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Original article

Functional results and patient satisfaction after long fusion for spinal deformity in Parkinson's disease

C. Scemama [a,*], G. Mangone [b], R. Bonaccorsi [a], H. Pascal-Moussellard [a]

[a] *Service de Chirurgie Orthopédique et Traumatologie, Hôpital Pitié Salpétrière, Université Pierre et Marie Curie, 83 Boulevard de l'Hôpital, 75013 Paris, France*
[b] *Centre d'Investigation Clinique, CR-ICM, INSERM UMRS 1127, CNRS UMR 7225, Université Pierre et Marie Curie, 83 Boulevard de l'Hôpital, 75013 Paris, France*

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ABSTRACT

Background: Patients with Parkinson's disease often present abnormal posture or severe sagittal malalignment, causing significant disability. Surgical fusion is these cases shows high rates of complications, but may nevertheless provide functional benefit; however, this remains to be assessed.
Hypothesis: Long fusion for patients with Parkinson's disease and postural disorder could alleviate disability despite the high risk of complications.
Methods: We retrospectively reviewed 18 Parkinson patients treated by long fusion for spinal deformity. Functional results on the Oswestry Disability Index (ODI) and patient satisfaction were assessed at a minimum 2 years' follow-up. Predictive factors for good outcome were analyzed.
Results: Median follow-up was 44.4 months (IQR, 36–62.4 months). ODI showed significant improvement, from 64 (IQR, 59–77) preoperatively to 49 (IQR, 40–57) at last follow-up ($p = 0.0014$). Fifteen patients (83%) were very satisfied ($n = 5$) or satisfied ($n = 10$) with the procedure. On multivariate analysis, only age was significantly associated with improvement in ODI at last follow-up (estimate: −9.8; $p = 0.5$).
Discussion: Although long spinal fusion involves a high risk of complications in Parkinson's patients, the improvement in autonomy and patient satisfaction should be borne in mind before rejecting surgery, especially with motivated patients.
Level of evidence: IV.

1. Introduction

Parkinson's disease is a neurodegenerative condition affecting about 7 million persons worldwide. Prevalence is reported as 1–4% after 60 years of age [1]. Parkinson patients are frequently disabled by postural disorder and sagittal malalignment such as camptocormia, antecollis, Pisa syndrome or scoliosis. Pathophysiology is poorly known, and treatment is difficult. These postural disorders are resistant to L-dopa, and attempts at brain stimulation treatment have been inconclusive [2]. When medical management fails, surgery may be the only means of restoring autonomy.

Spinal surgery in Parkinson's disease incurs a high risk of complications, bone fusion being hard to achieve. The patients show poor bone quality, muscular degeneration and other frequently associated degenerative conditions such as orthostatic hypotension, motor fluctuation, cognitive impairment and poor physical form [3]. A literature review including 95 patients reported complications rates ranging from 43% to 100% in Parkinson patients, taking all types of spine surgery together [4]. Some authors proposed a decision-tree for Parkinson patients with postural disorder; the sole agreed indication for spinal surgery is an association of fixed postural disorder and radiculopathy or myelopathy; any surgery should be kept as simple as possible [5]. Others consider it mandatory to restore perfect sagittal alignment to prevent mechanical failure and postoperative complications [6].

The complications of spine surgery in Parkinson patients have been widely described, but few studies assessed treatment by long fusion [7–10]. They mainly concerned small series, and focused on camptocormia. The largest series was that of Bouyer et al. [10], with a complications rate of 42%, and often poor functional results; assessment, however, did not use validated scores, making conclusions uncertain. Bourghli et al. [7] reported improved sagittal alignment and good patient satisfaction despite a 50%

* Corresponding author.
E-mail address: caroline.scemama@aphp.fr (C. Scemama).

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complications rate; quality of life was assessed on the SRS 30, only at last follow-up, making it impossible to demonstrate real benefit. Schroeder et al. [11] used the Hoehn-Yahr score, but even so none of the published studies included precise assessment of the severity of the patients' Parkinson's disease, although this is highly likely to impact quality of life significantly and should be taken into account in interpreting results. Finally, most studies of surgery in Parkinson's disease reported heterogeneous series of degenerative spinal pathology, and the real benefit of long fusion remains unknown.

We report a retrospective study of a cohort treated by long fusion for spinal deformity in Parkinson's disease. The aim was to assess functional benefit and satisfaction at follow-up. Predictive factors for good outcome were analyzed.

2. Materials and methods

2.1. Center, surgeons and inclusion criteria

A single-center retrospective study was conducted in a specialized spine surgery center. The inclusion period was 2002–2014. Surgery was performed by 2 senior spine surgeons. Inclusion criteria comprised: Parkinson's disease of ≥2 years' progression, with spinal deformity requiring fusion of ≥5 levels, with ≥2 years' follow-up. Exclusion criteria comprised: revision surgery, and infectious, tumoral or traumatic etiology.

2.2. Patients, measurements, origin of data

Eighteen patients were included (Table 1). The median number of fusion levels was 10 (Q1-Q3: 9–16). Two patients had associated transpedicular osteotomy (11%) and 2 had multiple Smith-Petersen osteotomies (11%) to correct sagittal malalignment. Median operative time was 240 min (1st to 3rd interquartile range (IQR), 220–300 min), and median blood-loss 800 ml (IQR, 700–1000 ml). Median follow-up was 44 months (IQR, 36–62 months).

Preoperative work-up comprised clinical and radiological assessment, with AP and lateral full-spine views. Postoperative assessment comprised the same examinations at 3, 6, 12 and 24 months and then annually. Bone mineral density was assessed preoperatively on dual-energy X-ray absorptiometry (DXA) if available, with T-score ≤2.5 SD defining osteoporosis. Where DXA was not available, osteoporosis risk was defined by vertebral density <120 Hounsfield units on preoperative CT, as described in the literature [12]. Demographic, clinical and radiological data were entered in a dedicated data-base (Keops, SMAIO, Lyon, France) and extracted for the study. The study had institutional review board approval (CPP Paris 6).

2.3. Endpoints

The main endpoint was the Oswestry Disability Index (ODI). The ODI is a self-administered questionnaire comprising 10 items on pain intensity, personal care, lifting, walking, sitting, standing, sleeping, sex life, social life and traveling, assessed on 0–5 Likert scales, with 5 corresponding to severe disability. Item scores are summed and multiplied by 2 to give a global score of 0–100, with 0 corresponding to no disability and 100 to maximum disability [13]. Last follow-up ODI was assessed after completion of all surgery, including when revision was required.

Secondary endpoints comprised preoperative and last follow-up SF-12 functional score and Glasmann satisfaction score at last follow-up [14]. The Glasmann score comprises 4 statements on the impact of surgery on pain and function and 1 on whether the patient would undergo the procedure again, rated as "definitely true" to "definitely false". Radiologic measurements comprised preoperative and last follow-up sagittal parameters on lateral view: pelvic incidence (PI), C7 plumbline, and the difference between PI and lumbar lordosis (LL). Mechanical complications [15,16] and infections requiring revision surgery were inventoried.

Parkinson severity at last follow-up was assessed by a specialized neurologist. Two validated scores were used: the MDS-UPDRS (Movement Disorder Society – Unified Parkinson's Disease Rating Scale) and the MMSE (Mini Mental State Examination). The MDS-UPDRS is a 4-part clinical score, with questions on non-motor experiences of daily living, motor experiences of daily living, motor examination and motor complications, on 0–4 Likert scales, with 4 corresponding to severe disability; the score on each part is calculated at the end [17]. The MMSE assesses 5 cognitive axes: orientation, memory, attention and calculation, recall, and language; maximum score is 30 and scores below 23 indicate cognitive impairment [18].

We investigated preoperative variables potentially predictive of ODI at last follow-up after adjustment on preoperative score: age (continuous variable), gender, presence of comorbidity (apart from Parkinson's disease), body-mass index (BMI), osteoporosis (dichotomous variable), presence of radiculopathy, and preoperative C7 plumbline. Surgical variables comprised: laminectomy associated to fusion, operative time, blood loss, number of levels of fusion, C7 plumbline at last follow-up, and complications requiring revision surgery.

Table 1
Demographic data.

Variables	*N* (%) or median (IQR)
Female	11 (65%)
Age (years)	69 (64–73)
Body-mass index	23.8 (22.7–26.1)
Preoperative radiculopathy	6 (33%)
Fusion levels	10 (9–16)
Follow-up (months)	44.4 (36–62.4)
Parkinson disease preoperative progression (years)	7 (6–10)
Number of preoperative Parkinson drugs	3 (3–3)
Patients with preoperative brain stimulation treatment	1 (5%)

2.4. Statistics

Continuous variables were reported as median (IQR), and categoric variables as rates number (percentage). Pre- and postoperative scores and sagittal parameters were compared on parametric Student t test after checking normal distribution. Predictive factors for ODI were identified by linear regression. Variables were tested on univariate analysis, and on multivariate analysis if found significant at $p < 0.2$ (with minimal association). ODI at last follow-up was adjusted on preoperative ODI for these analyses.

Analyses used R software (version 3.1.3, R Core Team).

3. Results

3.1. Main endpoint

Median ODI fell significantly, from 64 (IQR, 59–77) preoperatively to 49 (IQR, 40–57) at last follow-up ($p = 0.0014$). Functional improvement mainly concerned pain ($p < 0.001$), personal care ($p = 0.006$), prolonged sitting ($p = 0.02$), sleep ($p = 0.002$) and social life ($p = 0.03$).

3.2. Secondary endpoints

There were no significant changes in SF-12 scores: physical, 25 (IQR, 25–29) preoperatively vs. 26 (IQR, 24–38) at last follow-up

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