ORİJİNAL ARAŞTIRMA ORIGINAL RESEARCH

DOI: 10.31609/jpmrs.2019-70367

Lumbar Spinal Stenosis in Parkinson's Disease

Parkinson Hastalığında Lomber Spinal Stenoz

Tuba Tülay KOCA[a],
Vedat NACİTARHAN[a],
Yılmaz İNANÇ[b]

Departments of
[a]Physical Medicine and Rehabilitation,
[b]Neurology,
Kahramanmaraş Sütçü İmam University
Faculty of Medicine,
Kahramanmaraş, TURKEY

Received: 25 Jun 2019
Received in revised form: 17 Sep 2019
Accepted: 02 Oct 2019
Available online: 03 Oct 2019

Correspondence:
Tuba Tülay KOCA
Kahramanmaraş Sütçü İmam University
Faculty of Medicine,
Department of Physical Medicine and
Rehabilitation, Kahramanmaraş,
TURKEY/TÜRKİYE
tuba_baglan@yahoo.com

ABSTRACT Objective: Parkinson's disease (PD) is a progressive nervous system disorder that affects movement. In recent publications, spinal degenerative findings are significantly higher in patients with PD than healthy controls. Spinal deformities and motor movement disorders are responsible. Spinal stenosis and PD may show common clinical findings. Here, lumbar sagittal and axial spinal for this diameter measurements at Magnetic Resonance Imaging (MRI), will be analyzed in patients with PD. **Material and Methods:** The study was planned as a case-control study. The patients who were admitted to the outpatient clinic with a diagnosis of PD during the recent year were analyzed. The control group consisted of healthy volunteers with a similar age (p=0.105) and gender (p=0.54). On lumbar MRI, L1, L2, L3, L4, L5 spinal canal diameters were measured in all patients and the narrowest anteroposterior and coronal spinal canal diameter measurements in the axial section were performed by the same experienced clinician. **Results:** The study included 50 patients with PD with a mean age of 63.2±11.9 years and 41 control patients with a mean age of 67.2 ± 6.6 years. Accordingly, sagittal diameter L2 (p=0.006), L3 (p=0.008), L5 (p=0.006), axial cross-sectional anteroposterior diameter (p<0.001) and axial section coronal diameter (p=0.006) measurements were found significantly low in patient group compared to healthy controls. **Conclusion:** Lumbar spinal diameter was significantly low in patients with PD. Spinal disorders in PD may be caused by motor effect of degenerative process or primary disease. In addition, neurodegenerative pathogenesis in disease development may contribute to the degenerative process in the spinal canal.

Keywords: Parkinson's disease; spinal stenosis; neuro-rehabilitation

ÖZET Amaç: Parkinson hastalığı (PH) hareketi etkileyen progresif bir sinir sistemi bozukluğudur. Son yayınlarda spinal dejeneratif bulgular Parkinson hastalarında sağlıklı kontrollere göre anlamlı olarak daha yüksektir. Omurga deformiteleri ve motor hareket bozuklukları sorumlu tutulmaktadır. Spinal stenoz ve PH yaygın ortak klinik bulgular gösterebilir. Burada, Parkinson hastalığı olan hastalarda Manyetik Rezonans Görüntüleme (MRG)'de, lomber sagittal ve aksiyal spinal çap ölçümleri analiz edilecektir. **Gereç ve Yöntemler:** Çalışma vaka kontrol olarak planlandı. Son 1 yılda polikliniğe PH tanısı ile başvuran hastalar analiz edildi. Kontrol grubu, benzer yaş (p=0,105) ve cinsiyette (p=0,54) olan sağlıklı gönüllülerden oluşmaktadır. Lumbar MRG'de, L1, L2, L3, L4, L5 spinal kanal çapı ölçümleri tüm hastalara yapıldı ve aksiyal kesitte en dar anteroposterior ve koronal spinal kanal çapı aynı deneyimli klinisyen tarafından ölçüldü. **Bulgular:** Çalışmaya Parkinson hastalığı olan 63,2±11,9 yaş ortalamasında 50 hasta ve yaş ortalaması 67,2±6,6 yıl olan 41 kontrol hastası alındı. Buna göre lomber sagittal çap L2 (p=0,006), L3 (p=0,008), L5 (p=0,006), aksiyal enine kesit anteroposterior çap (p<0,0001) ve aksiyel kesit koronal çap (p=0,006) ölçümleri sağlıklı kontrollere göre istatistiksel olarak anlamlı düşük bulundu. **Sonuç:** Çalışmamızda Parkinson hastalarında lomber omurga çap ölçümleri anlamlı olarak düşüktü. Parkinson Hastaların'daki spinal bozukluklar, dejeneratif süreç veya primer hastalık nedeniyle motor etkiden kaynaklanabilir. Ayrıca, hastalık gelişiminde nörodejeneratif patogenez, omurgadaki dejeneratif sürece katkıda bulunabilir.

Anahtar Kelimeler: Parkinson hastalığı; spinal stenoz; nöro-rehabilitasyon

Parkinson's disease (PD) is the second leading progressive neurodegenerative disorder with increasing prevalence in the elderly. It is caused by degeneration or pathophysiological loss of dopaminergic neurons in the substantia nigra and the development of neuronal Lewy bod-

ies in the midbrain. Advanced age, family history, pesticide exposure and chemicals are the known risk factors. Resting tremor is characterized by motor and non-motor symptoms such as rigidity, bradykinesia and stooped posture. However, depression, anxiety, dementia and autonomic dysfunction may be related.[1,2]

Spinal canal or foraminal narrowing is a common finding in the spine. Generally, spinal stenosis is diagnosed in the presence of neurogenic claudication and/or cervical myelopathy. The most common cause of cervical myelopathy is cervical spinal stenosis over 50 years. Symptomatic canal constriction is congenital or more frequently acquired. Acute cases can develop due to systemic diseases such as endocrinopathies, calcium metabolism disorders, inflammatory diseases and infectious diseases. Therefore, the diagnosis of spinal stenosis is made by computerized tomography (CT) and magnetic resonance imaging (MRI) with sequential images and clinical diagnosis.[3] Lumbar spinal stenosis is the most common cause of spinal surgery over the age of 65 years with narrowing of the lumbar spinal canal and nerve root canals which causes chronic low back and leg pain and paresis.[4]

In recent publications, spinal degenerative findings are significantly higher in patients with PD than healthy controls. Spinal deformities and motor movement disorders are responsible for this situation.[5,6] In addition, the treatment of spinal pathologies in these patients requires a special approach due to the accompanying deformities and motor disorders. Spinal stenosis and PD share common clinical neuromotor symptoms.[7] A few publications on spinal pathologies in patients with PD are available in literature. In PD, spinal canal diameter may be affected due to various factors. Whether diameter of spinal canal is affected by the development or outcome of the disease process is not clear. Here, lumbar sagittal and axial spinal diameter measurements and the presence of lumbar spinal stenosis will be analyzed for the first time in the literature in patients with Parkinson's disease.

MATERIAL AND METHODS

The study is designed as case-control. The patients who were admitted to the outpatient clinic with diagnosis of PD were during the recent one year analyzed retrospectively. The control group consisted of age (p=0.105) and gender (p=0.54) matched healthy volunteers. Lumbar MRI of the participants were analysed by using hospital data system.

On lumbar MRI, T_2-weighted images of L1, L2, L3, L4, L5 spinal canal diameter measurement (Figure 1) and the narrowest anteroposterior and coronal spinal canal diameter in the axial section (Figure 2) were performed by the same experienced clinician. All patients were in the same supine position during MRI measurement. Postural changes do not affect the canal diameter. The patients with a history of spinal surgery, trauma, neuromotor degenerative disease other than PD, malignancy, cerebrovascular diseases, history of congenital spinal deformity were excluded from the study. The study was approved by the Local Ethics Committee (protocol number: 386, 2018) and conducted in accordance with Helsinki criteria.

STATISTICAL ANALYSIS

Analysis was performed by using Statistical Package for the Social Sciences 22 (IBM SPSS for Windows version 22, IBM Corporation, Armonk, New York, USA). Continuous data were presented as mean±standard deviation and categorical variables were summarized as percentages. Kolmogorov Smirnov test was used for the evaluation of normal distrubution. Comparisons between groups were made by using chi-square tests for categorical variables, independent samples student's t tests for normally distributed continuous variables and Mann-Whitney U tests when the distribution was skewed. A p value <0.05 was considered statistically significant.

RESULTS

The study included 50 patients with PD with a mean age of 63.9±11.9 years, and 41 control subjects with a mean age of 67.2±6.6 years. The groups

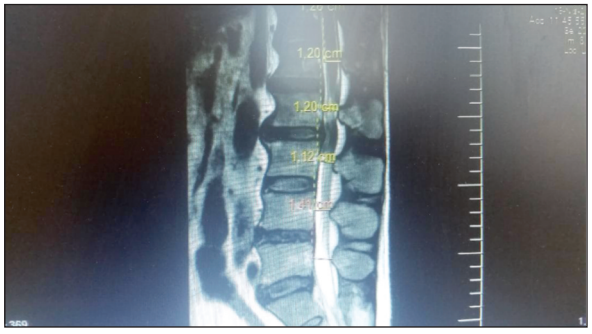

FIGURE 1: Measurements of sagittal cross-sectional, lumbar L1, L2, L3, L4, L5 vertebrae spinal canal diameter at T_2-weighted images.

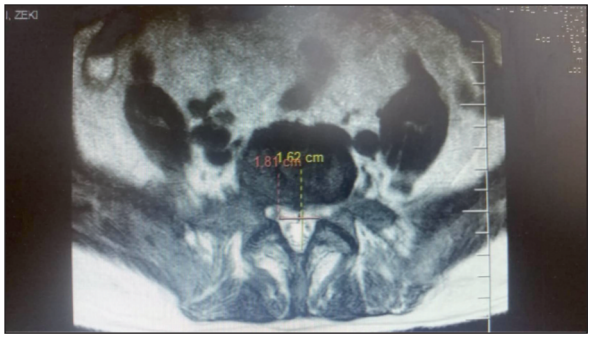

FIGURE 2: Measurements of axial anteroposterior and coronal, lumbar L1, L2, L3, L4, L5 vertebrae spinal canal diameter at T_2-weighted images.

were similar in terms of age (p=0.105) and gender (0.548). The descriptive and analytic data for both groups are summarized at Table 1. Accordingly, sagittal diameter at vertebrae L2 (p=0.006), L3 (p=0.008), L5 (p=0.006) and axial cross-sectional anteroposterior diameter (p<0.001) and axial section coronal diameter (p=0.006) were significantly lower than controls. Sagittal at L2 diameter was 1.23±0.30 cm, 1.23±0.22 cm, at vertebrae L5 was 1.24±0.23 cm at L5 in patients with PD. Lomber axial anteroposterior diameter was 1.15±0.34 cm, lomber axial coronal diameter was 1.58±0.48 cm in patients with PD.

DISCUSSION

In the last century, involuntary movements and parkinsonism are among the subjects of interest. Parkinson's disease is a degenerative neurological condition characterized by tremor, rigidity, bradykinesia and loss of postural reflex. Spinal deformities are more commonly seen in patients with PD compared to controls according to current literature. With the development of anatomic and physiological studies on neural circuits between motor systems, the pathophysiology and brain imaging of movement disorders increased. Multichannel electromyography of the affected muscles provides objective and analytical data on chorea, ballismus, athetosis and dystonia.[8]

In autopsy studies, evidence for spinal cord involvement is increasing in PD. Some changes at spinal projections of many neurotransmitters other than dopamine have been observed. Spinal neurons are thought to be more sensitive to the neurodegenerative process in neurodegenerative disorders.[9] Galazky et al. observed that low back pain and lumbar degeneration were more frequently seen in PD compared to healthy controls.[6] Pain intensity and disability scores were associated with advanced PD. The hypokinetic subtype was more associated with pain intensity; the prevelance of lumbar arthrosis was 79.6%, scoliosis 38.8% and spondylolisthesis 24.1% in their study. Motor function and motor complications, low lumbar lordosis, limited lumbar range of motion and stooped posture are found to be the factors that aggravate chronic low back pain in patients with PD.[10] Watanabe et al. who examined the features of the spinopelvic alignment, did not find any difference between the vertical axes and pelvic incidences.[11] But there were significant differences in thoracic kyphosis, lumbar lordosis and pelvic tilt angles. Hoehn and Yahr staging revealed a significant correlation between the vertebral, thoracolumbar kyphosis and the lumbar range of motion in their study.[11] In the study by Oh et al., the frequency of sagittal spinopelvic dysfunction was found to be higher in PD.[5]

In patients with PD, cervical positive sagittal malalignment was found to be higher in association with disease severity. Pathogenesis of neuromuscular disease may play a role in these disorders.[12] Parkinson's disease and cervical myelopathy due to cervical spinal stenosis may have similar gait disturbances.[13] The neurophysiology of gait is complex and includes several structures in the central nervous system. Walking disorders, especially PD, are common and may be difficult to treat at later ages.[14]

TABLE 1: Descriptive and analytic characteristics of the groups.

	Parkinson's Disease (N=50) Mean+standard deviation	Control (N=41) Mean±standard deviation	P
Age (year)	63.9±11.9	67.2±6.6	0.105
Gender (Male/female)	30/20	22/19	0.548
Lomber Sagittal diameter (cm)			
L1 vertebrae	1.27±0.33	1.35±0.31	0.261
L2 vertebrae*	1.23±0.30	1.42±0.32	0.006
L3 vertebrae*	1.18±0.31	1.35±0.27	0.008
L4 vertebrae	1.23±0.22	1.27±0.24	0.372
L5 vertebrae*	1.24±0.23	1.47±0.47	0.002
Lumbar axial anteroposterior diameter (cm)*	1.15±0.34	1.47±0.30	<0.001
Lumbar axial coronal diameter (cm)*	1.58±0.48	1.84±0.35	0.006

*Independent samples t test: p<0.05, statistically significant difference.

Lumbar spinal stenosis (LSS) is a clinical syndrome that involves concentric narrowing of the spinal canal especially in the cervical and lumbar region. The absence of clear radiological findings is one of the simplest problems. Spinal stenosis is divided into lateral resess and spinal canal stenosis. It is diagnosed as segmental narrowing involving the spinal canal with relative change of the other segments at MRI and the typical clinical findings of the disease.[15,16] Spinal canal measurements vary with spinal level, gender, age and height.[17-19] The most common cause of spinal stenosis is the degeneration of structures such as intervertebral disc, facet and ligamentum flavum from spinal components. Although the historical development of cervical and lumbar spinal stenosis varies, the diagnosis is similar.[20] Spinal lumbar stenosis is a disease that develops in the 5th to 7th decade of life. Degenerative factors are the most common cause of acute cases. Spinal canal narrowing may be caused by factors such as disc, bulging, ligamentum flavum hypertrophy, facet capsule thickening and osteophyte formation. The classical symptom is sciatica pain that decreases flexibly and increases with ambulation. Neurological examination is often normal and the most common imaging modality is MRI.[21,22]

In our study, the lumbar spinal canal diameter of patients with PD was found to be significantly lower in both axial and sagittal sections compared to the controls. The development of lumbar spinal canal stenosis appears to be accompanied by common pathogenetic pathways in the development of PD. Some patients have been misdiagnosed with PD because of severe spinal canal stenosis symptoms. Should we consider spinal stenosis in differantial diagnosis of PD? To answer this question, it is necessary to plan a prospective study which evaluates the patients together with their clinical characteristics and other associated factors. As known, spinal stenosis is most often the result of a degenerative process, which begins in the intervertebral disk as the number of viable cells, water, and proteoglycan content decrease in the nucleus pulposus.[23] So, common pathogenetic factors related with both PD and LSS may play a role.

LIMITATIONS OF THE STUDY

Not taking into account many factors affecting the spinal diameter measurement and small sample size are the limitations of the study. As the study was retrospective, the body mass index and clinical findings that could affect the spinal canal diameter could not be recorded. Patients were evaluated with MRI measurements only. Spinal diameter measurements before the diagnosis and repeated measurements after long term follow-up will provide us useful information about the disease process.

CONCLUSION

In our study, the sagittal and axial lumbar diameter measurements of the spinal canal were found to be narrower in patients with PD than controls. Parkinson's disease is seen in an increasing frequency in the elderly population. Spinal disorders in PD may be caused by degenerative or disease-related motor effects. In addition, neurodegenerative pathogenesis in disease development may contribute to the degenerative process in the spinal canal. It is necessary to pay attention to the spinal deformity, complex drug interactions and PD-associated osteoporosis related to the treatment of spinal pathologies in PD. Also the complication rates of these patients are particularly high after surgery. These patients should be considered specifically for spinal pathologies and lumbar spinal stenosis.

Conflict of Interest

The authors declare that they have no conflict of interest.

Informed Consent

Informed consent was obtained from the of participants included in the study.

REFERENCES

1. Beitz JM. Parkinson's disease: a review. Front Biosci (Schol Ed). 2014;6:65-74. [Crossref] [PubMed]
2. Morales-Briceño H, Cervantes-Arriaga A, Rodríguez-Violante M. Premotor diagnosis of Parkinson's disease. Gac Med Mex. 2011;147:22-32. [PubMed]
3. Melancia JL, Francisco AF, Antunes JL. Spinal stenosis. Handb Clin Neurol. 2014;119:541-9. [Crossref] [PubMed]
4. Deasy J. Acquired lumbar spinal stenosis. JAAPA. 2015;28:19-23. [Crossref] [PubMed
5. Oh JK, Smith JS, Shaffrey CI, et al. Sagittal spinopelvic malalignment in Parkinson disease: prevalence and associations with disease severity. Spine (Phila Pa 1976). 2014;39:E833-41. [Crossref] [PubMed]
6. Galazky I, Caspari C, Heinze HJ, et al. The prevalence of chronic low back pain and lumbar deformities in patients with Parkinson's disease: implications on spinal surgery. Eur Spine J. 2018;27:2847-53. [Crossref] [PubMed]
7. Guppy KH, Khandhar SM, Ochi C. Reversible Parkinson-like symptoms in patient with bilateral chronic subdural hematomas and cervical spinal stenosis. World Neurosurg. 2018;109:285-90. [Crossref] [PubMed]
8. Yanagisawa N. Functions and dysfunctions of the basal ganglia in humans. Proc Jpn Acad Ser B Phys Biol Sci. 2018;94:275-304. [Crossref] [PubMed] [PMC]
9. Watanabe K, Hirano T, Katsumi K, et al. Characteristics and exacerbating factors of chronic low back pain in Parkinson's disease. Int Orthop. 2015;39:2433-8. [Crossref] [PubMed]
10. Watanabe K, Hirano T, Katsumi K, et al. Characteristics of spinopelvic alignment in Parkinson's disease: comparison with adult spinal deformity. J Orthop Sci. 2017;22:16-21. [Crossref] [PubMed]
11. Moon BJ, Smith JS, Ames CP, et al. Prevalence and type of cervical deformities among adults with Parkinson's disease: a cross-sectional study. J Neurosurg Spine. 2016;24:527-34. [Crossref] [PubMed]
12. Diamandis P, Amato D, Finkelstein J, et al. 79-year old man with Parkinsonism and acute spinal cord compression. Brain Pathol. 2014;24:101-2. [Crossref] [PubMed]
13. Vivacqua G, Casini A, Vaccaro R, et al. Spinal cord and parkinsonism: neuromorphological evidences in humans and experimental studies. J Chem Neuroanat. 2011;42:327-40. [Crossref] [PubMed]
14. Santens P. Neuromodulatory procedures for gait disorders in Parkinson's disease. Acta Neurol Belg. 2018;118:13-9. [Crossref] [PubMed]
15. Hughes A, Makirov SK, Osadchiy V. Measuring spinal canal size in lumbar spinal stenosis: description of method and preliminary results. Int J Spine Surg. 2015;9:3. [Crossref] [PubMed] [PMC]
16. Hall S, Bartleson JD, Onofrio BM, et al. Lumbar spinal stenosis. Clinical features, diagnostic procedures, and results of surgical treatment in 68 patients. Ann Intern Med. 1985;103:271-5. [Crossref] [PubMed]
17. Ulbrich EJ, Schraner C, Boesch C, et al. Normative MR cervical spinal canal dimensions. Radiology. 2014;271:172-82. [Crossref] [PubMed]
18. Singh K, Samartzis D, Vaccaro AR, et al. Congenital lumbar spinal stenosis: a prospective, control-matched, cohort radiographic analysis. Spine J. 2005;5:615-22. [Crossref] [PubMed]
19. Sirvanci M, Bhatia M, Ganiyusufoglu KA, et al. Degenerative lumbar spinal stenosis: correlation with Oswestry Disability Index and MR imaging. Eur Spine J. 2008;17:679-85. [Crossref] [PubMed] [PMC]
20. Hashizume H, Yoshida M. Spinal stenosis. Nihon Rinsho. 2014;72:1768-72. [PubMed]
21. Baker JF, McClelland S 3rd, Hart RA, et al. Management of spinal conditions in patients with Parkinson disease. J Am Acad Orthop Surg. 2017;25:e157-65. [Crossref] [PubMed]
22. Molina M, Wagner P, Campos M. Spinal lumbar stenosis: an update. Rev Med Chil. 2011;139:1488-95. [Crossref] [PubMed]
23. Schroeder GD, Kurd MF, Vaccaro AR. Lumbar spinal stenosis: how is it classified? J Am Acad Orthop Surg. 2016;24:843-52. [Crossref] [PubMed]