ORIGINAL RESEARCH

Eighty-One Patients with Multiple Sclerosis and Parkinson's Disease Undergoing Upper Cervical Chiropractic Care to Correct Vertebral Subluxation: A Retrospective Analysis

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ABSTRACT

Objective: The objective of this article is threefold: to examine the role of head and neck trauma as a contributing factor to the onset of Multiple Sclerosis (MS) and Parkinson's disease (PD); to explore the diagnosis and treatment of trauma-induced injury to the upper cervical spine through the use of protocol developed by the International Upper Cervical Chiropractic Association (IUCCA); and to investigate the potential for improving and arresting MS and PD through the correction of trauma-induced upper cervical injury. Data from 81 MS and PD patients who recalled prior trauma, presented with upper cervical injuries, and received care according to the above protocol are reviewed.

Clinical Features: Each patient was examined and cared for in the author's private practice in an uncontrolled, non-randomized environment over a five-year period. Of the 81 MS and PD patients, 78 recalled that they had experienced at least one head or neck trauma prior to the onset of the disease. In order of frequency, patients reported that they were involved in auto accidents (39 patients); sporting accidents, such as skiing, horseback riding, cycling, and football (29 patients); or falls on icy sidewalks or down stairs (16 patients). The duration between the traumatic event and disease onset varied from two months to 30 years.

Intervention and Outcome: Two diagnostic tests, paraspinal digital infrared imaging and laser-aligned radiography, were performed according to IUCCA protocol. These tests objectively identify trauma-induced upper cervical subluxations (misalignment of the upper cervical spine from the neural canal) and resulting neuropathophysiology. Upper cervical subluxations were found in all 81 cases. After administering treatment to correct their upper cervical injuries, 40 of 44 (91%) MS cases and 34 of 37 (92%) PD cases showed symptomatic improvement and no further disease progression during the care period.

Conclusion: A causal link between trauma-induced upper cervical injury and disease onset for both MS and PD appears to exist. Correcting the injury to the upper cervical spine through the use of IUCCA protocol may arrest and reverse the progression of both MS and PD. Further study in a controlled, experimental environment with a larger sample size is recommended.

Key Indexing Terms: *upper cervical spine, chiropractic, Parkinson's disease, Multiple Sclerosis, trauma*

Introduction

While the link between head trauma and the later development of Parkinson's disease (PD) or Multiple Sclerosis (MS) remains controversial, many PD and MS researchers have confirmed the connection.[1-12] Several researchers have reported a strong association between head trauma and the subsequent development of PD in retrospective case-controlled studies and have found this association to be stronger than that of other environmental agents long suspected as risk factors for PD.[1-5] On average, these studies found that head trauma occurred two to three decades prior to PD onset.[1-2,5] One recently published study, performed at the Mayo Clinic and headed by Dr. J.H. Bower, investigated the association between head trauma and PD in more detail.[1] By reviewing the complete medical records of both cases and controls, the study team was able to objectively determine prior occurrence of head trauma without introducing recall bias. Study results suggest that head trauma is associated with the later development of PD, even when study limitations were taken into consideration.

In a discussion regarding the possible role of trauma in the development of MS, Dr. Charles Poser [9-11] notes that "in some patients with MS, certain kinds of trauma (to the brain and/or spinal cord, including whiplash injuries) may act as a trigger at

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some time for the appearance of new or recurrent symptoms." Poser goes on to suggest that trauma to the central nervous system may alter the blood-brain-barrier (BBB), which many researchers consider to be a critical step in the formation of MS lesions. He cites research conducted on monkeys demonstrating that mild trauma inflicted on the central nervous system, including whiplash injury, results in a breakdown of the BBB. He also cites several researchers who observed the correlation between trauma and the formation or exacerbation of MS lesions. He further notes that the "relationship (between cervical spondylosis and MS) has been well documented by MRI in many patients with MS, revealing a close anatomical correspondence between compression of the cervical spinal cord by spondylosis or herniated discs … and intraspinal plaques at the same level."

In 1996, a British court awarded damages to a plaintiff based on the rapid onset of MS closely following a motor vehicle accident.[12] The presiding judge stated that he was "satisfied that (the plaintiff) did sustain a whiplash injury….and that the symptoms he later displayed indicated that MS had developed in the very area which had been affected by the trauma." Experts testified that hundreds of MS cases diagnosed subsequent to auto accidents existed; too many, they claimed, to be caused by chance.

While links between trauma and the later development of MS and PD have been established, researchers have yet to define an exact mechanism to explain the onset of MS and PD following trauma, nor have they isolated an objective method for measuring and/or diagnosing the kind of trauma-induced injuries that appear to precipitate MS and PD. This paper serves to address the above issues through the summary of case histories, diagnostic test results, and treatment responses of 81 MS and PD patients, 78 of whom recalled head or neck trauma prior to disease onset. These patients were examined and cared for in the author's private practice over a five-year period in a non-experimental environment without control subjects. This paper does not purport to be a controlled research study, but rather serves to provide a foundation for future research.

Case reports of two of the 81 cases (1 MS case and 1 PD case) were published in indexed, peer-reviewed journals.[13-14] Other reports documenting successful treatment of patients with similar diagnoses using upper cervical chiropractic care are limited primarily to Palmer's upper cervical research conducted seventy years ago, which was never published in a peer-reviewed, indexed fashion.[15-16] Patients with other neurological conditions such as Migraine headaches and Tourette Syndrome also responded favorably to IUCCA upper cervical chiropractic intervention.[17-18] In both cases, patients reported substantial traumas to the head or neck prior to the onset of symptoms and diagnoses.

Clinical Features

Of 81 total cases of Multiple Sclerosis (MS) and Parkinson's disease (PD), 44 individuals with MS and 37 with PD consented to examination and treatment in the author's private practice. Patients began treatment at various intervals over a five-year period. Treatment duration varied from one to five years depending on the individual. Patient data for the 44 MS patients and for the 37 PD patients were compiled and listed in Tables 1 and 2 respectively.

MS patients ranged in age from 21 to 66 years old and presented with a one to thirty year history of MS, as diagnosed by their neurologists. PD patients ranged in age between 34 and 77 years and presented with a one to twenty year history of PD, as diagnosed by their neurologists. Most patients reported that they "had tried everything" to relieve their symptoms including prescription medications, chiropractic adjustments, osteopathic manipulation, physical therapy, massage therapy, rolfing, acupuncture, herbs, Chinese medicine, chelation, special diets, supplements, and removal of dental amalgams.

Patients were questioned as to whether they recalled a history of trauma (blow to the head, concussion, whiplash, accident, fall, etc.) prior to the onset of MS or PD. Of the 44 MS patients, 43 (98 %) recalled a history of trauma. (Table 1) Of the 37 PD patients, 35 (95%) recalled a history of trauma. (Table 2) Of the 78 patients who recalled traumas (many recalled more than one), 39 (21 PD patients and 18 MS patients) reported experiencing one or more auto accidents (many were minor rear-end collisions); 29 reported multiple blows to the head and/or neck during sporting activities including skiing, cycling, horse back riding, football, gymnastics, etc.; and 16 reported falls on icy sidewalks or down stairs. In other lesser-reported incidences, one man reported being kicked in the head by a cow; another man reported blows to the head as a result of heavy machinery accidents; and two female patients reported concussions from domestic abuse. The duration between the traumatic event and disease onset varied from two months to 30 years.

It should be noted that sixteen additional MS patients and seven additional PD patients were examined and accepted for care during the same period but chose to discontinue care during the early treatment weeks. Data from these patients were not included in this report.

Intervention

Each patient was examined and cared for utilizing protocol developed by the International Upper Cervical Chiropractic Association (IUCCA), including the use of paraspinal digital infrared imaging, laser-aligned upper cervical radiography, knee-chest adjusting posture, and post-adjustment recuperation.[19] The care, described in detail in previous publications,[13-18] is based on the original upper cervical chiropractic research performed by Palmer seventy years ago.[15-16]

To diagnose spinal injury, a paraspinal thermal analysis was performed using the Tytron C-3000 (Titronics Research and Development) according to thermographic protocols.[20-23] (Figure 1) In all 81 cases, paraspinal scans contained static thermal asymmetry of 0.5°C or higher, which indicates neuropathophysiology originating from the upper cervical spine.[24-27] (Figure 2) (Table 1)

Based on the results of the thermal scans, a cervical x-ray series (lateral, anterior-to-posterior, open mouth, and base posterior) was taken utilizing a specially designed machine (American X-ray Corp.) that incorporates a laser-aligned frame, a laser mounted to the x-ray tube (Titronics Research and Development), a positioning chair, and head clamps.[28] (Figure 3) This configuration is designed to ensure accuracy when measuring

Figure 1: Tytron C3000.

the deviation of the upper cervical spine from the neural canal. Analysis of the upper cervical radiographs revealed deviation of the upper cervical spine from the neural canal, or upper cervical subluxations, in all 81 cases. On average, each patient's atlas and axis deviated from the foramen magnum (occiput) laterally (to the left or right) five millimeters or less and rotationally (anterior or posterior) five degrees or less. In Tables 1 and 2, atlas listings are depicted with laterality of left (L) or right (R) and rotation of anterior (A) or posterior (P). The lateral movement of axis is listed to the left (ESL) or right (ESR).

Because upper cervical subluxations were discovered in all 81 cases, it was recommended that these patients receive care to correct their cervical injuries. Before initiating care, patients were cautioned to continue medical treatment including medications unless otherwise advised by their physicians. After consent was obtained, care was administered according to IUCCA protocol to correct the lateral and rotational deviation of each patient's upper cervical spine. To administer the adjustment, each patient was placed on a knee-chest table with his or her head turned to the side of laterality (either left or right). (Figure 4) Using the posterior arch of atlas or lamina of axis as the contact point, an adjusting force was introduced by hand.[29]

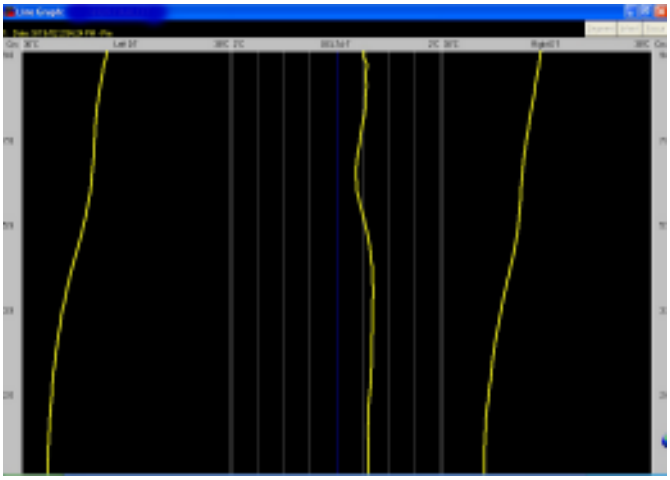

Figure 2: A cervical paraspinal digital infrared image performed with the Tytron C3000. The scan contains static thermal asymmetry of 0.5°C, which is indicative of neuropathophysiology originating from the upper cervical spine.

Following the adjustment, the patient was placed in a post-adjustment recuperation room for fifteen minutes as per thermographic protocol.[20-23] After the recuperation period, a post-adjustment thermal scan was performed to ensure restoration of normal neurophysiology. (Figure 5)

All subsequent office visits began with a thermal scan. An adjustment was administered only when the patient's presenting thermal asymmetry returned. If an adjustment was given, a second scan was performed after a recuperation period to determine whether restoration of normal thermal symmetry had occurred. On average, patients were seen two times per week during the first two weeks of care, one time per week during the following four weeks, two times per month during the following month, one time per month for the following three months, and once per quarter thereafter.

Figure 3: Upper cervical x-ray configuration that includes a laser-aligned frame, a laser mounted to the x-ray tube, positioning chair, and head clamps for accuracy in measuring upper cervical subluxation.

Outcome

Outcomes of the 44 Multiple Sclerosis (MS) patients and 37 Parkinson's disease (PD) patients are illustrated in Tables 3 and 4 respectively. The tables list gender, age, years since diagnosis, initial symptoms, improved symptoms, and category of improvement (minor, moderate, substantial or no change). If the patient's condition remained the same during the care period, "no change" was listed. Patients reporting improvement with, or absence of, less than half of their symptoms were indicated

Figure 4: Knee-chest adjusting posture. The adjustment, based on x-ray findings, is performed to correct lateral and rotational deviation of the upper cervical spine from the foramen magnum.

as showing "minor" improvement. Patients reported reporting improvement with, or absence of, half of their symptoms were identified as having "moderate" improvement. If patients showed improvement or with, or absence of, the majority of their symptoms, they were categorized as having "substantial" improvement.

Of the 44 MS cases, 40 (91%) reported improvement. Of these, 28 showed "substantial" improvement; 8 showed "moderate" improvement; and 5 showed "minor" improvement. No further progression of MS was noted in the improved cases during the care period, which ranged from one to five years depending on the patient. Four cases reported "no change" in their condition.

Of the 37 PD cases, 34 (92%) reported improvement. Of these, 16 showed "substantial" improvement; 8 showed "moderate" improvement; and 11 showed "minor" improvement. No further progression of PD was noted in the improved cases during the care period, which ranged from one to five years depending on the patient. Three cases reported "no change" in their condition.

Hypotheses

Seventy-eight of the 81 Multiple Sclerosis (MS) and Parkinson's disease (PD) patients recalled head or neck trauma prior to the onset of the disease, including blows to the head, whiplash, or concussion sustained as a result of motor vehicle, sporting, or other accidents. These findings are consistent with published retrospective studies conducted with MS and PD patients regarding head trauma sustained prior to disease onset.

In this case, patients were examined to confirm trauma-induced spinal injuries. Two diagnostic tests - paraspinal digital infrared imaging and laser-aligned upper cervical radiography - were administered according to the protocol of the International Upper Cervical Chiropractic Association (IUCCA). In all 81 cases, trauma-induced upper cervical subluxations were discovered.

After administering IUCCA upper cervical chiropractic care, 91% of the MS patients and 92% of the PD patients improved, and no further progression of MS or PD was noted in the improved patients during the care period. Seventy percent of the improved MS patients and 47% of the improved PD patients showed "substantial" improvement, reporting the absence or significant improvement with the majority of symptoms.

Hypotheses: MS and PD both can be induced as a result of head and neck trauma and the resultant injury to the upper cervical spine. Further, this injury can be diagnosed and corrected through the administration of IUCCA upper cervical chiropractic care. Finally, it is the correction of this injury that may arrest and reverse the disease processes involved in MS and PD.

Conclusion

Eighty-one patients with either Multiple Sclerosis (MS) or Parkinson's disease (PD) were evaluated and cared for using protocol developed by the International Upper Cervical Chiropractic Association (IUCCA). Histories of trauma to the head and/or neck were recalled in 78 cases; upper cervical subluxations were found in all 81 cases; and 91% of the cases responded to care, with symptoms improved and/or reversed and no further progression of either MS or PD detected. These results indicate a causal link between trauma, upper cervical injury, and disease onset for both MS and PD. Correcting the injury to the upper cervical spine through the use of IUCCA protocol may arrest and reverse the progression of both MS and PD. Further study in a controlled environment with a larger sample size is recommended.

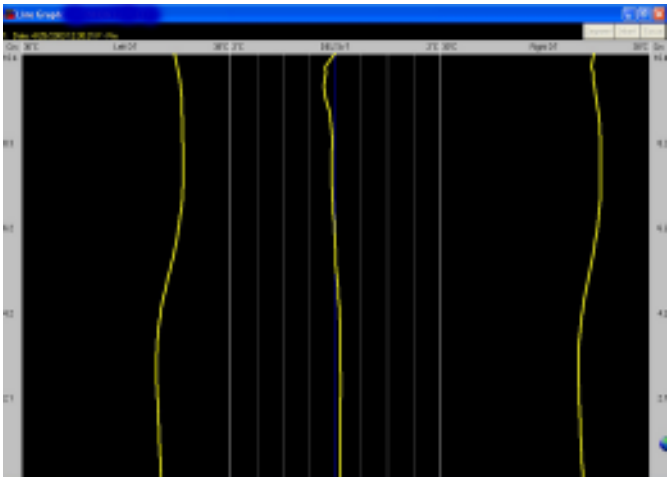

Figure 5: Paraspinal digital infrared image performed after an adjustment was administered. The scan contains normal thermal symmetry.

Table 1. Case Histories and Examination Findings for 44 Multiple Sclerosis Patients

Patient	Gender	Age	Years Since MS Diagnosis	History of Trauma	Thermal Deviation	X-ray Listing
1	F	43	7	auto accident	0.5°C	AR
2	M	65	10	auto accident	0.5°C	ALP
3	F	55	30	bike	1.2°C	ARP
4	F	56	15	auto accident	0.6°C	ARA
5	M	32	3	skiing (multiple)	0.8°C	ESL
6	F	48	23	skiing (multiple)	0.7°C	ESL
7	F	30	2	fall	0.5°C	ALA
8	F	49	10	ice fall	0.5°C	ARP
9	F	32	13	auto & ice fall	0.5°C	ARA
10	F	59	1	auto accident	0.5°C	AL
11	F	33	1	roller skating	0.7°C	ALA
12	M	53	1	horseback fall	0.5°C	AL
13	F	55	9	stair fall	0.5°C	ARP
14	F	35	1	bike	0.5°C	ESR
15	F	44	8	auto & ski	0.5°C	AR
16	M	37	1	fall	0.5°C	ARP
17	M	49	20	horseback fall	0.6°C	AL
18	F	50	2	auto accident	0.5°C	AR
19	F	41	2	domestic abuse	0.6°C	ARP
20	F	34	1	auto accident	0.5°C	AL
21	F	40	1	auto accident	0.5°C	ESR
22	F	47	2	auto accident	0.5°C	ARP
23	F	45	10	auto accident	0.5°C	AL
24	M	40	5	wrestling	0.5°C	ESL
25	F	41	2	auto accident	1.0°C	ALA
26	F	41	6	auto accident	0.5°C	ESL
27	F	45	4	body surfing	0.5°C	ESL
28	F	42	6	auto accident	0.6°C	AR
29	M	35	1	none	0.5°C	ALA
30	M	50	2	weight lifting	0.5°C	ESR
31	F	46	1	ice fall	0.6°C	ESR
32	F	54	3	physical therapy	0.5°C	ESL
33	F	39	20	auto accident	0.7°C	ALP
34	F	48	15	fall	0.5°C	ESR
35	F	53	9	fall	1.0°C	ALA
36	F	53	5	ice fall	0.7°C	ESL
37	M	57	12	horseback fall	0.5°C	ESL
38	F	66	8	auto accident	0.5°C	AR
39	F	39	15	skiing (multiple)	0.5°C	ALA
40	F	46	20	auto accident	0.5°C	AL
41	F	21	2	auto accident	0.5°C	ALP
42	F	44	14	fall	0.5°C	ESR
43	F	54	15	stair fall	0.5°C	ALP
44	F	38	1	ice fall	1.0°C	ESL

Table 2. Case Histories and Examination Findings for 37 Parkinson's Disease Patients

Patient	Gender	Age	Years Since PD Diagnosis	History of Trauma	Thermal Deviation	X-ray Listing
45	M	63	10	football	0.5°C	ALA
46	F	70	2	auto accident	0.8°C	ALP
47	F	60	3	auto accident	0.7°C	ESR
48	M	74	10	football & auto	0.5°C	ESL
49	M	60	7	football, horseback, auto	0.6°C	AR
50	M	70	14	heavy machinery traumas	0.6°C	ALA
51	M	62	2	football, hockey, & auto	0.5°C	ESR
52	M	58	1	auto accident	0.5°C	ESL
53	M	34	2	heavy lifting	0.5°C	ESR
54	F	76	10	motorcycle, fall on ice	0.8°C	ALA
55	F	56	5	blow to the head	0.5°C	ESL
56	M	74	7	kicked by cow, auto	0.8°C	AL
57	F	56	11	auto accident	0.8°C	ESR
58	M	61	2	skiing & auto	0.5°C	ALP
59	F	53	20	gymnastics & auto	0.6°C	AL
60	M	53	2	auto accident	0.5°C	ESL
61	M	67	8	fall	0.5°C	AR
62	M	76	4	none	0.7°C	ARA
63	M	54	15	auto accident	0.5°C	AR
64	F	65	2	auto accident	0.5°C	ESL
65	M	49	12	headfirst fall	0.7°C	ESR
66	F	54	2	none	0.5°C	ESR
67	F	64	9	auto accident	0.6°C	ALA
68	M	66	7	football & auto	0.5°C	ESL
69	F	66	8	skiing (multiple)	0.9°C	ESL
70	M	69	11	motorcycle accident	0.5°C	ARP
71	M	41	8	cycling (multiple)	0.5°C	ESR
72	M	67	3	football & skiing	0.5°C	ESL
73	M	60	12	football & auto	0.5°C	ESL
74	F	59	13	domestic abuse	0.5°C	AR
75	F	77	3	falls on ice	0.5°C	AL
76	M	49	5	waterskiing (multiple)	0.5°C	ESR
77	M	72	7	football concussion & auto	0.5°C	ESR
78	M	59	1	skiing (multiple)	0.5°C	ESL
79	F	64	2	headfirst fall	0.6°C	AL
80	M	47	10	football concussion & auto	1.0°C	ESR
81	M	60	3	auto accident	0.5°C	AL

Table 3. Outcome of 44 Multiple Sclerosis Patients

Patient	Gender	Age	Years Since Diagnosis	Initial Symptoms	Improved Symptoms	Category of Improvement
1	F	43	7	ENW, L	All improved/absent	substantial
2	M	65	10	ENW, NP, HA	All improved/absent	substantial
3	F	55	30	ENW, L, C, B, Walker	All improved/switched to cane	substantial
7	F	30	2	ENW, F, B, Cane	All absent /eliminated cane	substantial
10	F	59	1	ENW, F, V, NP	All improved/absent	substantial
11	F	33	1	ENW, F, HA	All improved/absent	substantial
12	M	53	1	ENW, F, V	All improved/absent	substantial
13	F	55	9	ENW, NP, L, F	ENW, NP, L	substantial
14	F	35	1	Right-sided paralysis, NP	All improved/absent	substantial
15	F	44	8	ENW, NP, LBP, L, C, B	ENW, NP, LBP, L	substantial
16	M	37	1	ENW, L, NP, LBP	All improved/absent	substantial
19	F	41	2	ENW, L, F, NP	All improved/absent	substantial
20	F	34	1	ENW, F, HA, NP, L	All improved/absent	substantial
21	F	40	1	ENW, F	All improved/absent	substantial
22	F	47	2	ENW, CA	All improved/absent	substantial
24	M	40	5	ENW, NP, B	All improved/absent	substantial
25	F	41	2	ENW, NP, L, C	All improved/absent	substantial
27	F	45	4	ENW, F, Cane	All absent /eliminated cane	substantial
29	M	35	1	ENW	All improved/absent	substantial
30	M	50	2	ENW, F, NP, SS	All improved/absent	substantial
31	F	46	1	ENW, NP, HA, B, C	All improved/absent	substantial
32	F	54	3	ENW, NP, LBP	All improved/absent	substantial
34	F	48	15	ENW, NP, HA	All improved/absent	substantial
35	F	53	9	ENW, L, V	All improved/absent	substantial
36	F	53	5	ENW, NP	All improved/absent	substantial
41	F	21	2	ENW, L, C, B, NP, LBP	All improved/absent	substantial
44	F	38	1	ENW, V	All improved/absent	substantial
5	M	32	3	ENW, L, V, B	ENW, L	moderate
8	F	49	10	ENW, L, B, NP, V, Cane	NP, L, V	moderate
9	F	32	13	ENW, F, Cane	ENW, F	moderate
23	F	45	10	ENW, NP, HA, F, B	ENW, NP, HA	moderate
26	F	41	6	ENW, LBP, HA, L, NP	L, NP, HA	moderate
28	F	42	6	ENW, F, HA, NP, LBP	ENW, NP, HA	moderate
38	F	66	8	ENW, LBP	ENW	moderate
43	F	54	15	C, S, B, Wheelchair	C, S, switched to walker	moderate
6	F	48	23	NP, LBP, HA, V, B, SS, Wheelchair	B, HA, NP, LBP	minor
17	M	49	20	ENW, NP, F, B, S, V, Wheelchair	ENW, NP	minor
33	F	39	20	ENW, B, C, Walker, HA	HA	minor
39	F	39	15	ENW, F, B, S, C, SS, Wheelchair	ENW, F	minor
42	F	44	14	ENW, NP, B, F, V	ENW, NP	minor
4	F	56	15	ENW, V, L, B	None	no change
18	F	50	2	ENW, NP, F	None	no change
37	M	57	12	CA,B,F,LN&W	None	no change
40	F	46	20	ENW, NP, SS, B, F, Wheelchair	None	no change

Table 4. Outcome of 37 Parkinson's Disease Patients

Patient	Gender	Age	Years Since Diagnosis	Initial Symptoms	Improved Symptoms	Category of Improvement
46	F	70	2	SD, F, T, NP	All improved / absent	substantial
49	M	60	7	C, D, SS, HW, FA, FR, T, R, SD, F	All improved / absent	substantial
51	M	62	2	D, LBP, NP, CO, SS, T, G, R	All improved / absent	substantial
52	M	58	1	NP, HA, T, LBP	All improved / absent	substantial
57	F	56	11	NP, HA, F, R, T, SS, SW, G, SD	All improved / absent	substantial
58	M	61	2	T, R, SA	All improved / absent	substantial
59	F	53	20	NP, HA, LBP, SD, F, FR, G, SS, T, R	All improved / absent	substantial
63	M	54	15	NP, LBP, HA, R, D, C, SD, F	All improved / absent	substantial
64	F	65	2	NP, R, T	All improved / absent	substantial
69	F	66	8	C, D, SS, SW, G, R	All improved / absent	substantial
71	M	41	8	T, R, NP, SD, F, C	All improved / absent	substantial
78	M	59	1	T, R, HW, NP	All improved / absent	substantial
79	F	64	2	T, SS, HA, F, SD, LBP	All improved / absent	substantial
80	M	47	10	C, D, SS, HW, T, R, G, NP, LBP	All improved / absent	substantial
81	M	60	3	C, D, SS, SA, HW, T, SD, R, FE	All improved / absent	substantial
45	M	63	10	D, HW, T, R, NP, LBP, FR, FE	NP, LBP, R, FE, D	moderate
47	F	60	3	SS, HW, G, T, R, NP, LBP, F, SD	G, T, SD, F, NP	moderate
56	M	74	7	SS, SW, T, G, B, R, F	F, G, R, SS	moderate
72	M	67	3	F, T, G, HW, NP	F, NP, T	moderate
73	M	60	12	NP, LBP, T, G, C, R, SD, F	SD, NP, LBP, F, G	moderate
74	F	59	13	SS, HW, G, T, FE, R, SD, F, NP, LBP	SD, F, NP, LBP, G	moderate
75	F	77	3	NP, R, HA, T, HW, F	NP, HA, F, R	moderate
76	M	49	5	FR, C, SS, HW, T, R, F	FR, R, F	moderate
48	M	74	10	D, SS, SA, HW, G, T, R, SD, F, HA	SD, F, T	minor
50	M	70	14	G, FR, FE, D, C, SD, SW, R, FA, LBP	C, D, G	minor
53	M	34	2	NP, T, G	NP	minor
54	F	76	10	NP, LBP, SD, F, FR, T	NP, LBP, T	minor
55	F	56	5	T, NP, HA, LBP, FR, G, D, R	NP, HA, F	minor
61	M	67	8	F, SD, LBP, FR, G, Cane	LBP, G	minor
62	M	76	4	C, SS, SA, SW, FE, T, G, R, F, NP	F, NP	minor
65	M	49	12	C, D, SS, HW, T, FE, R, LBP	LBP, T	minor
66	F	54	2	T, F, NP, LBP, C	NP, LBP, C	minor
67	F	64	9	C, SS, SA, SW, T, R, F, SD, HA	SD, F, HA, R	minor
70	M	69	11	SD, F, R, FA, CO, NP, LBP	SD, R	minor
60	M	53	2	C, D, SS, FA, G, FE	None	no change
68	M	66	7	C, SS, SA, HW, FA, G, T, R, NP, LBP	None	no change
77	M	72	7	D, SS, SA, SW, HW, FA, T, G, R	None	no change

Symptom Key for Figures 3 and 4

B	Bladder incontinence or urgency
C	Cognitive deficit
CO	Constipation
D	Depression / loss of motivation
ENW	Extremity numbness & weakness
F	Fatigue
FA	Falls
FE	Frozen facial expression
FR	Freezing
G	Shuffling gait / stutter steps
HA	Headache
HW	Handwriting difficulty
L	Lhermitte's Sign
LBP	Low Back pain
NP	Neck Pain
R	Rigidity
S	Spasticity
SA	Excess salivation
SD	Sleep disorder
SS	Slurred speech
SW	Swallowing difficulty
T	Tremor
V	Vision loss

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