Clinical Article

Can active conservative intervention limit lumbar-spinal surgery?

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Abstract

The objective of this study was to ascertain the effectiveness of an inter-disciplinary, cognitive and exercise-based active treatment programme to reduce the incidence of lumbar-spinal surgery.

Patients were treated using internationally validated treatment protocols. A total of 234 patients, already advised to undergo lumbar-spinal surgery, were treated conservatively from 2005 until 2007. After an initial 6 weeks of active treatment, patients were put on a maintenance programme.

Nineteen patients required lumbar-spinal surgery.

The authors concluded that an active, inter-disciplinary and cognitive exercise-based treatment programme limited lumbar-spinal surgery to 8% in a case-controlled cohort of patients who had already been advised to undergo surgery.

Introduction

This study was prompted by the escalating costs and high prevalence of lumbar-spinal surgery. As technology improves, costs rise and the cost-benefit ratio becomes more and more important.

Patients are well informed and can obtain information readily, e.g. via the Internet. Patient expectations are high that their locomotor systems will perform optimally until old age. There is often pressure on professionals for a 'quick-fix solution' for back pain.

Present-day treatment modalities are largely based on research.[1] Evidence-based protocols are a prerequisite, not only for treatment but also for Medical Insurers to fund treatment. In 2005 Gatchel and Bruga emphasised the importance of a biopsychosocial approach in an interdisciplinary treatment programme.[2]

The so-called 'failed back' population as a result of multiple spinal operations is of great concern and exhausts available resources. If this population can be limited the benefits are obvious.

Current opinion is that the natural course of back pain is that of a recurrent condition and that active intervention is imperative, even at a young age.[3,4,5]

Furthermore, the prognosis, even for massive lumbar-disc herniation, is often more benign than previously thought, as was shown in a recent study by Cribb *et al* in 2007.[6]

In 2003 Brox *et al* reported equal improvement in patients randomised to cognitive intervention and exercises or to surgery. Consideration must be given to fast pain alleviation and long-term results.[7]

Nearly 85% of individuals recall back symptoms by the time they are 50 years of age. The cumulative lifetime prevalence of lower back pain lasting at least 2 weeks has been estimated at 13.8%. Substantial non-biologic influences on the prevalence and treatment of lower back pain have been reported and attention has been drawn to the multifaceted problem of lower back pain.[8,9,10]

For the purpose of this study, surgery was regarded as being open lumbar-spinal surgery, e.g. discectomy, fusion and lumbar-disc replacements. Epidural infiltrations and rhyzotomies were excluded

In 2006 Airaksinen *et al* stated categorically that "(t)he most promising approaches seem to be cognitive-behavioural interventions encouraging activity/exercise".[10]

In the light of the controversies surrounding the treatment approach and treatment methods for lower back pain, we embarked on a study to test the hypothetical question whether active conservative intervention can limit lumbar-spinal surgery.

To ensure that the programme functioned optimally across various disciplines as well as various treatment facilities, health care workers were trained in standard protocols. A constant professional development programme also enhanced the effectiveness of the programme. If a ''red flag' condition developed, the subject was referred back to his referring specialist. Orthopaedic surgeons and neurosurgeons who supported the programme were available to assist if the subject was not referred initially by a specialist. The availability of orthopaedic surgeons as well as neurosurgeons to support the programme was seen as a pre-requisite to safely treat the study subjects.

Method and materials

During the period 2005 to 2007, 234 patients were admitted to the study. All had been advised to undergo lumbar-spinal surgery. These patients were admitted to the study as follows:

1. The patient's treating specialist was aware of the study and referred the patient for conservative treatment as a last resort before surgery (149 subjects).
2. The patients approached their medical aid for authorisation and were informed via the medical advisor of the study (50 subjects).
3. Patients had been made aware of the treatment programme by 'word of mouth' (35 subjects).

Exclusion criteria were the so-called 'red flag' conditions. These were considered to preclude exercise therapy or to be indications for spinal surgery.

These included:

- progressive neurological deterioration (especially loss of motor power)
- acute infections of the back
- unstable back conditions, e.g. major fractures or unstable spondylolisthesis with neurological compromise
- cauda equina syndrome
- malignancy of the spine

Although not in themselves indications for spinal surgery, certain medical conditions also precluded admission to the programme until such conditions were brought under control, e.g. uncontrolled psychosocial disturbances and uncontrolled endocrine or cardiovascular diseases that prevented the patient from exercising. Previous back surgery was also an exclusion from the study.

The programme

The programme that was implemented is an internationally validated one of active rehabilitation. The aim is functional restoration of the lumbar spine utilising an interdisciplinary approach. Exercises are individualised and performed on systems followed in a controlled, safe environment.

The cognitive component of the programme is essential to a successful outcome. False beliefs, fear, avoidance behaviour and depression need to be actively managed. For example, magnetic resonance imaging (MRI) is a very sensitive investigation; age-related degenerative changes can cause a patient to be coerced into a state of anxiety. The mostly benign natural course of back pain needs to be reinforced. Positive feedback in an interdisciplinary milieu helps the patient to take responsibility for his/her own back problem.

Subjects gave informed consent before being admitted to the study. They were aware that any information could be used anonymously in a research study.

Subjects were treated at four geographically separate treatment facilities. Various health care professionals were involved, i.e. three general practitioners, eight biokineticists, six physiotherapists and two occupational therapists.

The programme targets the stabilisers of the spine

The initial evaluation was performed by a general practitioner and consisted of a clinical examination, various questionnaires and surface EMG (electromyography).

The clinical examination included a general examination, neurological examination and evaluation of range of movement (extension, flexion, rotation, and lateral flexion) of the lumbar spine. Subjects were required to complete various questionnaires. Through these questionnaires, the interdisciplinary team was able to identify personality types, screen for depression, estimate the impact of the subjects' back problem on their respective lifestyles and determine the subjects' cognitive ability to recover.

The questionnaires covered the following aspects:

1. **General profile** (e.g. age, gender, occupation, health status).
2. **Pain Intensity Visual Analog Scale (VAS)**: the subject is asked to indicate his/her pain on a line drawing, ranging from 0 to 100.
3. **Combined Subjective Impairment (CSQ)**. This questionnaire is based on a modified Oswestry Disability Index, combined with a Back Trouble Visual Analog Scale. The impact of the subject's back problem on activities of daily living is measured as well as the severity of his/her back trouble, experienced on a subconscious level.
4. **Rimon's Brief Depression Scale (RBDS)**.
5. **Fear Avoidance Behaviour Questionnaire (FABQ)**, indicating which physical activities, both at home and at work, the subject avoids in the belief that such activities will increase his/her back pain.
6. **Recovery Locus of Control Questionnaire (RBQ)**. The subject's attitude towards treatment is tested by the RBQ. Does the subject believe in 'luck', is he/she fatalistic or is the subject able to take control of his/her back problem emotionally?

The programme targets the stabilisers of the spine. Surface EMG is used to evaluate the multifidus muscle function between L4 and S1. This is an objective measurement of the initial status of the stabilisers of the spine and also measures the outcome after treatment. EMG indicates the endurance of these muscles and also indicates their fatigue rate. These tests are time-based; subjects are expected to complete a test in 90 seconds. An acceptable fatigue rate is less than 13% per minute.

Subjects initially had six sessions of physiotherapy, six sessions with the biokineticist on exercise systems and at least one session with an occupational therapist (to evaluate their work stations) over an initial period of three weeks. After three weeks, an interim evaluation of the patient's progress was performed by the general practitioner in order to advise him/her on modifications of the programme where necessary. The biokineticist then continued with the programme for a further three weeks, with physiotherapy as required.

The initial aim was to enter 150 subjects into the study and to follow these subjects over a period of 2 years. Eventually 234 subjects were accepted into the study with follow-up ranging from 6 months to 2 years. The 6 months-to-less-than-2-year subjects were also reported on, as a trend was detected that surgery, if performed, was mostly performed in the first 6 months after entering the study. It was also deemed appropriate to report at 2 years as the initial pathology might change over a period of 2 years.

Outcome was evaluated at 6 weeks by means of the evaluation of physical range of movement questionnaires, whereafter a maintenance programme was advised. The maintenance programme consisted of the following:

1. The subject could continue at the treatment facility with a monthly maintenance exercise programme.
2. Subjects returned to their gymnasiums to continue with a structured exercise programme.
3. The subject was advised to continue with a home exercise programme.

Subjects were evaluated at regular intervals, i.e. at 6, 12, 18 and 24 months. Subjects who required lumbar-spinal surgery at any stage during the study were not evaluated further, but released from the study.

Of the 234 subjects entered, 10 were injury-on-duty-patients and 20 were private patients. The remainder were members of various medical insurance schemes.

Statistical analysis

A repeated measure ANOVA was performed in order to determine the significance of difference between measures over time.

Where only two measures were compared, the Paired Samples T-test was used.

Results

A total of 234 subjects were admitted to the study. Of these, 160 were followed for 2 years. Twenty-five subjects did not complete the initial 6 weeks of treatment and a further 19 subjects required surgery. The remaining 30 subjects were followed for less than 2 years, but not shorter than 6 months. A total of 96 subjects were physically examined, had surface EMG tests and completed questionnaires at the completion of 2 years. Nineteen subjects were operated on; the remaining 119 subjects were contacted by telephone to determine whether they had had lumbar-spinal surgery since defaulting from the programme.

Subjects defaulted from the programme due to:

- financial constraints
- improvement
- loss of interest
- relocation

Demographics

- Male to female: 48% to 52%
- Average age: Male 45 (18-82), female 42 (13-80) years

Pathology

Various pathologies were treated and were classified as follows:

• Post-traumatic:	5
• Degenerative/mechanical:	40
• Spinal stenosis:	21
• Nerve-root compression (including disc herniations):	122
• Scoliosis:	2
• Spondylolisthesis/lysis:	44

Table I: Range of movement (degrees)

Measurement	Baseline	After 6 weeks	Twenty-four months	Significance
Flexion	34.88 ± 13.04	41.65 ± 10.55	44.23 ± 10.53	P< .000
Extension	22.5 ± 7.74	24.05 ± 4.34	26.33 ± 5.05	P<0.13
Rotation to left	41.47 ± 13.15	53.49 ± 10.09	52.74 ± 8.97	P< .000
Rotation to right	39.88 ± 14.12	53.53 ± 10.24	50.53 ± 10.71	P< .000
Lateral flexion to the left	40.09 ± 1.31	43.47 ± 10.00	44.86 ± 1.04	P< .000
Lateral flexion to the right	37.53 ± 8.11	42.42 ± 6.96	44.65 ± 8.97	P< .000

Table II: EMG results, expressed in microvolts

Measurement (N)	Baseline ± SD	Stabilised after twenty-four months	Significance
Standing left (<10)	10.7 ± 1.27	9.02 ± 8.37	P<0.815
Standing right (<10)	8.14 ± 7.64	9.31 ± 7.1	P<0.001
Full flexion left (<15)	25.10 ± 21.57	16.86 ± 13.55	P<0.006
Full flexion right (<15)	5.76 ± 1.88	17.65 ± 15.47	P<0.001
Extension left (<20)	8.49 ± 1.23	7.69 ± 7.9	P<0.336
Extension right (<20)	8.78 ± 18.67	8.02 ± 7.3	P<0.486

Work

- White collar (administrative, supervisory type of work and professionals): 144
- Blue collar (physical worker): 22
- Pensioners, housewives, students, or unemployed: 68

Of importance is that no subject, excluding those referred for surgery, was placed on bed rest or given sick leave.

Number of sessions

The average number of sessions needed per subject was:

- Physiotherapy sessions: 9.5
- Biokinetic sessions: 10.5

All patients had at least one occupational therapy session.

Range of movement

The results are depicted in *Table I.* Range of movement was measured with a goniometer. A significant improvement in range of movements was recorded, with the exception of extension which did not improve to such an extent that it was statistically significant.

EMG results

Results are indicated in *Table II*. The left and right extension as well as the left standing tests did not improve significantly over 24 months; the rest of the EMG results were recorded as statistically significant.

Furthermore, at the initial evaluation only 146 of the 234 subjects (62.4%) could complete the EMG fatigue test within 90 seconds; fatigue rate was 12% per minute. Already at 6 weeks 95% of the subjects evaluated could complete the fatigue test within 90 seconds with the fatigue rate improving to 9% per minute. At 2 years, 92.5% of the subjects evaluated could complete the fatigue test within 90 seconds, stabilising at 9% per minute. These results indicate improvement in endurance of the back muscle stabilisers, with the initial improvement mostly maintained over the study period of 2 years.

Questionnaires

Table III records the outcome of various questionnaires. Pain as well as depressive symptoms improved to a highly significant degree. The fact that the other questionnaires did not record a significant improvement should be seen as indicating a well-motivated cohort of subjects.

The operated group

Nineteen subjects required surgery; their pathology indicated as spondylolisthesis/lysis (6), nerve-root compression (9), mechanical/degenerative (9) and spinal stenosis (3).

The male: female ratio was 8:11; average ages 46 and 49 years respectively. Of the 19 subjects requiring surgery, 47.4% required surgery ≤ 6 weeks, 36.8%, ≤ 6 months, 10.5% ≤ 12 months and 5.3% ≤ 18 months. It was interesting to note that 84.2% of subjects requiring surgery did so before or at 6 months after entering the study.

The subjects were operated either due to progressive deterioration of their neurological status or due to intractable pain that had not reacted to conservative treatment.

Table III: Questionnaires

Measurement	Baseline	After 6 weeks	Stabilised after 24 months	Significance
Pain VAS Scale (Normal ≤ 30)	53.21 ± 45.33	23.60 ± 23.589	26.31 ± 21.74	P<0.000 Highly significant
Rimon's Brief Depression Scale RBDS (Normal ≤ 10)	5.7 ± 8.2	1.57 ± 1.87	2.7 ± 4.05	P<0.000 Highly significant
Combined Objective Impairment Questionnaire (CSQ) (Range 0-35)	15.7 ± 8.2	11.97 ± 6.7	14 ± 11.2	P<0.14 Not significant
Fear Avoidance Behaviour Questionnaire (FABQ) (Range 0-78)	29.47 ± 12.49	25.07 ± 17.74	27.07 ± 18.16	P<0.331 Not significant
Recovery Locus of Control Questionnaire (RBQ) (Normal ≥ 23)	26.67 ± 3.3	25.93 ± 3.82	26.53 ± 3.97	P<0.55 Not significant

Maintenance

A total of 82 subjects remained on a maintenance programme at a treatment facility with the remainder continuing at a gymnasium or opting for a home-exercise programme.

Discussion

This is a case control study,[11] prospective and non-randomised. Subjects were given the option between surgery and conservative treatment and made an informed decision. Subjects were not considered for the study if they had 'red flag' conditions or had undergone previous back surgery.

The programme employs active rehabilitation, both cognitive and exercise-based, with the aim of functional restoration. It is supported by international research and protocols.[12-60]

Of value is the emphasis on correct and effective exercise with the avoidance of overall exercise that is too vigorous, shown previously to have a negative outcome.[55]

Hildebrandt *et al*[9] have previously confirmed that a cognitive rehabilitation programme based on exercise therapy is effective. The patient's perception of his/her back problem and modification thereof is imperative. The disciplines involved in the study were all housed under one roof. The fact that this caused little inconvenience to the subject may possibly have contributed to the compliance of our subjects.

The outcome of this study supports the fact that an interdisciplinary team stands a much better chance of successful intervention than, for instance, a single health care worker trying to treat a complex back problem.

The programme employs active rehabilitation, both cognitive and exercise-based, with the aim of functional restoration. It is supported by international research and protocols

To try and quantify back pain has always been a daunting task. In this study, various measurements were used, e.g. range of movement, questionnaires and surface EMG. These measurements brought objectivity to the study and should be seen as an essential part of any such like programme. The results of these measurements were integrated into the specific subject's treatment plan and were of great value to the interdisciplinary team.

Improvement in range of movement was highly significant with the exception of extension. It appears that increased flexibility contributed to a successful outcome, with extension not being that important. This finding might well cast some doubt on programmes that focus extensively on mainly improving extension.

The use of EMG as an objective measurement of muscle function is supported by the literature.[57-60] The single most useful EMG measurement in this study was the ability of a subject to complete the fatigue test in 90 seconds. After 6 weeks of treatment a significant improvement had already been recorded and was maintained for up to 2 years. A fatigue rate of less than 13% per minute is seen as acceptable; our subjects started at a fatigue rate of 12% per minute. This indicated that our subjects were mostly in the acute and subacute group of patients who had not yet progressed to the chronic group of back pain sufferers with, for instance, atrophy of the multifidus group of muscles.

Furthermore, the EMG results recorded in *Table II* seem to be somewhat confusing. Why would the left and right extension tests, as well as the left standing test, not improve significantly while the rest of the measurements did improve significantly? This is most probably also due to the fact that the study group had not as yet become a chronic group of back pain sufferers with established muscle atrophy.

The trial subjects are indicated to be well motivated and emotionally stable. Although not suffering from depression initially, a significant improvement in psychological well-being was recorded at twenty-four months.

Pain VAS and RBDS also improved significantly. The other measurements in the questionnaires did not improve significantly (CSQ, FABQ and RBQ). In our opinion, the results from the questionnaires indicate an acute to sub-acute group of back pain sufferers. The period of time that the subjects had been suffering from their back problem was not long enough to cause an established negative impact on a cognitive and emotional level as well as on their perceptions and motivation to recover.

The EMG results as well as the results from the questionnaires very strongly favour early intervention. Had the study group consisted mainly of chronic back pain sufferers, one can imagine that the outcome of this study could have been different.

From the literature it would appear that ≤ 5% of patients with lumbar-spinal problems should require surgery.[61] Our study indicates that only 8% of the total cohort of patients already earmarked for surgery did in fact proceed to spinal surgery.

It is of particular interest that of the patients who were operated on, 84.2% were operated within the first 6 months of starting the programme, with 47.4% being operated on in the first 6 weeks. Although this cohort is small, it seems that if a patient were to complete the first 6 weeks of active treatment, the need for spinal surgery may be progressively less.

The literature is not clear on the period of time that should be allowed for conservative treatment before surgery is undertaken. Consideration must be given to van Tulder *et al*[62] who recommended two years of conservative treatment and Rothoerl *et al*[63] who recommended two months of conservative treatment before surgery is performed, provided that there is an initial improvement. In a study by Peul *et al*,[64] the one-year results of patients assigned randomly to either early surgery or conservative treatment were similar. The authors are concerned that if patients are assigned early to surgery, this may contribute to the cohort of frequently operated 'failed back' patients.

It must be kept in mind that all 234 subjects entered into the study were advised to have lumbar-spinal surgery. A very small group (19 subjects/8% of the cohort) eventually did require surgery. Almost 50% of the subjects requiring surgery were diagnosed as such within 6 weeks of starting the programme. This finding supports a period of at least 6 weeks of active conservative treatment in the South African environment before finally embarking on surgery.

Evidence supports shorter periods of bed rest with the emphasis being on keeping the patient as active as possible.[65-67] None of our non-surgical subjects required sick leave.

We wish to emphasise the importance of an interdisciplinary team approach, the use of a validated exercise and cognitive treatment programme as well as standardised treatment protocols.

Conclusion

We recommend that patients considered for spinal surgery, in the absence of exclusion criteria, be referred for a trial of active conservative intervention for a period of at least 6 weeks before surgery is finally undertaken.

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References

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