Prognosis of subacute low back pain patients according to pain response

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Abstract Centralization of referred pain or failure to centralize has in earlier studies been shown to be a predictor of low back pain prognosis. Research suggests that there are differences in how males and females experience pain. The aim of this study was to evaluate the outcome after 1 year, and to evaluate the prognostic value of the pain response in a mechanical test at the first consultation at a spine clinic, and the influence of gender, in order to identify patients with especially high risk of chronicity. The patients in this study were low back pain patients, included consecutively from a spine clinic in Northern Denmark. The criteria for entering this spine clinic were neck or low back pain with radiating symptoms and a duration of 4–26 weeks, without satisfactory improvement after treatment in the primary care system. The 793 patients were categorised into four subgroups according to their pain response in a mechanical test performed at the initial examination: centralization, non-lasting centralization, peripheralization and no effect. The

patients were instructed in doing specific exercises according to the test results. The four subgroups were compared after 1 year with regard to changes in back and leg pain, disability and return-to-work status. The statistical evaluation was undertaken for the study group as a whole and stratified according to gender. A significant improvement in all outcome measures was found in all the subgroups, among both men and women. There were no systematic or statistically significant differences in the prognosis between the four subgroups of patients. The proportion of Centralizers in this study was 18%. The mechanical test at baseline is important for deciding the subject-specific exercises, but when treated according to test results, the prognostic value of the test seems limited.

Keywords Low back pain · Prognosis · Mechanical diagnosis and therapy · Directional preference · Gender

The project is approved by the Regional Scientific Ethical Committee.

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Introduction

Low back pain, with and without leg pain, is a common problem. Epidemiological studies in Scandinavia have shown that 40–50% of all adults have experienced low back pain within the last year [15]. A large population survey indicated a lifetime prevalence of back pain of 77% in men and 74% in women. The lifetime prevalence of any associated leg pain was found to be 35% in men and 45% in women [8]. Other studies have shown differences between males and females in the perception and experience of pain [3, 6]. Research suggests that women experience more pain episodes across the lifespan than men [19].

Clinically, it is often observed that the pain can be increased or decreased by making different movements or assuming certain positions. The centralization phenomenon

was observed by McKenzie [13]. It has gained wide acceptance in evaluation and treatment of patients with low back pain, with and without referred leg symptoms. The centralization phenomenon refers to the abolition of distal pain emanating from the spine in response to therapeutic exercises. This is the core definition, but in some studies the definition also includes reduction in intensity of the most distal symptoms. Werneke et al. applies a stricter definition, including centralization occurring only in the clinic, and symptoms progressing sequentially toward the spine on each occasion until all symptoms are abolished [21]. Several studies indicate a better outcome for both acute and chronic patients for whom the symptoms did centralize when tested, compared to patients with unchanged or worsened symptoms [1, 11, 18, 21].

The subgroup classification according to the McKenzie Method is referred to as Mechanical Diagnosis and Therapy.

The aim of this study was to evaluate the outcome after 1 year, and to evaluate the prognostic value of the pain response in a mechanical test at the first consultation at a spine clinic, and the influence of gender, in order to identify patients with especially high risk of chronicity.

Methods

Subjects

The patients in this study were consecutively included from the Spine Clinic, at Aalborg Hospital, Denmark. The Spine Clinic had an interdisciplinary professional team.

The criteria for entering the Spine Clinic were neck or low back pain with radiating symptoms, with a duration of 4–26 weeks, and without satisfactory improvement after treatment in the Primary Care system.

Inclusion criteria: low back pain patients referred to the Spine Clinic and assessed by a team physiotherapist.

Exclusion criteria: the patients who did not answer the primary patient questionnaire.

The project was approved by the Regional Scientific Ethical Committee.

Procedures

The patients in this sample were assessed by a rheumatologist and assigned to the participating physiotherapists, of which both are trained and experienced in the Mechanical Diagnosis and Therapy method of assessment. Briefly, the Mechanical Diagnosis and Therapy method of assessment includes history taking and a series of repeated movements and static positions to explore the pain response. Based on the findings at the first consultation, the

patients were categorized as “centralizers”, “non-lasting centralizers”, “peripheralizers” and patients without pain responses (“no effect”).

The definitions have been as follows: centralizers: patients where the most distal pain is relocated more proximally/centrally during the mechanical evaluation and remains there after standing up, for at least 1 min. Non-lasting centralizers: patients with pain reduction or non-lasting centralization during the mechanical evaluation. Peripheralizers: patients where the pain has relocated more distally or has increased during the mechanical evaluation and remained that way after standing up. No effect patients: patients for whom there were no change or a temporary increase of pain during the mechanical evaluation.

After assessment, the patients were given the following instructions: they should avoid movements and positions that increased or peripheralized the leg pain, and instead use movements that reduced or centralized the pain. Each patient was given an individualized exercise program consisting of repeated movements and/or sustained positions in direction of directional preference (i.e., improvement in pain from performing repeated movements or sustained positions). Patients without directional preference were instructed in stabilizing, strengthening, mobilizing and/or stretching exercises. The patients where all kinds of movements and positions provoked the leg pain were instructed in rest and relief from work. Most of the patients treated themselves after the given advice, but some were referred to, or continued treatment at the physiotherapists in the Primary Care system. A few were hospitalized because of severe pain. The patients were provided with a phone number of the team for use when necessary. Both the rheumatologist and the physiotherapist assured the patients of good prognosis of back and leg pain and advised them to be as active as possible, but without provoking the leg pain. If required, a social worker could be consulted.

After the first assessment, the patients had 1–4 check-ups (on average two), the first after 2–4 weeks to evaluate their status and adjust their exercise program. If the leg pain had disappeared or decreased, the adjustment included progression of existing exercises, muscle strengthening, mobilizing, stabilizing or stretching exercises. If there was no satisfactory improvement, or the leg pain had increased, the patients were referred to a MR-scan and some of them also to a surgical assessment. At the final check-up, the patients were offered four lessons covering working positions, strategies for lifting, etc., with the occupational therapist.

Outcome measures

The baseline description of the patients includes the findings and test results of the first assessment and a

questionnaire filled in by the patient before the first assessment. The questionnaire includes subjective pain ratings of low back pain and leg pain, questions concerning functional level, sick leave, retirement and work situation.

The follow-up measures were collected after 1 year through a mailed questionnaire, similar to the primary questionnaire. Those who had not returned the questionnaire after 2 weeks were sent a written reminder.

Four types of measurements are used:

1. Differences from baseline to 1-year follow-up in subjective pain ratings of low back pain. Average pain during the past 2 weeks on a pain rating scale of 0–10. (0 as no pain to 10 as the worst possible pain).
2. Differences from baseline to 1-year follow-up in subjective pain ratings of leg pain. Average pain during the past 2 weeks on a pain rating scale of 0–10. (0 as no pain to 10 as the worst possible pain).
3. Differences from baseline to 1-year follow-up in perceived disability ratings specified on The Low Back Pain rating scale. Functional capacity (0% no difficulty to 100% highest difficulty) [14].
4. Return-to-work status of the patients who at baseline were in regular jobs and <59 years.

The questionnaires are extended versions of those used nationally in Denmark in “Dansk Discusbase <http://www.danskdiscusbase.dk>” (i.e., Danish database of back patients), all validated [14].

Statistical analysis:

Changes in low back pain and related symptoms during 1 year were evaluated for the continuous variables, using *t* tests and analysis of variance. For the categorical variables, multinomial logistic regression analysis were used. In multivariate analysis, information concerning age, employment,

previous experiences of low back pain, previous treatment and additional disease characteristics at the baseline evaluation were included as potential confounders. Effect measure modification from gender and age was evaluated in subgroup analyses.

A secretary not attached to the Spine Clinic entered the data into a database. Two statisticians at The Aalborg University, Denmark, did the statistical analysis.

Results

The 793 patients (418 men and 375 women) in this study were low back pain patients included consecutively during the period of September 1997–October 1999 and observed for 1 year (Fig. 1)

Baseline:

Baseline characteristics of the patients, stratified according to gender, are shown in Table 1.

Sixty three percent had previous episodes of back pain, and 11% had lumbar surgery previously. Ninety six percent had leg pain, 69% had one or more neurological deficits. Fifty six percent were on sick leave and 14% were retired due to age or health conditions.

Women generally felt more pain and disability than men, but had fewer neurological deficits.

Subgrouping according to the results of the mechanical test, the size of the subgroups ranges from 45 to 202, with Peripheralizers as the smallest and the No Effect group as the largest. Comparing subgroups, Peripheralizers have had more prior lumbar operations (17%) compared to Centralizers (7%). With respect to the other compared characteristics, the subgroups are relatively homogeneous.

Outcome:

Tables 2 and 3 present changes in low back pain, leg pain, disability score and employment at 1-year follow-up.

Seventy five percent returned the questionnaire, and the four outcome measures were close to 100%.

Fig. 1 Patient flow chart

Table 1 Baseline Subject Characteristics ($n = 793$)
Number and percentages of patients in all and in each patient subgroup

	All	Centralizers	Non-lasting centralizers	Peripheralizers	No effect
Men					
Number	418	86	85	45	202
Age, years, mean	44	44.2	45.5	45.0	44.1
10/90(%) percentiles	30–60				
Employment					
In regular jobs (%)	76	77	75	69	77
Retired %	11	9	15	13	10
Other work conditions ^a (%)	12	14	9	18	12
On sick leave (%)	56	60	49	60	56
Prior back history					
Prior episodes (%)	66	64	73	71	63
Lumbar surgery (%)	12	7	13	22	12
Sick leave ≥ 90 days (%)	7	7	4	9	9
Symptoms					
Low back pain ^b	4.8	4.3	4.9	5.3	4.9
Leg pain ^b	5.3	5.3	6.0	6.1	4.7
Disability ^c	53.7	53.1	56.4	57.8	51.9
Abnormal reflexes (%)	42	47	25	40	37
Atrophy (%)	24	24	25	16	25
Reduced strength (%)	36	35	41	42	32
Women					
Number	375	53	83	57	182
Age, years, mean	44	46.3	46.3	45.2	43.7
10/90(%) percentiles	29–60				
Employment					
In regular jobs (%)	64	72	64	60	61
Retired (%)	17	9	17	16	18
Other work conditions ^a (%)	19	19	19	24	21
On sick leave (%)	57	58	59	60	54
Prior back history					
Prior episodes (%)	60	47	65	68	58
Lumbar surgery (%)	9	6	5	11	11
Sick leave ≥ 90 days (%)	6	4	6	9	5
Symptoms					
Low back pain ^b	5.3	5.8	5.1	5.8	5.4
Leg pain ^b	5.8	6.3	6.3	6.4	5.4
Disability ^c	60.5	60.6	61.7	66.2	58.1
Abnormal reflexes (%)	32	34	40	26	28
Atrophy (%)	10	13	13	9	8
Reduced strength (%)	25	26	34	26	20

^a Includes house wives not working away from home, students and people on social security or in jobs subsidized by the state

^b Pain rating scale (0–10). Average pain for the last 2 weeks

^c Perceived disability ratings specified with 0 as no disability at all and 100 as the worst disability

The outcomes improved significantly for both men and women, during the study period.

Women felt more pain and were more disabled than men at point of entry and after 1 year.

No systematic or statistically significant differences in prognosis were found for the four patient subgroups. This applied to both men and women.

Control for potential confounding factors from other patient characteristics did not change these results.

Among the men, only minor differences were found between the Centralizer, Non Lasting Centralizer and the Peripheralizer groups regarding the outcome measures for low back pain, leg pain and disability. Of the men who were in regular jobs at the inclusion, 100% in the

Table 2 Changes in low back pain and related symptoms after 1 year of follow-up, men and women

Men (<i>n</i> = 317)	Baseline	1 year	Δ
Low back pain ^a	5 (2–8)	3 (0–7)	–2
Leg pain ^a	5 (2–8)	2 (0–6)	–3
Disability ^b	54 (27–82)	29 (7–70)	–25
Working ^c (%)	34	87	53
Women (<i>n</i> = 281)			
Low back pain ^a	5 (2–9)	4 (0–8)	–1
Leg pain ^a	6 (2–10)	3 (0–8)	–3
Disability ^b	62 (35–82)	44 (10–80)	–18
Working ^c (%)	34	86	52

^a Pain rating scale (0–10), median values. () 10/90% percentiles

^b Perceived disability ratings specified with 0 as no disability at all and 100 as the worst disability, median values. () 10/90% percentiles.

^c Includes only those in regular jobs and <59 years at baseline (Men: *n* = 228, Women: *n* = 175). Δ the difference between the 1 year and the baseline value.

Peripheralizer group and 96% in Centralizer group had returned to work at the 1-year follow-up. The No Effect group had the least improvements for all outcome data.

The women's Peripheralizer group had least improvement concerning low back pain, leg pain, disability and sick leave at the 1-year follow-up (*n* = 45). Dividing this group according to age, in intervals of 10 years, showed that women between 30–40 years (*n* = 6) had the most disabilities and leg pain after 1 year. More subjects were on sick leave after 1 year than at the point of entry in this age group. Since this group also had the most leg pain and disability at baseline, these results are not significant.

Some patients had more pain after 1 year. Almost 1/3 had unchanged or worse low back pain. Leg pain had generally decreased more than low back pain.

Comparing subjects on sick leave and those who had returned to work after 1 year, similar patterns were found for both men and women: 50% of the men on sick leave had unchanged or worse back pain compared to 30% in the

Table 3 Changes in low back pain and related symptoms after 1 year of follow-up, subgroups

Men (<i>n</i> = 317)	Centralizers			Non lasting centralizers		
	Baseline	1 year (<i>n</i> = 67)	Δ	Baseline	1 year (<i>n</i> = 70)	Δ
Low back pain ^a	4 (1–7)	2 (0–5)	–2	5 (2–8)	3 (0–6)	–2
Leg pain ^a	5 (2–8)	2 (0–4)	–3	6 (4–8)	3 (0–6)	–3
Disability ^b	50 (31–75)	25 (7–57)	–25	56 (29–83)	28 (7–71)	–28
Working ^c (%)	35	96	61	32	89	57
Women (<i>n</i> = 281)	(<i>n</i> = 43)			(<i>n</i> = 61)		
Low back pain ^a	6 (3–8)	3 (1–8)	–3	5 (2–8)	4 (1–8)	–1
Leg pain ^a	7 (3–9)	3 (0–7)	–4	6 (3–9)	4 (0–8)	–2
Disability ^b	63 (43–79)	40 (8–70)	–23	63 (42–80)	47 (12–73)	–16
Working ^c (%)	37	81	44	34	97	63
Men (<i>n</i> = 317)	Peripheralizers			No effect		
	Baseline	1 year (<i>n</i> = 33)	Δ	Baseline	1 year (<i>n</i> = 147)	Δ
Low back pain ^a	5 (2–8)	2 (0–8)	–3	5 (2–8)	3 (0–8)	–2
Leg pain ^a	6 (4–8)	3 (0–7)	–3	5 (2–8)	2 (0–6)	–3
Disability ^b	63 (30–81)	38 (10–63)	–25	53 (21–80)	30 (4–75)	–23
Working ^c (%)	26	100	74	36	81	45
Women (<i>n</i> = 281)	(<i>n</i> = 45)			(<i>n</i> = 132)		
Low back pain ^a	7 (1–10)	5 (1–8)	–2	5 (1–8)	3 (0–8)	–2
Leg pain ^a	7 (3–10)	5 (0–8)	–2	5 (1–9)	2 (0–7)	–3
Disability ^b	67 (46–85)	60 (20–80)	–7	61 (32–82)	39 (7–77)	–22
Working ^c (%)	21	71	50	35	86	51

^a Pain rating scale (0–10). Average pain for the last 2 weeks. In median values. () 10/90% percentiles

^b Perceived disability ratings specified with 0 as no disability at all and 100 as the worst disability in median values. () 10/90% percentiles

^c Includes only those in regular jobs and <59 years at baseline (Men: *n* = 228, Women: *n* = 175). ΔThe difference between the 1 year and the baseline value

working group. Forty three percent had unchanged or worse leg pain compared to 16% in the working group. Among the women, the numbers were 71 and 33% for back pain, and 63 and 25% for leg pain.

Nine percent ($n = 29$) of the men and 11% ($n = 32$) of the women had back surgery between baseline and the 1-year follow-up (7% of these were reoperations). These were evenly distributed among the four subgroups. The outcome, generally, after 1 year did not differ significantly between the patients having surgery and the patients who were conservatively treated. The women, however, who had back surgery, had less pain and disability after 1 year, than the women who were conservatively treated, while the men had the opposite result.

Possible effect measure modification by age was explored, but no systematic age-related differences in outcome were observed.

Two questions have not been referred to in the results because of low response. At point of entry, 50% answered the question of how the episode would influence their future lives. After 1 year, 65% answered the question referring to their general back status (better, unchanged, worse).

At 1-year follow-up, the subjects were asked if they had received treatment during the 1 year observation period. Thirty one percent had received physiotherapy, 7% chiropractice and 12% had received alternative therapy. Nine percent had tried two or more kinds of treatment. No difference was observed between the treated group and the non-treated group.

Twenty five percent ($n = 195$) of the patients who were assessed at baseline did not return the 1-year follow-up questionnaire. They were evenly distributed in the pain response groups and according to gender.

The baseline data in this group were not different from that of the whole group. Selection bias can, however, not be excluded.

Discussion

The present study evaluated the outcome after 1 year, and the prognostic value of the pain response to Mechanical Diagnosis and Therapy test, at the first consultation, for patients with low back pain in order to identify the patients who have an especially high risk of chronicity. For both men and women, all outcomes improved significantly during the follow-up period. There were no systematic or statistically significant differences in prognosis for the four subgroups of patients. Control for potential confounding factors from other patient characteristics did not change the study results.

In this study, the patients were assessed and classified by one of the two physical therapists with experience in

Mechanical Diagnosis and Therapy. Inter-examiner reliability in identifying centralization in patients with low back pain has been shown to be high [7]. Studies have shown that this reliability is highest among therapists who are trained and experienced in the Mechanical Diagnosis and Therapy assessment system [10, 16].

The patients were classified after the first assessment. Werneke has shown that some Centralizers are not identified until subsequent assessment sessions [21]. It is therefore possible that some of the patients would have been reclassified after further assessment in subsequent sessions.

The reported prevalence of centralization in low back pain patients ranges between 31 and 89% [5]. The prevalence seems to be dependent on several factors. The more acute the pain, the higher the prevalence. Werneke found that patients with only buttock pain were primarily classified in the centralization group while the patients with leg pain were more often found in the noncentralization group [21]. The definition of centralization also has some variations, and it seems that a stricter definition gives a lower prevalence [1]. In this study, the prevalence of centralization is only 18%, which is markedly lower than in other studies. There may be several reasons for this: 71% of the patients had received some kind of treatment before entering the Spine Clinic. The patients referred to the Spine Clinic are those who do not have their problem solved in the Primary Care System. Seven percent of the patients had been on sick leave for more than 3 months at baseline. Ninety six percent of the patients in our study had leg pain at baseline.

The differences between males and females are considered in this article because previous research proposes that there may be gender differences in the experience of pain. Hormones, genetic factors and biopsychosocial variables may be contributing to individual differences in pain response and to some of the differences in pain reaction between males and females [4, 17].

This study did not show statistically significant differences in outcome for the four groups. Several studies show a better outcome for the Centralizer groups [21]. Werneke and Hart's 1-year follow-up study shows that failure to achieve centralization had greater prognostic significance than centralization [20]. Their results may differ from ours due to the fact that the patients, referred to the Spine Clinic, have not been helped in the Primary Care system, and therefore may have more complex back problems. In a study by Albert, the Peripheralizers were also shown to have almost as good a prognosis as the Centralizers, while the No effect group had the poorest outcome [2].

Long showed that when treated with exercises matching the patient's directional preference, the patients improved in all outcomes, and patients treated with exercises opposite the directional preference were worse [12]. The

patients in this study were treated with exercises matching their directional preference.

In general, the patients were doing significantly better after 1 year, according to all effect measures. Part of the effect is probably due to the nature of back problems. The majority of patients with low back pain will improve even without treatment. Different structures in the low back are able to refer somatic pain into the buttock and lower limb. Most herniated discs will be reabsorbed in weeks or months, which results in decreasing pain and disability. Due to no control group in this study, it was not possible to conclude how much the nature of back problems influenced the results.

The thorough assessment by both rheumatologists and physiotherapists, information regarding the good prognosis and the availability of telephone contact were all intended to reduce any sense of fear and insecurity in the patients. The patients were empowered to become actively involved in their own recovery. They were recommended to stay as active as possible without provoking more leg pain. A similar regime was tested by Indahl in 1995 [9] and he found that the patients in the intervention group had a reduction in sick leave that could be registered even 5 years later. All of the patients in his study had been on sick leave for more than 8 weeks at baseline. No gender differences were found, in the outcome, in the intervention group, while more women than men in the control group did not return to work.

Conclusion

The present study evaluated the outcome after 1 year for subacute low back pain patients, the prognostic value of a mechanical test (Mechanical Diagnosis and Therapy) at the first assessment and the influence of gender. The patients were treated in a multidisciplinary spine clinic. The intervention included examination, information and guidance.

A significant improvement in all outcome measures was found among both men and women. There were no systematic or statistically significant differences in the prognosis between the four subgroups of patients. The proportion of Centralizers in this study was 18%. The mechanical test at baseline is important for deciding the subject-specific exercises, but when treated according to the test results, the prognostic value of the test, in this study, seems limited.

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References

1. Aina A, May S, Clare H (2004) The centralization phenomenon of spinal symptoms—a systematic review. *Man Ther* 9(3): 134–143
2. Albert HB (2004) Conservative treatment of patients with sciatica—a randomized controlled trial. (Dissertation) Odense: faculty of Health Sciences, University of Southern Denmark (In Danish)
3. Berkley KJ, Holdcroft A (1999) Sex and gender differences in pain. In: Wall P, Melzack R (eds) *Textbook of pain*, 4th edn. Churchill Livingstone, London
4. Craft RM, Mogil JS, Aloisi AM (2004) Sex differences in pain and analgesia: the role of gonadal hormones. *Eur J Pain* 8(5): 397–411
5. Donelson R, Silva G, Murphy K (1990) Centralization phenomenon. Its usefulness in evaluating and treating referred pain. *Spine* 15(3):211–213
6. Fillingim RB (ed) (2000) Sex, gender and pain. *Progress in pain research and management*. IASP Press, Seattle
7. Fritz J, Delitto A, Vignovic M, Busse RG (2000) Interrater reliability of judgements of the centralization phenomenon and status change during movement testing in patients with low back pain. *Arch Phys Med Rehab* 81:57–61
8. Heliövaara M (1989) Risk factors for low back pain and sciatica. *Ann Med* 21:257–264
9. Indahl A, Haldorsen E, Holm S, Reikerås O, Ursin H (1998) Five-year follow-up study of a controlled clinical trial using light mobilization and an informative approach to low back pain. *Spine* 23(23):2625–2630
10. Kilegpainikoski S, Airaksinen O, Kankaanpää M, Leminen P, Videman T, Alen M (2002) Interexaminer reliability of low back pain assessment using the McKenzie method. *Spine* 27:E207–E214
11. Long AL (1995) The centralisation phenomenon: it's usefulness as a predictor of outcome in conservative treatment of chronic low back pain. *Spine* 20:2513–2521
12. Long A, Donelson R, Fung T (2004) Does it matter which exercise? *Spine* 29(23):2593–2602
13. McKenzie R. (1981) *The lumbar spine: mechanical diagnosis and therapy*. Spinal Publications, Waikanae
14. Manniche C, Asmussen K, Lauritsen B, Vinterberg H, Kreiner S, Jordan A (1994) Low back pain rating scale: validation of a tool for assessment of low back pain. *Pain* 57:317–326
15. Nachemson A, Jonsson E (2000) *Neck and back pain: the scientific evidence of causes, diagnosis and treatment*. Lippincott Williams & Wilkins, Philadelphia
16. Razmjou H, Kramer JF, Yamada R (2000) Intertester reliability of the McKenzie evaluation in assessing patients with mechanical low-back pain. *JOSPT* 30:368–389
17. Rollman GB, Jennifer A, Joanne M, Kevin J (2004) Does past pain influence current pain: biological and psychosocial models of sex differences. *Eur J Pain* 8(5):427–433
18. Sufka A, Hauger B, Trenary M, Bishop B, Hagen A, Lozon R, Martens B (1998) Centralization of low back pain and perceived functional outcome. *JOSPT* 27(3):205–212
19. Unruh AM (1996) Gender variations in clinical pain experience. *Pain* 65:123–167
20. Werneke M, Hart D (2001) Centralization phenomenon a prognostic factor for low back pain and disability. *Spine* 26(7): 758–765
21. Werneke M, Hart D (1999) A descriptive study of the centralization phenomenon. A prospective Analysis *Spine* 24(7):676–683