1% of those over 65 and 4% of those over 85 years of age<sup>1</sup>.

PD exhibits a critical threshold of 80% loss of nigro-striatal dopaminergic neurones and results in a series of disabilities, both motor and non-motor<sup>2</sup>. Disease onset is usually diagnosed by resting tremor in one upper limb, with motor symptoms progressing to bradykinesia, stiffness and shuffling gait. Non-motor symptoms include non-motor muscle stiffness (causing constipation, problems with swallowing and facial expressions), pain, depression and sweating, with 25-30% experiencing dementia<sup>3</sup>.

Currently, a disease with no cure, Parkinson's patients rely heavily on rehabilitation and drug treatments to control the symptoms, which progress variably with time as degeneration continues, demanding dynamic and adaptive rehab techniques.

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<sup>a</sup> Parkinson's disease is not to be confused with Parkinsonism, an umbrella term referring to neurological syndromes sharing some of the symptoms of PD.

<sup>b</sup> Early onset of Parkinson's Disease is rare and is defined as that affecting persons under the age of 50.

Interestingly, since the introduction of dopaminergic drugs such as Levodopa, both the mortality and prognosis of the disease have drastically improved: mortality decreased by 50% and longevity has extended from ~7 to over 25yrs<sup>4</sup>.

### **What rehabilitation techniques are currently in use to improve mobility impairment?**

PD patients each undergo a unique set of challenges with regards to activities in daily life, cognitive limitations, social anxiety, safety and changes in social roles. Rehabilitation for PD is therefore multidisciplinary and can be categorised into mobility, activities of daily life (ADL), cognition and community reintegration, each with sub-categories. The effectiveness of treatments can be measured using a variety of scales, but a universally accepted system is the Unified Parkinson's Disease Rating Scale (UPDRS)<sup>5</sup>, which also includes a modified version of the well established Hoehn and Yahr staging. Although UPDRS gives an arbitrary measure of overall efficacy, this does not necessarily show direct effect of treatment. Often, treatment programmes simply improve self confidence and sense of security, increasing the self-efficacy of the patients<sup>6</sup>. Due to limited test-subjects, double blind studies become less applicable and practical choices of treatment often vary between therapists.

Physical therapies concentrate mainly on improving tremor, balance, muscle strength and gait cycles in order to reduce the fall-rates in PD patients<sup>7</sup>. Physiotherapy with stretches and range of movement (ROM) exercises has been the traditional technique used to improve tremors, rigidity, postural difficulties and flexibility<sup>8</sup>. Activities can be as simple as squeezing stress-balls to more complex sequences of movement such as knitting. A recent advancement in gait rehabilitation is Body-Weight-Supported-Treadmill-Training (BWSTT), which uses an overhead

harness to support part of the body weight while the patient walks on a treadmill. The treatment shows improvement in cadence, stride length and vertical ground reaction force (GRF) for up to 4 months post therapy<sup>9</sup>.

Frozen gait is a symptom frequently suffered by PD patients as the disease increases in severity. This symptom results from a reduced ability to initiate patterns of movement. Regular visual and auditory cues can help PD patients overcome the block in gait initiation<sup>10</sup>. Rigorous research, initiated by the revolutionary discovery of laser-pens as a self-help technique by a PD patient, Stan Clark, has led to the finding that the use of laser-canes to generate lines of light is by far the most efficient intervention to overcome freezing gait when compared to others such as auditory<sup>11</sup> and vibrating metronomes<sup>12,13</sup>. However, the comparative efficacy and safety in the use of any of these interventions outdoors is yet to be determined.

A startling observation in the effectiveness of vibratory metronomes has been the paradoxically preserved ability to ride a bicycle in PD patients<sup>14</sup>, first observed in a 58 year old patient, with an incapacitating freezing of gait. This has led to a revolution in providing PD patients with an escape from sedentary lifestyles, with one patient taking an 1150 mile cycling challenge to raise money for PD research<sup>15</sup>. The pedals are thought to serve as an external pacing cue, absent in normal gait.

Mental rehearsal techniques are also popular and have been shown to be highly effective when combined with physical practice<sup>16-17</sup>. Methods such as the Alexander Technique have been tested for efficacy and are increasing in demand<sup>18</sup>. Other rehab strategies involve prescription of safety measures such as walkers, stair-case rails and wheelchairs. Walking sticks are also

generally used to improve posture (which can also improve swallowing difficulties and cardio-pulmonary status<sup>19</sup>) and provide balance<sup>20</sup>.

Overall, the general advice for managing Parkinson's disease related movement impairments has been to maintain regular exercise, practicing movement techniques. Current research in macaques is also looking into the possibility that exercise can slow down degeneration in PD after encouraging results in rats<sup>21</sup>.

### **Mobility in relation to Activities of Daily life (ADL):**

Rehabilitation of mobility not only involves improving the patient's ability to move from one place to another, but must also consider occupational therapy to support the patient's involvement in everyday activities to help them maintain independence as far as possible<sup>22</sup>.

Ease of access and simplification of movement are the main concerns when considering ADL. For example, feeding techniques can be improved with the use of weighted or built up utensils and scoop plates. Similarly, substitutions with electrical appliances such as electric toothbrushes, razors, kitchen gadgets can have substantial effects on self-maintenance. Other commonly recommended equipment include soap mitts, long shoe horns, trolleys and hands free computer software to name a few<sup>23</sup>. These products, which are easily available online, help to reduce restrictions in social roles, with a large impact on the patient's wellbeing and self confidence, which in turn avoid related cognitive disorders such as depression<sup>24</sup>.

Interestingly, recent research has come to show that rehabilitation programmes are best when conducted within the home of the patients to improve ADL<sup>25</sup>. This comes to show that

rehabilitation relies not only on persistent practice, but the patient centred approach also relies on the patient's sense of security and familiarity such that the learnt activities can be effectively translated into daily life.

### **Mobility and community reintegration**

A deep-seated issue that frequently affects the quality of life of patients with PD is the inability to maintain their roles in community. While some patients may be able to gain sufficient skill from rehabilitation techniques to reclaim their social roles, many find it difficult to keep pace with non-PD friends, due to both fear of social stigma and also physical disability<sup>26</sup>. Hence rehab practitioners may find it useful to introduce patients to new communities, such as local or regional PD societies, to enable patients to comfortably appreciate the margins of their physical abilities.

### **Latest Innovations**

Recent advancements in Parkinson's research have introduced several rehabilitation equipments and strategies with numerous interesting projects being run globally. The usefulness of each of these equipment/ strategies will depend on the patients' stage in the disease and the dynamics of their movement impairment. A portable aid to gauge movement in PD patients using a variety of sensors has been devised and is starting to become a prime research tool in the development of other rehab techniques<sup>27</sup>. Further developments of such computerised gauges are also being supported by Parkinson's UK<sup>28</sup>.

A novel advancement from the use of laser canes has been initiated by the ParkWalkers project, which has produced virtual imagery glasses for PD patients to walk without aid. These glasses, currently in the marketing phase are expected to soon be readily available for PD patients, perhaps with additions of auditory cueing facilities also<sup>29</sup>.

It has been found that visual cueing can also be in the form of videos and freezing gait improvements are seen in patients who observe several videoed actions<sup>30</sup>. University of Hertfordshire is currently pursuing a project to look at the effect of different types of dance on improving mobility and balance in PD patients<sup>31</sup>, while other simple tactics such as the use of Nintendo-Wii is also being researched<sup>32</sup>. The variations in visual and auditory cues are thought to have an assortment of effects on PD patients.

## **Discussion**

The value of rehabilitation medicine in the treatment of Parkinson's disease patients is incontestable. However, with the ageing population, the NHS is seeing a steady increase in the number of patients suffering from PD, increasing the financial pressures on both pharmacological and rehabilitation interventions. Hence, cost-consequence ratings of the rehabilitation techniques must be rigorously reviewed to maintain a successful care pathway for PD patients<sup>33</sup>. Within the NHS, the main costs involved (up to one third<sup>34</sup>) in rehabilitation pay towards staff time, transport of patients to rehab centres and space used for treatment<sup>35</sup> with the equipments themselves costing much less. Cost efficiency may be achieved by enabling patients and carers to become more self-sufficient, hence reducing staffing cost<sup>36</sup>, by educating and training carers in rehabilitation techniques, increasing number of practice

sessions outside therapist supervision. Encouraging patient centred innovations in visual-video and auditory cueing techniques and specialist equipment to improve ADL may also prove to be highly cost effective for the NHS in the long term<sup>37</sup>. With the current economic climate in mind, outsourcing the manufacture of equipment from industrial countries such as China may further serve as a means of cutting costs<sup>38</sup>, especially when considering the implementation of new technological advancements. Investments (both financial and otherwise) in mobility related research provides a high economic return as it has a substantial impact in all other associated symptoms affecting the quality of life of patients, and must therefore be encouraged.

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