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Which patients with osteoarthritis of hip and/or knee benefit most from behavioral graded activity?

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Running head: Patients benefiting from behavioral graded activity

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ABSTRACT

Objective – To investigate whether behavioral graded activity (BGA) has particular benefit in specific subgroups of osteoarthritis (OA)-patients.

Subjects –200 patients with OA of hip and/or knee (clinical ACR-criteria), participated in a randomized clinical trial on the efficacy of BGA compared to treatment according to the Dutch physiotherapy guideline (usual care, UC).

Methods – Changes in pain (VAS), physical functioning (WOMAC and MACTAR) and patient global assessment (PGA) were compared for specific subgroups. Subgroups were assigned by the median-split-method and analyzed using analysis of covariance.

Results - Beneficial effects of BGA were found for patients with a relatively low level of physical functioning ($p \leq 0.03$). Furthermore, beneficial effects of BGA in patients with a low level of internal locus of control were marginally significant ($p=0.05$).

Conclusion – Patients with a relatively low level of physical functioning benefit more from BGA compared to UC. Compared to UC, BGA is the preferred treatment option in patients with a low level of physical functioning.

Osteoarthritis (OA) is a common joint disorder, which has a major impact on functioning in daily life (Dekker et al, 1992; van Baar et al, 1998b). Available evidence indicates beneficial short term effects of exercise therapy on pain, physical function and patient global assessment (PGA) in patients with OA. However, these short term effects decline over time and disappear in the long term (Fransen, McConnel & Bell, 2002; van Baar et al, 1999).

To enhance long term effects of exercise therapy, integration of exercise therapy with daily performed activities based on cognitive-behavioral principles and additional boostersessions seems promising. This treatment is based on the assumption that psychosocial factors interfere with the physical function of patients (Linton, Hellsing & Andersson, 1993). Indeed, a behavioral graded activity program was found to result in beneficial long-term outcomes, however, the outcome was not superior to usual care (Veenhof et al, 2006). It remains to be investigated whether specific characteristics of the patients are effect modifiers, and thus, whether specific subgroups of patients would particularly benefit from a treatment based on behavioral principles.

With regard to subgroups, three specific expectations can be formulated. Firstly, the main objective of behavioral graded activity is to realize a more active lifestyle (Veenhof et al, 2006). A low level of functional activities can be caused by avoidance behavior of the patients. Long-lasting avoidance of activities leads to disuse and increased disability (Vlaeyen & Linton, 2000). Because of the systematic attempt towards a more active lifestyle, patients with a relative low level of physical functioning are expected to benefit more from behavioral graded activity. Secondly, it has been demonstrated that especially patients with passive coping strategies, such as retreating, worrying, and resting, have high levels of physical and psychological disability and tend to avoid activity (Keefe et al, 2002; Steultjens, Dekker & Bijlsma, 2002). Therefore, it can be expected that patients with passive coping strategies have particular benefit from behavioral graded activity. Finally, since patients with high internal locus of control report less pain (Keefe et al, 2002), beneficial effects of behavioral graded activity are expected in patients with low levels of perceived control. A low levels of perceived control is operationalized in two ways, as a low level of internal locus of control and as a high level of powerful others locus of control.

The aim of the study is to determine whether behavioral graded activity, compared to usual care, has particular benefit in specific subgroups of patients. Beneficial long-term effects are expected in: (1) patients with a relatively low level of physical functioning at the start of the treatment; (2) patients with passive coping styles to pain; (3) patients with a relative low level of internal locus of control or a relative high level of powerful others locus of control.

METHODS

Subjects

A cluster randomized controlled trial was conducted, comparing two interventions in 200 patients with hip and/or knee OA. Inclusion criteria of eligible patients were OA of hip or knee according to the clinical criteria of the American College of Rheumatology (Altman et al, 1986; Altman et al, 1991). An extensive description of the methods of the trial is published elsewhere (Veenhof et al, 2006). All patients completed written informed consent. An assessor, blinded for the allocated treatment, performed assessments at baseline, 13 weeks (post-treatment) and after 39 weeks and 65 weeks follow up. The study was approved by the medical ethics committee of the VU University Medical Center, Amsterdam.

Interventions

Behavioral graded activity

BGA is a behavioral treatment integrating the concepts of operant conditioning with exercise therapy comprising boostersessions. The intervention is directed at increasing the level of activities in a time-contingent way, with the goal to integrate these activities in the daily living of the patients. The patient has many responsibilities during this treatment; the physiotherapist has a more coaching role. The treatment consisted of a 12-week period with a maximum of 18 sessions, followed by five pre-set boostermoments with a maximum of seven sessions (respectively in week 18, 25, 34, 42, and 55).

Usual care

The physiotherapists of the patients in the usual care group, were advised to treat their patients according to the Dutch physiotherapy guideline for patients with hip and/or knee OA (Vogels et al, 2001). The treatment consisted of maximum 18 sessions within a period of 12 weeks.

More specific information on the interventions has been published elsewhere (Veenhof et al, 2006). Both BGA and usual care were given individually by physiotherapists in primary care.

Outcome measures

Primary outcome measures were pain, physical function and patient global assessment (PGA), according to the core set of outcome measures of clinical trials with patients with OA defined by OMERACT III (Bellamy et al, 1997). Patients rated their pain at assessment and in the past week on a VAS (0-10). Physical function was assessed with the subscale physical function of the condition-specific WOMAC (range: 0-68) and the patient-oriented MACTAR (range: -15 to 15) (Bellamy et al, 1988; Tugwell et al, 1987). PGA was assessed by patients on a 8-point scale (1=vastly worsened; 8=completely recovered) (van der Heijden, 1996).

Subgroups

For each possible effect-modifying factor patients were classified into two subgroups. Subgroups were determined by the median-split-method. In this method, two groups are composed (low, high) for each variable with the median as cut off point. The following factors were studied.

Physical function. Physical function was assessed with the subscale physical function of the WOMAC (0-68) (Bellamy et al, 1988). The median for the WOMAC was 29.0. A higher score reflects more limitations in physical function.

Locus of control. Locus of control was assessed by the Multidimensional Health Locus of Control (MHLC), which consists of separate subscales for internal locus of control and powerful others locus of control (range 6-36) (Wallston, Wallston & DeVellis, 1978). A high score reflects a high use of the specific locus of control. The median of internal locus of control was 21.0, the median of powerful others locus of control was 18.5.

Pain coping: The use of passive pain coping strategies is reflected by high levels of retreating, worrying and resting, which are subscales of the Pain Coping Inventory (range 0-4) (Kraaimaat, Bakker & Evers, 1997). A high score on a subscale means that the specific strategy is used when in pain. The medians on the subscales worrying, resting and retreating were 1.67, 2.20 and 1.71 respectively.

Characteristics of patients. In an exploratory analysis, the influence of the following features was studied:

- Demographic data: age (median split: median= 65.0) and sex (male / female).
- Clinical features: location of osteoarthritis (knee/hip; patients with both knee and hip OA were left out of this subanalysis), duration of complaints (5 years was chosen as a cut-off point for duration of complaints), obesity (Body Mass Index <30 / ≥ 30), pain assessed on a VAS (0-10) (median-split: median=5.0), and radiological score as assessed with Kellgren & Lawrence scale by a radiologist. We chose minimal OA (grade 2 or more) as a cut off point for radiological degeneration.
- Lifestyle: level of physical activity according to the SQUASH (Short Questionnaire to assess health enhancing physical activity) (median split: median= 1530 minutes/week) (Wendel-Vos et al, 2003).

Statistical analysis

Statistical analyses were performed according to the intention-to-treat principle. To analyze the effects, change scores for pain and physical function (WOMAC and MACTAR) were calculated (follow-up minus baseline scores). Only data on the 65 week follow-up were used for these secondary analyses. To study whether differences existed in the effects of BGA between subgroups, the effect modification of treatment was tested using analysis of covariance (ANCOVA). Corresponding with the primary analyses on the efficacy of BGA, the following covariates were included in the subgroup analyses in order to control for differences in patients' condition: duration of complaints, location of OA (hip, knee, or both), age, sex, and recruitment method (physiotherapist or newspaper) (Veenhof et al, 2006). In order to avoid overcorrection, this correction was omitted in analyses of subgroups based on these characteristics (e.g. in analyses of effect modification by age, age was not included as a covariate). The significance level for effect modification was set at 0.05.

RESULTS

As presented in table 1, at baseline there were no relevant differences between the studied groups on the prognostic variables sex, age, location of OA, duration of complaints, radiological degeneration, BMI, pain, physical function, used pain coping-style and locus of control.

[TABLE 1]

Physical function, locus of control and pain coping

In general, both BGA and UC resulted in beneficial long term effects. However, no differences were found between both interventions on the primary outcome measures pain, physical function and patient global assessment (Veenhof et al, 2006). In table 2 the effects of treatment are presented for subgroups of patients, on the basis of their physical function, pain coping and locus of control. The expected larger beneficial long-term effects of BGA in patients with a relatively low level of physical functioning were confirmed, both for the outcome measures pain and physical functioning, with the exception of the outcome measure 'pain at assessment'.

Also, the hypothesis of greater benefit of BGA in patients with a relatively low level of internal locus of control was confirmed for the outcome measure 'pain in past week', which was marginally significant (p=0.05). However, for the outcome measures 'pain at assessment', physical function (WOMAC / MACTAR), and PGA (not in table) this effect modification was not significant.

The remaining hypotheses of greater benefit of BGA in patients with a high level of powerful others locus of control, or in patients using passive coping strategies could not be confirmed.

[TABLE 2]

Additional analyses

Exploratory analyses were performed to study effect modification of eight features for the effectiveness of BGA (sex, age, location of OA, duration of complaints, radiological degeneration, BMI, pain, and level of physical activity), leading to a total number of 40 interactions which were tested (8 features and 5 outcome measures). Three significant effect modifiers were found. In patients without radiological evidence of OA, relatively great beneficial effects of UC were found on 'pain last week' (p=0.05), compared to patients with radiological evidence of OA. In addition, in patients with relatively high score of pain at the start of treatment a beneficial effect of BGA on patient-oriented physical function (MACTAR) was found compared to UC (p=0.03). Finally, in patients with obesity (BMI > 30) a beneficial effect of BGA on physical function (WOMAC) was found compared to UC (p=0.03).

DISCUSSION

In the present study three hypotheses were tested concerning subgroup analyses of a randomized clinical trial on the effectiveness of behavioral graded activity. As expected, patients with a relatively low level of physical functioning showed larger beneficial effects of BGA compared to UC, both on pain and physical functioning. According to the avoidance model, patients with more limitations in physical functioning, tend to avoid activities. Because of their inactivity, their physical condition deteriorates, resulting in more limitations (Vlaeyen & Linton, 2000). One of the primary goals of BGA is to gradually increase activity levels despite pain and to educate patients that their disease can be self-managed, which might explain the success of BGA in patients with a low level of physical functioning.

The other hypotheses could not be confirmed, with the exception of the beneficial effects we found for patients with a relative low level of 'internal locus of control' on the outcome measure 'pain in past week' which was marginally significant (p=0.05). Therefore, there is an indication that patients with a relatively low level of 'internal locus of control', assessed at baseline, benefit more from BGA, while patients with a relatively high level of 'internal locus of control' benefit more from UC. A possible explanation is that BGA-patients learn that their pain and limitations in activities are common conditions that can be self-managed, rather than serious conditions that need careful protection (Vlaeyen & Crombez, 1999). Probably, patients with a low level of internal locus of control have the opportunity to develop these skills and therefore make more improvements when treated with BGA.

Exploratory analyses were performed concerning effect modification by characteristics of the patients. Evidence was found of beneficial effects of UC in patients without radiological evidence of OA compared to patients with radiological evidence of OA, which is in line with the findings of Van Baar (van Baar et al, 1998a). Also, evidence was found of beneficial effects of BGA on physical function (WOMAC) in patients with obesity. A possible explanation is that BGA interrupts the vicious circle of obesity leading to inactivity (Petersen, Schnohr & Sorensen, 2004). Considering the high prevalence of obesity among OA-patients, the particular benefit of BGA in obese patients is of great potential value for OA-patients. However, taking the number of exploratory tests into account (n=40), these results should be interpreted with caution.

On basis of our findings, it can be concluded that both treatments result in beneficial effects which endure in long term. For patients with a relatively low level of physical functioning at the start of the treatment and, to a lesser degree, patients with a low level of internal locus of control, treatment with BGA (compared to UC) is the preferred treatment option, as particular benefit was found for these specific subgroups of patients.

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TABLES

Table 1. *Baseline Characteristics of the Intervention Groups Behavioral Graded Activity (BGA) and Usual Care (UC)*

Characteristics	BGA[a]		UC[b]	
Gender: female, *n* and %	73	75	81	79
Age, *M* and *SD*	65.1	7.4	64.5	8.3
Location of OA, *n* and %				
knee	67	69	63	61
hip	22	23	28	27
both	8	8	12	12
Duration of complaints, *n* and %				
< 1 year	23	24	24	23
1–5 years	39	41	33	32
> 5 years	33	35	46	45
Radiological evidence OA and KL ≥2[c]				
knee[d], *n* and %	26	52	31	61
hip[e], *n* and %	18	86	29	97
Body Mass Index, *M* and *SD*	28.2	4.2	28.8	4.6
Severity of pain, *M* and *SD*				
At assessment (VAS)	4.3	2.8	3.7	2.5
Past week (VAS)	5.7	2.2	5.5	2.2
Physical function, *M* and *SD* subscale physical function (WOMAC)	28.7	12.5	29.1	9.9
Physical activity, *M* and *SD* in minutes per week (Short Questionnaire to Assess Health Enhancing Physical Activity, SQUASH)	1761	1221	1664	984
Locus of Control (MHLC), *M* and *SD*				
Internal health locus of control	21.5	5.5	20.1	5.5
Powerful others health locus of control	18.5	5.6	18.3	5.3
Pain Coping Inventory *M* and *SD*				
Retreating	1.8	0.5	1.7	0.4
Worrying	1.7	0.5	1.7	0.4
Resting	2.2	0.5	2.3	0.5

Note. OA = Osteoarthritis; KL = Kellgren–Lawrence score; VAS = Visual Analog Scale; WOMAC = Western Ontario and McMaster Universities Osteoarthritis Index; MHLC = Multidimesional Health Locus of Control.
[a] $n = 97$. [b] $n = 103$. [c] $n = 146$. [d] $n = 101$. [e] $n = 51$.

Table 2A. *Mean Effects of Behavioral Graded Activity (BGA) Treatment (Δ Week 65–Baseline) in Subgroups According to Level of Physical Functioning (WOMAC)*

Physical Functioning	High Level of Physical Functioning		Low Level of Physical Functioning		*p* Value Effect Modification
	BGA[a]	Usual Care[b]	BGA[c]	Usual Care[b]	
Pain at assessment (VAS)	−0.28	−0.33	−2.21	−0.83	.12
Pain last week (VAS)	−1.55	−2.07	−2.82	−1.49	.03
Physical functioning (WOMAC)	−2.79	−4.72	−14.06	−10.04	.03
Physical functioning (MACTAR)	4.51	4.15	8.03	2.39	.01

[a] $n = 48$. [b] $n = 46$. [c] $n = 34$.

Table 2B. *Effects of Behavioral Graded Activity (BGA) Treatment in Subgroups According to Passive Coping Strategies*

Worrying	Low Level of Worrying		High Level of Worrying		*p* Value Effect Modification
	BGA[a]	Usual Care[b]	BGA[c]	Usual Care[d]	
Pain at assessment (VAS)	−0.98	−0.24	−1.10	−0.75	.57
Pain last week (VAS)	−2.10	−1.39	−1.77	−2.07	.28
Physical functioning (WOMAC)	−7.55	−5.50	−6.91	−9.24	.20
Physical functioning (MACTAR)	6.82	3.60	4.45	3.48	.40

[a] $n = 49$. [b] $n = 45$. [c] $n = 31$. [d] $n = 44$.

Resting	Low Level of Resting		High Level of Resting		*p* Value Effect Modification
	BGA[a]	Usual Care[b]	BGA[c]	Usual Care[d]	
Pain at assessment (VAS)	−0.56	−0.32	−1.45	−0.72	.52
Pain last week (VAS)	−2.02	−1.78	−1.88	−1.65	.82
Physical functioning (WOMAC)	−7.39	−6.25	−7.27	−8.66	.73
Physical functioning (MACTAR)	5.25	3.70	6.67	3.33	.35

[a] $n = 49$. [b] $n = 50$. [c] $n = 33$. [d] $n = 39$.

Withdrawing	Low Level of Withdrawing		High Level of Withdrawing		*p* Value Effect Modification
	BGA[a]	Usual Care[b]	BGA[c]	Usual Care[d]	
Pain at assessment (VAS)	−1.55	−1.11	−0.73	−0.20	.40
Pain last week (VAS)	−2.28	−1.50	−1.80	−1.95	.33
Physical functioning (WOMAC)	−9.31	−5.59	−6.09	−8.80	.29
Physical functioning (MACTAR)	7.07	2.81	5.24	4.17	.44

[a] $n = 29$. [b] $n = 47$. [c] $n = 51$. [d] $n = 41$.

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