A study on 144 cases after lumbar spine endoscopic surgery. Classical rehabilitation vs. FPZ machines system.

Rudolf Morgenstern, Dr.med. Dr.Ing*, Christian Morgenstern, Dipl.-Ing.†, Ana Abelló, Carlos Vilella****

*Centro Médico Teknon, Barcelona, Spain
† Dept. ESAII, CREB, Universitat Politècnica de Catalunya, Barcelona, Spain
** Centro Médico de Terapia de la Columna, Barcelona, Spain

Corresponding author: *CTC, Mandri 51, 08022 Barcelona, Spain, E-Mail: rumor@endoscopiacolumna.com*
Keywords*: transforaminal endoscopic discectomy, posterolateral approach, FPZ system,*

Study Design. 144 private patients underwent endoscopic spine surgery (Yeung's YESS system) in a period of 4 years (2001-2005) All patients underwent rehabilitation after surgery using two different methods.

Objective. To determine if there is any influence on the final results using the FPZ method or the classical rehabilitation after endoscopic spine surgery using Yeung´s technique.

. **Methods.** 144 Endoscopic discectomies were done using a 20° rigid endoscope, Laser Holmium-Yag 80 Watt output and Radiofrecuency electrodes.
A visual pain scale, a force and movement measuring system and a questionnaire were used to determine the results with a minimal follow up of 3 months, but an average of 24.24 months.
During this period of time, rehabilitation was done splitting patients in two groups: classical rehabititation and FPZ method.

Results.
The results (like MacNab) in the 73 standard cases, were:
81% good/excellent results
15%fair results
4 % poor results
The results (like MacNab) in the FPZ 60 cases, were:
93 % good/excellent results
7 % fair results
0 % poor results

Conclusion. The FPZ Method provides a better and more objective control for evaluation and rehabilitation and better results for the group of fair results.

Introduction

Endoscopic transforaminal decompression techniques for radiculopathy secondary to lumbar disc herniation have been recognized as an alternative surgical procedure to the microscope assisted transcanal approach, see [6]

This study analyzes the factors that contribute to achieve better final results with two different rehabilitation methods after using Yeung's [13][14] endoscopic transforaminal technique (YESS system). This study comprises 144 patients consecutively operated by the senior author (RM) with the endoscopic transforaminal technique [13][14]. It focuses on the evolution of the technique's success rate after standard rehabilitation and rehabilitation using the FPZ method.

Historical background

The first, nonvisualized, posterolateral percutaneous central nuclectomy was reported by Hijikata et al. [7] in 1975, followed by Kambin and Gellman's [8] report of nine cases in 1983. In 1983 Forst and Hausmann [5] reported the direct visualization of intervertebral disc space with a modified arthroscope. Schreiber et al. [12] used a biportal endoscopic technique. Transforaminal approach was reported by Mathews [10] in 1996. Yeung [14] and Knight [9] used Holmium-YAG laser for foraminoplasty and decompression. In 1997 Yeung [13] introduced a rigid rod-lens, integrated, multichannel spinal endoscope with bevel-ended canula that allows same-field viewing of the epidural space, annular wall, and intradiscal space.

Methods

From Jan. 2001 to Feb. 2005 the senior author (RM) performed posterolateral endoscopic excisions of lumbar disc herniation, L1-L2 to L5-S1, on 144 consecutive patients.
The general inclusion criteria for this study required clinical evidence of lumbar disc herniation and more than 3 months of failed conservative treatment, intractable leg or buttock pain, and/or functional impairments.

Lumbar sagital and frontal Rx, MRI, blood analysis, ECG were standard performed.
Under local anaesthesia and light sedation, 144 patients underwent provocation discography (positive discography level = contrast escapes or profiles herniation). Discographic exclusion criteria was normal disc shape. The transforaminal endoscopic procedure was performed only at the positive level.

The procedure was done like described by Yeung et al. [13][14] using an 20° rigid endoscope with a working channel of 2,7 mm.; Laser Holmium-YAG 80 Watt with 90° side firing electrodes; radiofrequency coagulation system and indigo carmine to blue stain abnormal nucleus pulpous and annular fissure, see [12] .

Every procedure was video-recorded (mini-DV) for subsequent analysis and feedback learning purposes. Discography images were printed and added to the patient's documentation.

Statistics

A relational database and client software was specifically designed to allow storage of the patient's personal data and the case's documentation, including operation date, type of intervention, result, etc. The software calculates on request automatically statistics of the selected patients: follow-up median and standard deviation, age median and standard deviation, sex and result distribution of the operations.

The operated disc levels can be seen in Table 1 and the type of herniations in Table 2.

There were 96 (66.66%) male patients and 48 (33.33%) female patients.
The average male patient's age was 45.91 years and the average female patient's age was 44.56. The age range was 18 to 76 years. Global age average = 45.46 years, standard deviation = 12.42 years.

Disc level	L1- L2	L2- L3	L3- L4	L4- L5	L5- S1	Total discs
Number of discs	3	7	25	92	77	204
Percentage %	1,47	3,43	12,25	45,1	37,75	100

Table 1: Disc levels

Herniation location	bulging	central	lateral	foraminal	extra-foraminal	Total herniatons
Number of herniations	60	26	46	71	1	204
Percentage %	29,41	12,75	22,55	34,8	0,49	100

Table 2: Type of herniations

The aim of this study is to determine if the FPZ rehabilitation method provides a better result on operated patients (under the same surgical conditions) than the standard rehabilitation method, based both on measurable objective criteria [2].

Parameters

1) A visual pain scale, see Figure 1, was used to evaluate the patient's pain, 6 and 20 weeks after the surgical procedure
The physical condition of the patient's spine was tested in an independent therapy center [15] by professional physiotherapists with a questionnaire on the patient's physical condition and including the visual pain scale seen in Figure 1.
If the visual scale value was below 5 on a scale of 10, the author considered that the surgical procedure failed.

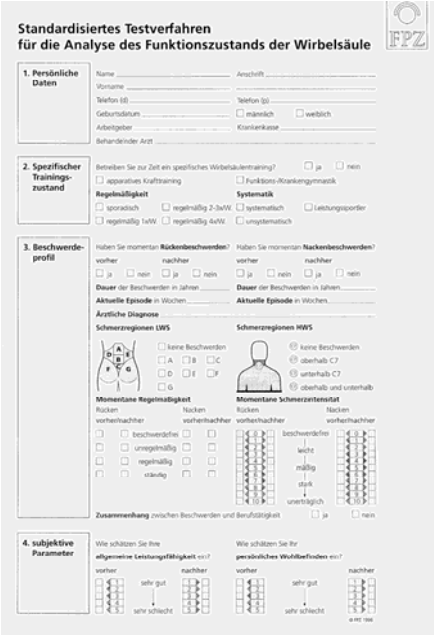
Standardisiertes Testverfahren
für die Analyse des Funktionszustands der Wirbelsäule
FPZ
1. Persönliche Daten
2. Spezifischer Trainings-zustand
3. Beschwerde-profil
4. subjektive Parameter

Figure 1: Patients data sheet with visual pain scale

2) Measurements of maximal isometric force and movement range of the lumbar spine were performed as described in the FPZ Method [3][4], on part of the operated patients, 6, 12 and 18 weeks after the surgical procedure.

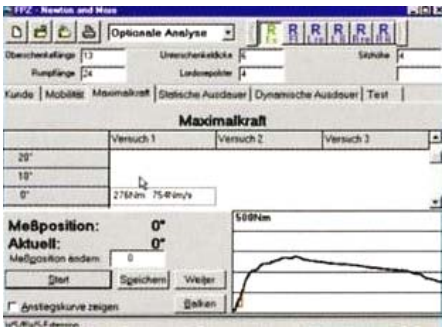

Figure 2: Isometric lumbar force measurement

Four different training machines based on the FPZ method [3][4] were used for measuring maximal isometric force and angular movement range on back extension, forward flexion, lateral right/left flexion and rotation of the lumbar spine, as seen in Figure 3 to 6.

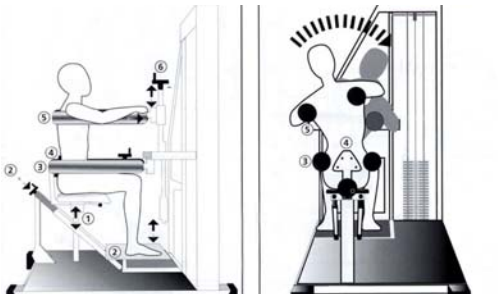

Figure 3: Lateral flexion

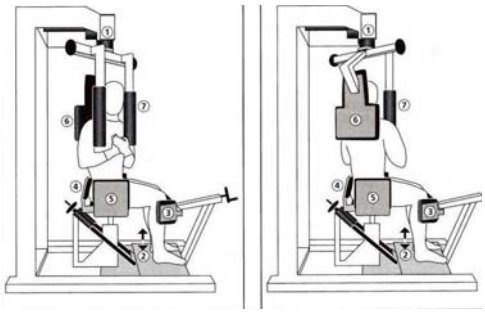

Figure 4: Rotation

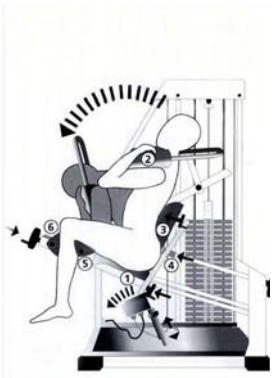

Figure 5: Forward flexion

Figure 6: Back extension

The contraction of other muscle groups was avoided thanks to specific blocking mechanisms on every single training machine. The isometric force/time curve and angular movement range were registered with a computer program linked to the measurement equipment integrated in each training machine. Force measurements were performed using force gauges, angular measurements with potentiometers.
To guarantee the precision of the measurements every single machine was previously zero calibrated before each patient's measurement was done.

The FPZ method includes a computer database with the mean value and standard deviation of the isometric force and angular movement range of 34,941 patients classified by age, weight, height and sex (database selection parameters) see [11].

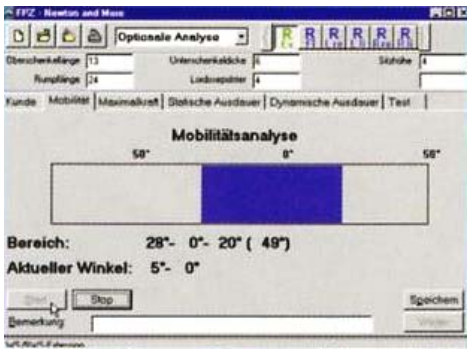

Figure 7: Angular movement range measurement

The measured isometric force and angular movement range of every patient were compared to the mean value of the selected sub-group of the database. Then the incremental percentage of the difference was calculated.

The calculated differences were graphically displayed in a table with the mean range in the middle column and the standard deviation (SD) ranges on its sides, negative SD on the left, positive SD on the right [11]. See Figure 8

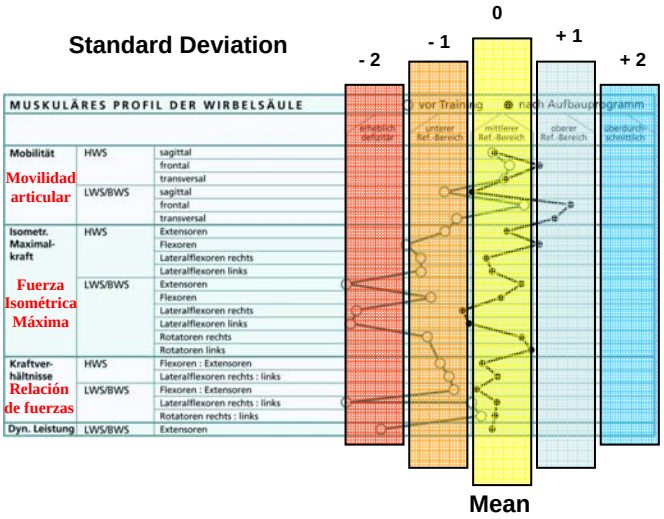

Figure 8: Force and movement ranges for a sample lumbar spine

If 18 weeks after surgery the patient's values were located in the column of minus one standard deviation or less, the author considered the surgical procedure failed.

3) A questionnaire comprising 4 questions (only yes/no answer), like described by Yeung et al. [13], was submitted to the patient after a min. of 6 months after the surgical procedure.

Questionnaire:

- *Since your endoscopic spine surgery, have you had subsequent lumbar spine surgery at the same level?*
- *Are you satisfied with the outcome of your endoscopic operation?*
- *Would you select the same endoscopic spine surgery again in the future, given the same disc herniation and your personal famialiarity with the operative experience?*
- *Are your current back or leg symptoms, if any, worse than before your endoscopic back surgery?*

If one question was answered differently to the answer pattern No/Yes/Yes/No, the author considered that the surgical procedure failed.
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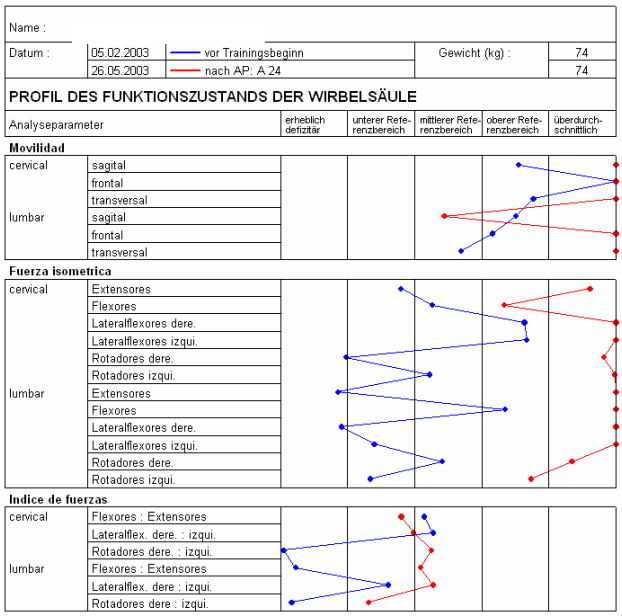

Figure 9: Example of good result: blue trace = first measurement red trace = measurement 14 weeks after treatment

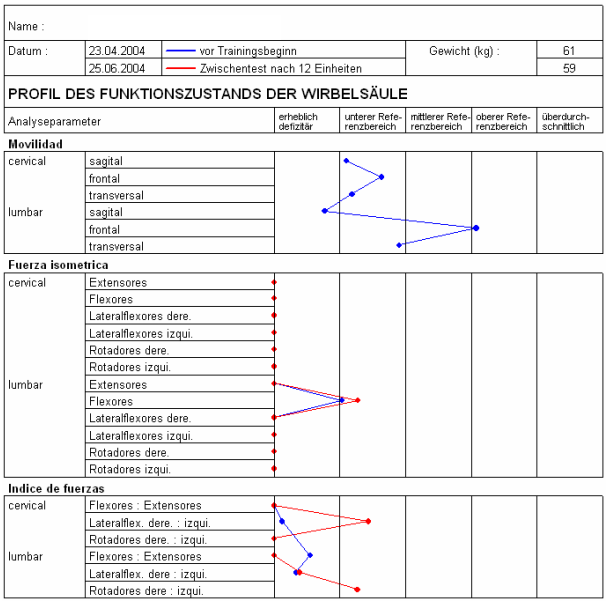

Figure 11: Example of poor result: blue trace = first measurement red trace = measurement 8 weeks after treatment

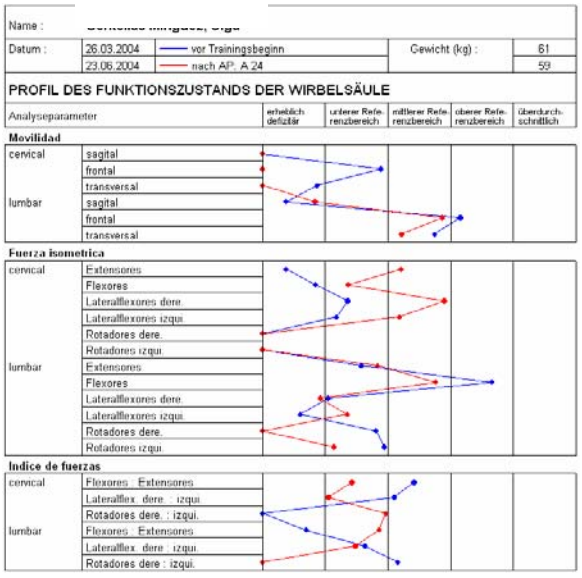

Figure 10 : Example of poor result: blue trace = first measurement red trace = measurement 12 weeks after treatment

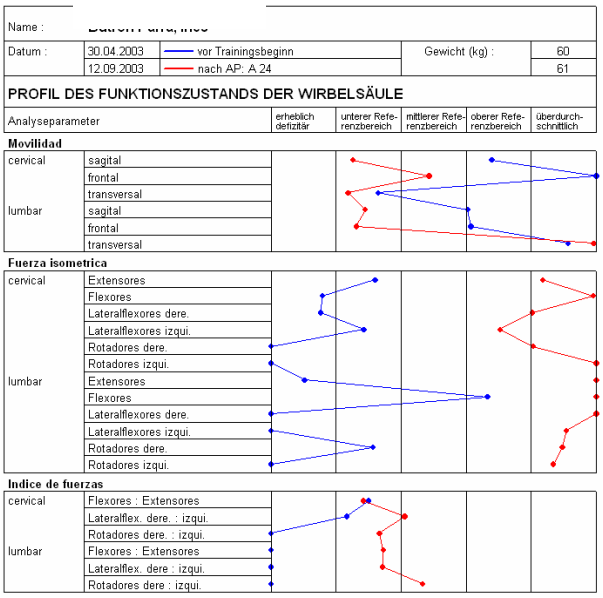

Figure 12 : Example of a good result: blue trace = first measurement red trace = measurement 18 weeks after treatment

Results

Overall results

The overall results, like Macnab can be found in Table 3 and are graphically represented in Fig. 13.

Type of result	Number of cases	Percentage of cases
Excellent and good	119	83%
Fair	20	14%
Poor	5	3%
Total	144	100%

Table 3: Overall results

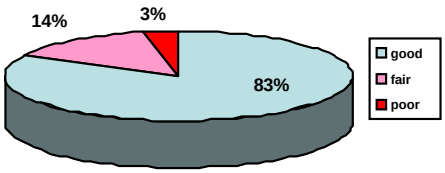

Figure 13: Overall results overview of the 144 cases

25 patients out of 144 cases had fair or poor results, as the feedback on at least one of the collected parameters (the visual pain scale and/or the measured force/movement measurements and/or the questionnaire) was below the required qualification.

This 25 fair and poor results were due to:
11 neuritis (1 with drop foot syndrome), 5 open re-interventions caused by foraminal stenosis or residual fragment, 2 discitis (unknown origin), 3 endoscopic re-interventions caused by residual fragment, 1 spinal stenosis and 3 instabilities (bad surgical indication for endoscopic surgery).

Results were evaluated by a post-op clinical control of a minimum of 3 months [15]. The average follow-up was of 24.24 months with a standard deviation of 13.32 months.

Out of the 144 patients, 60 were evaluated using the FPZ method (isometric lumbar muscle force and lumbar mobility analysis), the visual pain scale and the questionnaire.
For the resting 84 patients the physiotherapists only used the questionnaire for the evaluation, as the patients refused to use the FPZ method due to economical or logistic reasons.

Rehabilitation

Of the 144 cases, 90 underwent rehabilitation under direct supervision of the senior author. 43 were treated in other locations, but keeping periodical contact with the senior author.

For 11 cases the author does not have feedback on rehabilitation. From these 11 cases, 7 were considered as failed surgery, as the patients answered the questionnaire in a negative way or did not answer it at all.
In the resting 4 cases the patients answered the questionnaire in a positive way.

From the 133 rehabilitated patients, 60 patients used the FPZ method also for rehabilitation.
The 73 resting patients underwent standard physiotherapy (electrotherapy, isometric muscle and propioceptive exercises)

	Total	Good	Fair	Poor
Standard	73	59	11	3
FPZ	60	56	4	0

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Table 4: Result overview for standard and FPZ rehabilitation

The results of both groups (60 cases FPZ rehabilitation and 73 cases standard rehabilitation), are represented in figures 14 to 16.

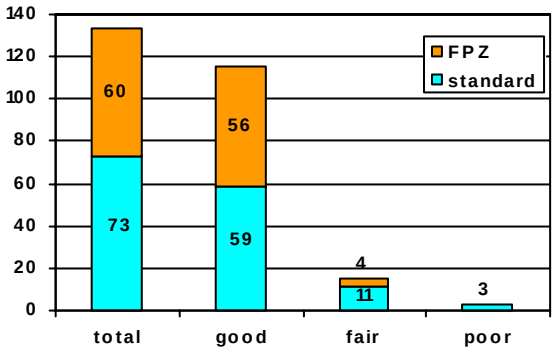

Figure 14: Results after standard rehabilitation or FPZ

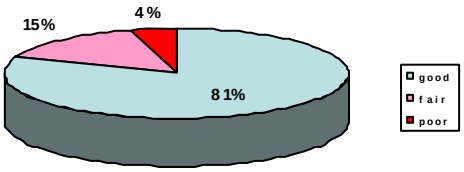

Figure 15: Standard rehabilitation results

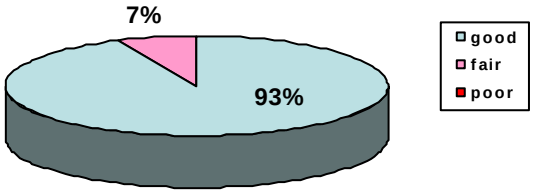

Figure16: FPZ method rehabilitation results

Discussion

Both groups had surgery under the same conditions, including the same operation room, equipment and surgical instruments.

	Standard (73 Cases)	**FPZ (60 Cases)**
Age average (in years)	46.68	44.66
Min-Max	18-76	26-72
Male	(47) 64%	(43) 71%
Female	(26) 36%	(17) 29%
Follow up mean	29,2	18,42
Max follow up	54,9	35,8
Min follow up	5	4,6
Standard deviation	13	8,7

Table 5: Follow up in months, sex and age distribution

No significant difference was found between the age average and sex distribution, as well as the follow-up of both groups.

An important difference can be observed between both methods for the group of fair results (15% of fair results for the classical, 7% for the FPZ method). Apparently the FPZ Method improves these results by helping avoiding medication and allows a faster return to physical activity and/or work.

For poor results, this is if the surgery failed, no rehabilitation method will improve a patient's result.

Conclusions

- The FPZ Method provides better and more object tive control during rehabilitation.
- The articular disc mobilisation and the specific training of the spine muscles done with the FPZ Method seems to speed up the return to normal physical activity without the need of medication.
- The FPZ System seems to provide better final results after endoscopic spinal disc surgery for the group of fair results after op.

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